

ICSM 2014

INTERNATIONAL CONFERENCE ON
SOFT MATERIALS



JAIPUR, OCTOBER 6-10, 2014

ABSTRACT BOOK

<http://icsm2014.mnit.ac.in>

Organized by:

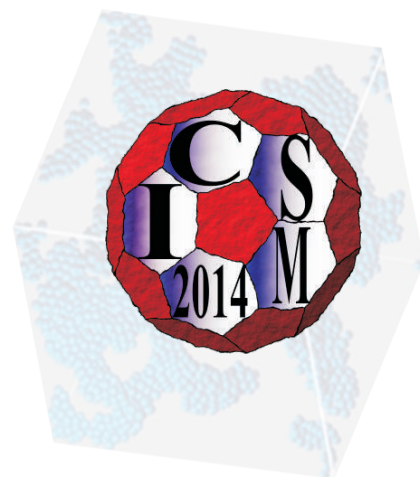


**Department of Physics
Malaviya National Institute of Technology
Jaipur (Rajasthan) 302017 India**

<http://www.mnit.ac.in>

ICSM 2014

INTERNATIONAL CONFERENCE ON
SOFT MATERIALS



JAIPUR, OCTOBER 6-10, 2014

TOPICS

- **Biological Soft Matter**
- **Dynamics of Complex Fluids**
- **Functional Materials**
- **Membranes**
- **Nano and Microfluidics**
- **Polymers, Colloids and Interface**
- **Self-Assembly**
- **Self-propelled Particles**
- **Soft Materials**
- **Soft Nanofabrication**

Patron
Prof. I. K. Bhat
Director, MNIT Jaipur

Chairman
Prof. K. C. Swami
Head, Department of Physics, MNIT Jaipur

Conveners
Dr. Kamendra Awasthi
Department of Physics, MNIT Jaipur

Dr. Sujin B. Babu
Department of Physics, IIT Delhi

Organizing Secretaries
Dr. Manoj Kumar
Department of Physics, MNIT Jaipur

Dr. Anjali Awasthi
Department of Zoology, University of Rajasthan, Jaipur

Organized by:

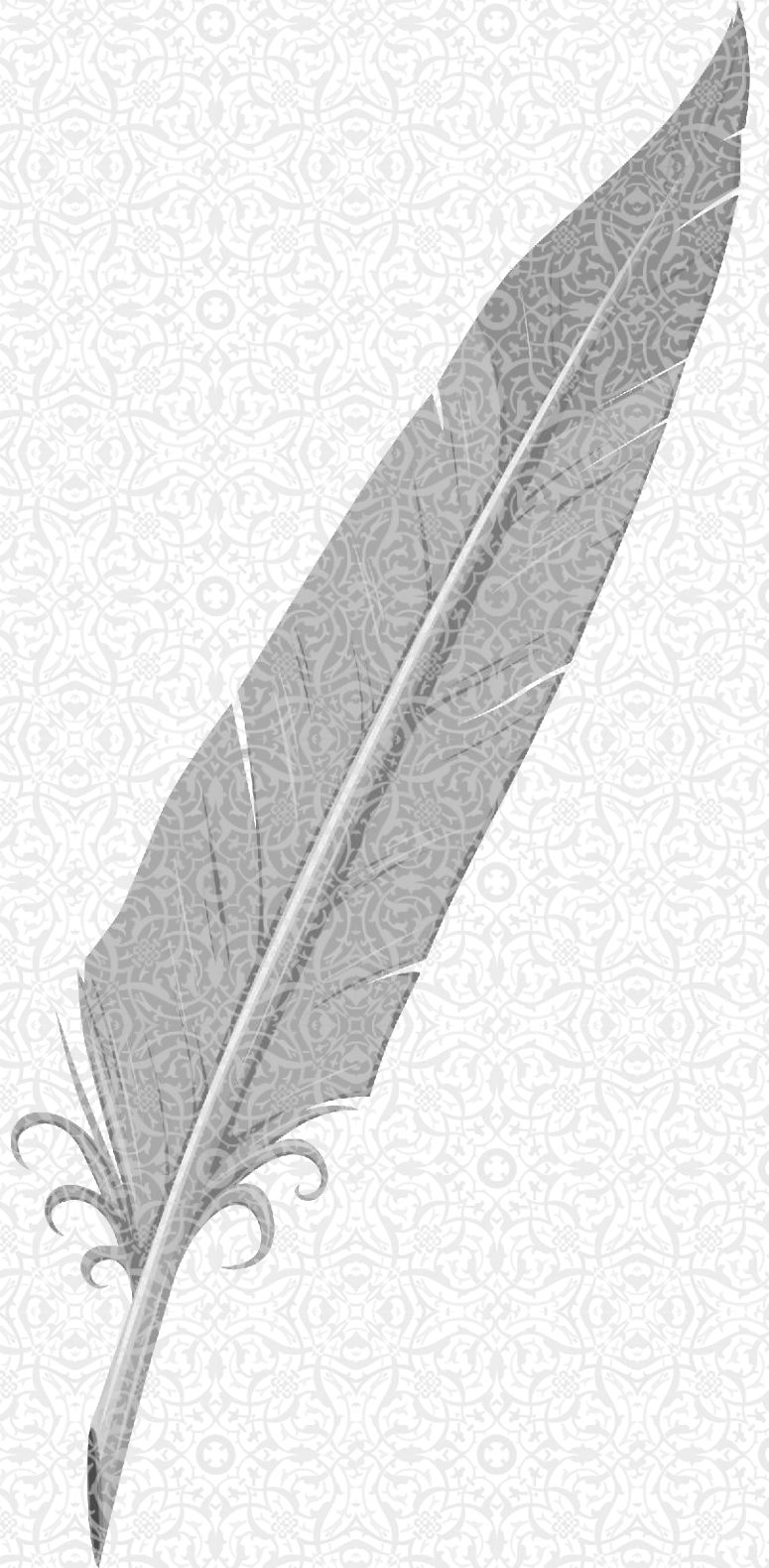
Department of Physics
Malaviya National Institute of Technology
Jaipur (Rajasthan) 302017 India

<http://www.mnit.ac.in>

ICSM 2014

Local Organizing Committee

Prof. K. C. Swami
Prof. S. K. Sharma
Dr. Kanupriya Sachdev
Dr. K. Venkataratnam
Dr. N. Srinivasa Rao
Dr. Subhayan Mandal
Dr. Rahul Singhal
Dr. Kamendra Awasthi
Dr. Sujin B. Babu
Dr. Manoj Kumar
Dr. Anjali Awasthi
Dr. Ritu Vishnoi
Dr. Balram Tripathi
Dr. Vibhav Kumar Saraswat
Dr. Kumud Kant Awasthi
Dr. Rishi Vyas
Ms. Yogita Kumari
Mr. Lokesh Kumar Jangir
Mr. Anil Kumar
Mr. Rajesh Kumar
Mr. Bhera Ram Tak
Mr. Nakul Jain
Ms. Priyanka
Mr. Vikas Sharma
Mr. Mahendra Singh Rathore
Mr. Arun Vinod
Mr. Dinesh Saini
Mr. Satyaveer
Ms. Kamakshi
Mr. Narendra Kumar Agarwal
Ms. Ankita Dube
Mr. Vineet Pathak





(Prof. I. K. Bhat)

Director, MNIT Jaipur

Patron ICSM 2014

It gives me immense pleasure to welcome all the distinguished delegates to the International Conference on Soft Materials (ICSM 2014) at Malaviya National Institute of Technology Jaipur during Oct. 6-10, 2014.

Theme of conference is “Soft materials” which has relevance to draw a roadmap for the futuristic studies in this important discipline that amalgamates different facets of physics, chemistry, biology, mathematics and engineering. Soft matter plays an important role in nearly every aspect of our daily lives. The soft materials have a broad, continuous range of materials, from colloid suspension of particles to flexible long chain polymer molecules. Many biological system such as proteins, DNA and virus have the characteristics of all these soft matter types.

I am sure that discussion and deliberations shall help us in understanding science of soft materials better. The organizing committee has drawn an elaborate programme to bring doyens in the field to update and discuss various issues pertaining to soft materials and to chalk out strategies for future R & D directions in this important field. The programme also gives an opportunity to young researcher to present their work and have interactive sessions with the leaders in the field.

Jaipur being known as pink city and famous for its hospitality and tourist attractions. I sincerely hope that your stay at this great city will be satisfying and scientifically fruitful.

A handwritten signature in green ink, appearing to read 'I. K. Bhat', with a long horizontal stroke extending to the right.

(Prof. I. K. Bhat)



(Prof. K. C. Swami)

Head, Department of Physics
MNIT Jaipur
Chairman ICSM 2014

I on behalf of Department of Physics, MNIT Jaipur as well as my own welcome you in International Conference on Soft Materials (ICSM 2014). I feel the theme selected for this conference is well sought and address to the most burning issue of present time.

Dr. Kamalendra Awasthi, Dr Sujin B Babu and their team members at MNIT Jaipur must be congratulated for aptly choosing the Soft Materials as the theme of meeting to provide an opportunity for researchers in India to interact with wide range of experts from the scientific fraternity for fruitful discussions and deliberations. I hope the concrete recommendation emanating from conference will give directions for future research in Soft materials.

I extend my warm greetings to the Conveners and wish the conference a grand success.

A handwritten signature in blue ink that reads "K. C. Swami". The signature is written in a cursive style with a long horizontal stroke at the end.

(Prof. K.C. Swami)



(Dr. Kamendra Awasthi)

Convener ICSM 2014



(Dr. Sujin B. Babu)

Convener ICSM 2014

With the objective of providing a scientific platform for both local and international soft materials scientists, engineers and technologists, we have initiated the organization of International Conference on Soft Materials (ICSM 2014).

ICSM 2014 consists of 15 technical sessions covering almost all the aspects of Soft Material Science, Engineering and Technology. There will be 10 plenary lectures and 24 invited talks by distinguished scientists. In addition, 33 oral and around 120 poster presentations are being presented by delegates. We are thankful to all those who are giving their presentations for the success of conference.

The proceedings of selected papers will be published in Journal of Macromolecular Symposia as a special issue after due process of review. We have instituted 15 awards for students to recognize and encourage for their presentation and also one best poster award by Journal Soft Matter.

This conference is hosted and supported by Malaviya National Institute of Technology Jaipur. Partial financial support received from Department of Science and Technology, Govt. of India, Department of Atomic Energy (DAE) -Board of Research in Nuclear Sciences (BRNS) Govt. of India, Council of Scientific & Industrial Research (CSIR) Govt of India and Material Research Society of India-Rajasthan Chapter is greatly acknowledged.

We are thankful to our International and national advisory board for their continued support and advice. It is our pleasant duty to thank all the members of program and organizing committee for their excellent job.

We are grateful to all the sponsors, supporters and exhibitors for their spontaneous response and encouragement by way of committing funds and extending help in kind.

We would like to place on record our sincere thanks to all the authorities of Malaviya national Institute of Technology Jaipur, in particular to its Director Prof. I. K. Bhat for hosting the event and providing necessary support.

A special mention is to be made for our volunteers for handling organization matters and support of Soft Materials Research group as a conference secretariat is greatly appreciated. Last but not least, we acknowledge the unconditional support from our Department of Physics

(Dr. Kamendra Awasthi)

(Dr. Sujin B. Babu)

Acknowledgement



सत्यमेव जयते

Government of India
Department of Science & Technology
Ministry of Science & Technology

Department of Science & Technology
Ministry of Science & Technology,
Government of India



सत्यमेव जयते

Government of India
Department of Atomic Energy (DAE)
Board of Research in Nuclear Sciences (BRNS)

Department of Atomic Energy,
Board of Research in Nuclear Sciences
Government of India



Council of Scientific &
Industrial Research
India



The Materials Research
Society of India
Rajasthan Chapter

Contents

ID	Title/Author	Page
PT01	Carbon NEMS and Nanowires in Health, Environment and Energy <i>Ashutosh Sharma</i>	1
PT02	Multi-responsive Hydrogels Formed by Interpenetrated Self-Assembled Polymer Networks <i>Anna Klymenko, Olivier Colombani, Christophe Chassenieu, Erwan Nicol, Lazhar Benyahia, Taco Nicolai</i>	1
PT03	Structure Formation of Integral Asymmetric Block Copolymer Membranes <i>Volker Abetz</i>	1
PT04	Critical Casimir Forces <i>S. Dietrich</i>	2
PT05	Functional Coatings with Polymer Brushes <i>Manfred Stamm</i>	2
PT06	Inorganic and Hybrid Nanomembranes: From Flexible Magnetoelectronics to Micro-biorobotics <i>Oliver G Schmidt</i>	2
PT07	Functional Nanocomposites From Fabrication to Function <i>Franz Faupel</i>	3
PT08	Active Motion: From Single Microswimmers to Their Emergent Collective Behavior <i>Holger Stark</i>	3
PT09	Aquaporin Z Embedded Biomimetic Membrane for Low Energy Water Purification <i>Tong, Y. W.</i>	3
PT10	Innovation in Science and Technology of Polymer-Composite Membranes <i>Y K Vijay</i>	4
IT01	From Metallic Gyroid Structures to Piezoelectric Nanoporous Networks <i>Katja Loos</i>	5
IT02	Functional Nanostructures for Energy and Health Applications <i>Sanjay Mathur</i>	5
IT03	New Generation Transparent Conducting Electrodes <i>Giridhar U. Kulkarni</i>	6
IT04	Do Ring Polymers Form a Topological Glass <i>D. Michieletto, W. C. Lo, D. Marenduzzo, E. Orlandini, G. P. Alexander, M. S. Turner</i>	6
IT05	Ion Beams Based Research in Polymers at IUAC <i>D.K. Avasthi</i>	7
IT06	VEGF Cancer Biomarker Protein Detection in Real Human Serum Using Capacitive Label-free apta-immunosensor <i>Anjum Qureshi, Yasar Gurbuz, Javed H. Niazi</i>	7
IT07	Free Volume and Positron Annihilation in Membrane Materials <i>K. Raetzke, S. Harms, T. Koschine, F. Faupel, L. Ravelli, W. Egger, M. M. Khan, T. Emmler, V. Filiz, V. Abetz</i>	7
IT08	Cooperative Motion of Active Brownian Spheres in Three-dimensional Dense Suspensions <i>Roland G. Winkler</i>	8
IT09	Multi-scale Simulation of Structure and Dynamics of Polymer-Nanotube Composites <i>Sudip Roy, Souvik Chakraborty</i>	8
IT10	Building with Colloids: Directing the Self-Assembly of Hybrid (Bio) Nanoparticles <i>Alexander Boker, Patrick van Rijn, Stephanie Hiltl, Patrick Wunnemann, Marco Schurings</i>	8
IT11	Maintaining the Shape: How do Biological Membranes do it? <i>P. B. Sunil Kumar</i>	9

ID	Title/Author	Page
IT12	Flame Transport Synthesized ZnO Nano- and Microstructures for Multifunctional Applications: From Advance Linker Elements to 3D Hybrid Flexible Networks <i>Yogendra K. Mishra, Soren Kaps, Jorit Grottrup, Tim Reimer, Arnim Schuchardt, Ingo Paulowicz, Xin Jin, Dawit Gedamu, Oleg Lupan, Rainer Adelung</i>	9
IT13	Collective Response and Emergent Structures in Active Suspensions <i>Ignacio Pagonabarraga</i>	9
IT15	Liquid Crystals for Driving, Steering and Reporting in Actuated or Active Soft Matter Systems <i>Francesc Sagues, Sergi Hernandez, Pau Guillamat, J. Ignés-Mullol, Pietro Tierno</i>	10
IT16	Many-body Microhydrodynamics of Active Colloidal Particles <i>Ronojoy Adhikari</i>	10
IT17	Synthesis of Tunable Nanomaterials and Poreshell Multifunctional Nanomaterials through Simple Chemistry <i>S. R. Vadera</i>	10
IT18	Irreversible and Reversible Deformations of Cellular Surfaces <i>Pierre Sens</i>	11
IT19	Active Computational Fluids <i>Madan Rao</i>	11
IT20	Recent Advances in Nanoparticle Synthesis and Electron Microscopy <i>Cathal Cassidy</i>	11
IT21	Correlation of Plasma Process Parameters to Tailor Surface Chemistry of Polymeric Materials for Application in Life Science <i>Marshal Dhayal</i>	12
IT22	Lipid Nanocapsules: A New Platform of Drug Delivery System <i>Emilie Roger</i>	12
IT24	EUV- Resists Changing the Integrated Circuits Fab. Landscape for Next Generation Technology Node <i>Satinder K. Sharma</i>	12
101	Amino acid regulated green synthesis and bioactivity of polymer stabilized silver nanoparticles <i>Bishnupada Roy, Suprabhat Mukherjee, Pranesh Chowdhury, Santi P. Sinha Babu</i>	14
103	Structural, optical, electrical and magnetic properties of PVA: Gd ³⁺ and PVA: Ho ³⁺ polymer films <i>M. Obula Reddy, L. Raja Mohan Reddy, P. Bayapu Reddy and K.V.Ramana Reddy</i>	14
104	Development of Novel Biological Soft Tissue Materials for Regenerative Medicine <i>Naveen Kumar</i>	14
105	Interaction of an antimicrobial peptide, NK-2 on phospholipid membranes <i>Sanat Karmakar, Rumiana Dimova</i>	15
108	Polymer Electrolyte Membrane: Regulates Reaction Environment for CO ₂ electroreduction to Fuel <i>L. M. Aeshala, A. Verma</i>	15
113	Nanoscale Effects on four Channel Drop Filter based on 2-D Dual Photonic Crystal Ring Resonator Heterostructure <i>Mayur Kumar Chhipa, Ekta Rewar</i>	15
115	Thermal Stability and Electrical Properties of Polyaniline Synthesized by Oxidative Polymerization Method <i>Anil Kumar, Amit Kumar, Ornav Maulik, Kamendra Awasthi, Vinod Kumar</i>	16
117	Electrostatic interaction between colloids trapped at an electrolyte interface <i>Arghya Majee, Markus Biero, S. Dietrich</i>	16
118	Green Synthesis of Polymer Inspired Gold Nanoparticles for the Evaluation of Their Bio-chemical Potency <i>Bishnupada Roy, Niladri Mukherjee, Pranesh Chowdhury, Santi P. Sinha Babu</i>	16
121	Transport Properties of Thermally Rearranged (TR) HAB-6FDA/Silica Nanocomposite Polymeric Membranes <i>N.K. Acharya</i>	17

ID	Title/Author	Page
122	Optical Studies of Zinc Oxide Nanoparticles filled Poly (ethylene terephthalate) <i>Harshita Agrawal, Kamlendra Awasthi, Vibhav K. Saraswat</i>	17
123	NEXAS Study of Pulsed Laser Deposited La _{1-x} Ca _x MnO ₃ (x=0.0, 0.3, 0.5 and 0.7) Thin Films on Si (100) <i>M. Ikram, Khalid Sultan, Sajad Ahmad Mir, Mir Zubida Habib</i>	17
125	Fabrication and Magnetic Properties of α -Fe ₂ O ₃ /SnO ₂ Heterostructures <i>C. S. Biju, D. Henry Raja, D. Pathinettam Padiyan</i>	18
126	Control of Droplet Size in Pickering Emulsions using Oppositely Charged Particles <i>Trivikram Nallamilli, Ethayaraja Mani, Basavaraj Madivala</i>	18
127	Control of Droplet Size in Pickering Emulsions using Oppositely Charged Particles <i>N. Kumar, P. L. Meena, A. S. Meena, K. S. Meena</i>	19
128	Sensing Applications of Liquid Crystal Films <i>Siddharth Kulkarni, Aditya Samant, Shaurya Seth, Prachi Thareja</i>	19
129	Colloidal Self-Assembly in Hexagonal Liquid Crystalline Phase <i>Prachi Thareja, Siddharth Kulkarni, Nidhi Mishra</i>	20
130	Electrohydrodynamics of Surfactant-Laden Drop <i>Purushottam Soni, Vinay A. Juvekar, Vijay M. Naik</i>	20
131	Pulling DNA: The Effect of Chain Length on the Mechanical Stability of DNA Chain <i>Amar Singh, Navin Singh</i>	21
133	Thin Films of Graphene Oxide-Cholesterol Biomolecules at Air-Water, Air-Solid Interfaces <i>A. Sarkar, K. A. Suresh, A. Sarkar</i>	21
134	Entropic Electrokinetics <i>Paolo Magaretti, Paolo Magaretti, J. Miguel Rubi</i>	21
135	Structural Transitions of Simple Liquids in Contact with Solid Surfaces Textured with Nanoscale Pits <i>Swarn Lata Singh, Lothar Schimmele, Siegfried Dietrich</i>	22
136	Self-Assembled Monolayer Modified SU8 Surface for Electrowetting-on-Dielectric Application <i>Vijay Kumar, Nitinipun Sharma</i>	22
137	Self-Assembled Monolayer for Dielectric Materials <i>Vijay Kumar, Nitinipun Sharma</i>	22
138	Mechanically Switchable Wetting from Optical Discs Patterned Topological Polydimethyl siloxane (PDMS) Film <i>Pratibha Goel, Samir Kumar, Raman Kapoor, J. P. Singh</i>	23
140	Electric Field Induced Indulations in Lipid Membranes: A MARTINI Simulation Study <i>K. R. Prathyusha, Ignacio Pagonabarraga, P. B. Sunil Kumar</i>	23
141	Flow Induced Structure Formation in a Gel Forming System <i>K. R. Prathyusha, Srikanth Sastry, P. B. Sunil Kumar</i>	24
144	Dynamics of Loop Closure in a Chemically Active Polymer <i>Debarati Sarkar, Snigdha Thakur</i>	24
145	Charge Carrier Controlling in Dual Gated Graphene Based Field Effect Transistors <i>Mahesh Soni, Satinder K. Sharma, Ajay Soni</i>	24
149	Synthesis & Characterization of ZnO Nanostructures with Block copolymer Templates <i>Lokesh Kumar, Yogita Kumari, Manoj Kumar, K. C. Swami, Kamlendra Awasthi</i>	25
150	Dynamics of the Critical Casimir Effect in a Binary Fluid <i>Sutapa Roy, Felix Hoing, Siegfried Dietrich</i>	25
151	Two-Dimensional Aggregates from Competing Interactions: Dynamics & Morphology <i>Tamoghna Das, Mahesh M. Bandi</i>	25
155	Silver nanoparticles and carbon nanotubes induced DNA damage in mice evaluated by single cell gel electrophoresis <i>Kumud Kant Awasthi, Anjali Awasthi, Rajbala Verma, Kamlendra Awasthi, P. J. John</i>	25

ID	Title/Author	Page
158	Effect of Mn and Cu Doping on the Electrical Properties of CdS Nanoparticles <i>K. S. Rathore, Deepika, N.S. Saxena</i>	26
159	Highly Sensitive Bragg Grating Refractive Index Sensor based on Plasmonic MIM Waveguide <i>Shikha Gaur, Rukhsar Zafar</i>	26
160	Synthesis & Characterization of TiO ₂ Nanostructures with Block copolymer Templates <i>Yogita Kumari, Lokesh Kumar, Manoj Kumar, K. C. Swami, Kamlendra Awasthi</i>	26
161	Thermal and Elastic Properties of SrCo _{1-x} Sb _x O _{3-δ} <i>Rasna Thakur, Rajesh K. Thakur, N.K. Gaur</i>	26
162	Study of Structural & Optical Properties of CdS Nanoparticles Prepared by Chemical Precipitation Method <i>Dinesh Saini, Rishi Vyas, R.K. Duchaniya, K.Sachdev</i>	27
163	Stabilization of Emulsion by Oppositely Charged Colloids: A Monte Carlo Simulation Study <i>Sam David Christdoss Pushpam, Basavaraj M. Gurappa, Ethayaraja Mani</i>	27
165	Optical and Structural Study of Polystyrene/Polyaniline Nano-Composites Thin Film <i>Anil Kumar, Yogita Kumari, Lokesh Kumar, Kamlendra Awasthi, Vinod Kumar</i>	27
166	Molecular Ordering in a Liquid Crystalline Compound from X-ray Studies <i>M. K. Usha, N. Vinutha, R. Somashekar, D. Revannasiddaiah</i>	28
167	Structural and Transport Properties of Ru doped Doped YMnO ₃ <i>Rajesh K. Thakur, Rasna Thakur, N. Kaurav, G.S. Okram, N.K.Gaur</i>	28
168	Antimicrobial activity of TiO ₂ doped Polystyrene membrane <i>Anjali Awasthi, Ankita Dubey, Kumud Kant Awasthi, Kamlendra Awasthi</i>	28
169	Glass-Glass Transition During Aging of a Colloidal clay <i>Roberta Angelini, Emanuela Zaccarelli, Giancarlo Ruocco, Barbara Ruzicka</i>	29
170	Relaxation Dynamics in a Colloidal Glass <i>B. Ruzicka, F. A. M. Marques, R. Angelini, E. Zaccarelli, G. Ruocco</i>	29
171	Elastic Properties of Ca Doped SrCoO ₃ Cobaltate <i>Rasna Thakur, Rajesh K. Thakur, Archana Srivastava, N.K. Gaur</i>	30
172	Smectic Translational Order in Two Liquid Crystalline Compounds from X-Ray Method <i>N. Vinutha, R. Somashekar, D. Revannasiddaiah</i>	30
173	Structural and Morphological Study of PS-ZnO Nanocomposite Membranes <i>Lokesh Kumar, Anil Kumar, Yogita Kumari, Manoj Kumar, K. C. Swami, Kamlendra Awasthi</i>	30
174	Dielectric Relaxation in a Newly Synthesized GdMn _{0.9} Cr _{0.1} O ₃ <i>Anchit Modi, Rajesh K. Thakur, Rasna Thakur, N. K. Gaur</i>	30
175	Experimental Study of Water based Al ₂ O ₃ Nanofluid Flow in Direct Absorption Solar Collector <i>Hemant Kumar Gupta, Ghanshyam Das Agrawal, Jyotirmay Mathur</i>	31
176	Synthesis of polystyrene nanoparticles by nano-precipitation from expanded polystyrene wastes <i>Ashna Rajeev, Madivala G Basavaraj</i>	31
177	Dynamics of Passive Triangular Swimmer in a Newtonian Fluid <i>Priyanka Choudhary, Sujin B. Babu, Shubhayan Mandal</i>	31
178	Kinetic Modelling of Growth of Gold Nanorods <i>Neethu Thomas, Ethayaraja Mani</i>	32
179	Nano-mechanical Characterization of Cross linked Chitosan/Hydroxyapatite Film <i>Amrita Rath, Pijush Ghosh</i>	32
180	Study of Bacterial Cell Colonization on Plasma Induced Bio-Adoptable Nanocomposites Polymer Membranes <i>Narendra Kumar Agrawal, Ravi Agarwal, Gautam Aashish Kumar, Y. K. Vijay, K. C. Swami</i>	33
183	Investigations on Multilayered TCO as Transparent Electrode in Organic Devices <i>Vikas Sharma, Pooja Meena, Amena Salim, Kanupriya Sachdev</i>	33
184	Structural and Morphological Study of PS-TiO ₂ Nanocomposite Membranes <i>Yogita Kumari, Anil Kumar, Lokesh Kumar, Manoj Kumar, K. C. Swami, Kamlendra Awasthi</i>	33

ID	Title/Author	Page
185	Fabrication of Topographic Meso Patterns with Programmable Feature Height using a Single Stamp <i>Nandini Bhandaru, Rabibrata Mukherjee</i>	33
187	Synthesis of Nanosheets Comprising Boron Honeycomb Lattice: Ultrasonication and Chelation Mediated Strategies <i>Asha Liza James, Kabeer Jasuja</i>	34
189	Computation of Thermal Conductivity of nano fluid- A Quantum mechanical Approach <i>S. Devashankar, N. Gurappa</i>	34
190	Brownian Cluster Dynamics with short range patchy interactions <i>Achutha Prabu, Sujin B. Babu, J. S. Dolado, J. C. Gimel</i>	34
191	Flow-induced Non-equilibrium Self-assembly in Suspensions of Stiff, Apolar, Active Filaments <i>Ankita Pandey, P. B. Sunil Kumar, R. Adhikari</i>	35
192	Self-Assembly and Template Guided Assembly of Colloidal Particles <i>Meneka Banik, Nandini Bhandaru, Rabibrata Mukherjee</i>	35
193	Influence of Particle Charge on Pickering Emulsions Stabilized by Shape Anisotropic Particles <i>T.G. Anjali, Madivala. G. Basavaraj</i>	36
194	A Novel Method of Synthesis of Patchy Particles <i>S Manigandan, S. Raman, Madivala G. Basavaraj, Ethayaraja Mani</i>	36
195	Electronic Properties of Cu-Pd Ordered Alloys <i>Yamini Sharma, Ramesh Sharma, Shalini Dwivedi</i>	36
196	Counterion Condensation Driven Shape Changes of Fluid Vesicles <i>K. K. Sreeja, John H. Ipsen, P. B. Sunil Kumar</i>	37
197	Elastic and Electronic Properties of TiC and TiN Crystals <i>Jitendra Kumar, K.C. Bhamu</i>	37
198	Study of Dielectric Properties of Nanocrystalline Cobalt Ferrite up to Microwave Frequencies <i>Jyoti, Jyoti Parashar, V. K. Saxena, S. N. Dolia, D. Bhatnagar, K. B. Sharma</i>	38
202	Membrane Elasticity and Polymerization Energy Modulate the Shape of Clathrin Coats <i>Mohammed Saleem, Sandrine Morlot, Annika Hohendahl, John Manzi, Martin Lenz, Aurelien Roux</i>	38
203	Chemotactic Dynamics of Gradient-sensing Eukaryotic cells <i>Ankush Sengupta, Raphael Voituriez, Paolo Maiuri, Nir S. Gov, Matthieu Piel</i>	38
204	Effect of Substrate Surface Energy on Morphology of As Cast Ultrathin Polymer Blend Film on Flat Substrate <i>Sahana Bhattacharyya, Palash Dhara, Meneka Banik, Rabibrata Mukherjee</i>	39
205	Carbon Nano Dots from Whey Protein: Fluorescent Nanoprobe for Live cell Imaging and Reduced Super Oxide Activity <i>Bodhisatwa Das, Prabhash Dadheech, Pavan Kumar Srivas, Pallabi Pal, Santanu Dhara</i>	39
206	Performance of Polymer Composite Membrane Electrode Assembly using Carbon Alloys as Anode Catalysts in Polymer Electrolyte Membrane Fuel Cell <i>Sri Mulijani, Armi Wulanawati, Kiagus Dahlan</i>	40
207	Orientation Dependence of Ultrasonic Parameters in CdO, CoO and FeO Crystals <i>Jitendra Kumar, K.C. Bhamu, Kailash, S.K. Srivastava</i>	40
209	Study of TCO/metal/TCO Structure Prepared by Chemical Route <i>Vikas Sharma, Amena Salim, Pooja Meena, Kanupriya Sachdev</i>	40
210	Structural and Switching Properties in Polymer Dispersed Ferroelectric Liquid Crystal Composites <i>Divya Jayoti, Praveen Malik</i>	41
211	Wide Temperature Range and Optical Studies of Polymer Stabilized Blue phases in a Binary Mixture <i>Arshdeep Singh, Praveen Malik</i>	41
212	Study of Hydrogen Adsorption on Multiwall Carbon Nanotubes (MWNTs) <i>Balram Tripathi</i>	41

ID	Title/Author	Page
213	Nano Ceramic (BaCO ₃)/Polymer Composites for Dielectric Study <i>Balram Tripathi, Vinod Chahar, G.Tripathi, K.B. Sharma, Y.K. Vijay</i>	42
218	Electro-Optic and Dielectric Studies in Magnetic Nanoparticle Doped Ferroelectric Liquid Crystal Mixtures for Soft Magneto-Electrics <i>Khushboo, Praveen Malik, Puneet Sharma, K. K. Raina</i>	42
219	Electronic Properties of Organic Schottky Diode based on Polycarbazole Nanocomposites <i>Arun Kumar Singh, Rajiv Prakash</i>	42
223	Synthesis and Characterization of Liquid Crystal Elastomer <i>Rita A. Gharde, Santosh A. Mani, Suman Lal, Samriti Khosla, S. K. Tripathi</i>	43
225	Influence of Substrate Stiffness and Cell Substrate Adhesions on Cell-Matrix De-Adhesion Dynamics <i>Soumya S S, Lakshmi Kavitha Sthanam, Ranjith Padinhateeri, Mandar M. Inamdar, Shamik Sen</i>	43
226	Dielectric behaviour of Ni _{0.2} Cu _{0.2} Zn _{0.6} Fe ₂ O ₄ Spinel Ferrite <i>Jyoti Parashar, V. K. Saxena, Jyoti, Deepak Bhatnagar, K. B. Sharma</i>	43
227	A Comparative Study of Fe- Doped ZnO Nanowire Bundle and their Spin Coated Thin Film for NO ₂ and CH ₄ Gas Sensing <i>Rishi Vyas, Sarla Sharma, Shabana Khan, R. Divakar, K. Sachdev, S. K. Sharma</i>	44
229	A Comparative Study on Effect of Conventional/Microwave Sintering in Tin Oxide, Antimony Oxide and Their Nanocomposite for NO ₂ Gas Sensing <i>Neeraj Goyal, Rishi Vyas, S. N. Dolia, S. K. Sharma</i>	44
230	Synthesis & Characterization of Co doped SnO ₂ nanoparticles <i>Kirti Sankhala, Rishi Vyas, S. K. Sharma</i>	44
231	Synthesis of Polyaniline-MgO Nanocomposite by In-situ Chemical Oxidative Polymerization <i>Ashutosh Shrivastava, Kashyap Dave, Rajveer Singh Rajaura, S. Shrivastava, M. Singh, Y. K. Vijay</i>	45
232	Structural and Thermal Characterization of Sol-Gel Derived Nanodimensional Zirconium Silicates <i>Surbhi, Saruchi, Sushil Kumar</i>	45
233	An Innovative Approach for Synthesis of Zero Valent Iron Nanoparticles and Its Antimicrobial Activity Against <i>Serratia Marcescens</i> <i>Ashutosh Shrivastava, Arpita Sundaria, Kailash Agrawal</i>	45
234	Development of Bioactive 3D Scaffold with Nano/Micro Hierarchy for Bone Tissue Engineering through Combinatorial Approach <i>Prabhash Dadhich, Bodhisatwa Das, Pavan Kr. Srivas, Pallabi Pal, Joy Dutta, Sabyasachi Ray, Santanu Dhara</i>	45
236	Synthesis of Star Shaped Cu doped CdS Nanoparticles and its Antibacterial Effect <i>Sundaria Arpita, Shrivastav Ashutosh, Vijay Bhavisha, Goyal Sumvit, Soni Ritesh, Meshugga Ronin, Agarwal K.</i>	46
238	The Structure and Self-Assembly of Amyloid Fibrils <i>Cait E. MacPhee</i>	46
239	Interfacial Self-assembly of the Bacterial Hydrophobin BslA <i>Cait E. MacPhee, Keith M. Bromley, Ryan J. Morris, Giovanni B. Brandani, Matthew McCluskey, Laura Hobley, Nicola R. Stanley-Wall</i>	47
240	Study of Magnetoresistive Behaviour of Praseodymium Substituted Perovskites LaMn _{0.8} Co _{0.2} O ₃ <i>B.L.Choudhary, Anjali Krishnamurthy, Bipin K. Srivastav</i>	47
242	Multifunctional Bio-Composites for Lightweight Structure: High Performance Materials and Health Monitoring with Conductive Nanocomposites <i>Kumud Malika Tripathi, Suvam Nag Chowdhury, Mickael Castro, Alain Bourmaud, Antoine Le Duigou, Jean-Francois Feller</i>	47
244	Sonochemically prepared Lead Tungstate (PbWO ₄) nanocrystals <i>S. Kannan, G. Sivakumar, S. Barathan, K. Mohanraj</i>	48

ID	Title/Author	Page
250	Carboxyl Group Functionalized CNT/ SPEEK Nanocomposite Membrane for Nanofiltration Application <i>Swati Gahlot, Prem P. Sharma, Vaibhav Kulshrestha</i>	48
251	Synthesis and Characterization of PVA/GO Nanocomposite Films <i>Swati Gahlot, Prem P. Sharma, Vaibhav Kulshrestha</i>	48
252	Synthesis and Characterization of Cu ₂ ZnSnS ₄ (CZTS) Nanoparticle <i>Garima Agarwal, Vaibhav Kulshrestha</i>	49
253	Water Desalination Performance of Quaternized Polyethyleneimine and f-GO based Anion Exchange Membrane <i>Prem P. Sharma, Swati Gahlot, Hariom Gupta, Vaibhav Kulshrestha</i>	49
254	Synthesis, Characterization and Applications of Ion Exchange Membranes <i>Vaibhav Kulshrestha</i>	49
255	Micro-Structural and Optical Characterization of Chemically Synthesized CdS Nanoparticles <i>Sushil Kumar, M. A. Majeed Khan</i>	50
256	Multiferroic BiD _{0.7} Y _{0.3} FeO ₃ thin films integrated with ZnO films: Characterization for potential applications <i>Deepak Bhatia, V.R. Palkar., R.S.Meena, Seeraj Nawaj</i>	50
257	Rheological Signatures of Gelation and Effect of Shear Melting on Aging Colloidal Suspension <i>Shweta Jatav, Yogesh M. Joshi</i>	51
258	Neutron Membrane Diffraction study of the solute profile of trehalose and sucrose between lamellar stacks of dioleoylphosphatidylcholine (DOPC) <i>Ben Kent, Tamim A. Darwish, Taavi E. Hunt, Bruno Deme, Thomas Haub, Christopher J. Garvey, G. Bryant</i>	51
259	Gelatin Organo-Nanocomposite Based Multiana lyte Biosensor <i>Anshu Sharma, Kamla Rawat, Pratima R. Solanki, H. B. Bohidar</i>	52
260	Dynamics in 1:1 Laponite-Montmorillonite Mixed Clay Dispersions <i>Nidhi Joshi, Kamla Rawat, H. B. Bohidar</i>	52
261	Interplay of Gelation in Protein/polyampholyte Aqueous Solutions <i>Jyotsana Pathak, Kamla Rawat, H. B. Bohidar</i>	52
263	Bioionogels of Gelatin and Agar as Functional Soft Materials <i>Kamla Rawat, P. R. Solanki, H. B. Bohidar</i>	53
266	Synthesis, Structure and Antibacterial Activity of 7-Fluoro-2-oxo-2Hchromene-3-carboxylic acid ethyl ester <i>Latha Rani N., Prashanth T, Sridhar M. A., Lakshmi Ranganatha V., Lakshmi Ranganatha V., Lokanath N.K.</i>	53
267	Nonequilibrium Fluctuations in a Sheared Model fluid <i>Pritha Dolai, Aditi Simha</i>	53
268	Structural and Thermal Study of TiO ₂ Embedded PC/PS Polymer Blend Nanocomposites <i>Shalini Agarwal, Y. K. Saraswat, Vibhav K. Saraswat</i>	54
269	Interaction of Graphene with Self Assembled Monolayers <i>Devanarayanan V. P, V. Manjuladevi, R. K. Gupta</i>	54
270	Structural, Optical and Magnetic behaviour of α -Cu ₂ V ₂ O ₇ <i>Hemant K. Arvind, Sangeeta Kalal, P. B. Punjabi, B. L. Choudhary, S. N. Dolia, Sudhish Kumar</i>	54
271	Synthesis, Structural and optical Characterization of Cadmium Sulphide Nanoparticles <i>Mahendra Singh Yadav, A. K. Sinha, M. N. Singh, Anuj Upadhyay, B. N. Rajasekar, T. K. Sharma, V. K. Dixit, Anil Pathak</i>	55
272	Characterization of Ionic Conduction in Poly(vinyl alcohol) montmorillonite Clay Nanocomposite Aqueous Colloidal Suspensions <i>Sonu Sankhla</i>	55
273	Electro-Optic and Dielectric Studies on Quantum Dot Doped Nematic Liquid Crystal <i>Jitendra Kumar, R. K. Gupta, Sandeep Kumar, V. Manjuladevi</i>	56

ID	Title/Author	Page
274	Fabrication of Organic Schottky Diode using Langmuir-Blodgett Technique <i>Saloni Gupta, Rajiv K. Pandey, Apurv Saxena, C. Upadhyay, Rajiv Prakash</i>	56
275	Effect of Gamma Radiation on Chitin-Nanosilver Membranes <i>Rita Singh, Durgeshwer Singh</i>	56
276	Morphology and Hydrophobic Properties of Tantalum Nanocluster Films Grown by Plasma Gas-condensation Method <i>Vidyadhar Singh, Cathal Cassidy, Panos Grammatikopoulos, Kengo Aranishi, Sushant Kumar, Murtaza Bohra, Jeong-Hwan Kim, Mukhles Sowwan</i>	57
277	Revealing Mechanism of Membrane Poration by Antimicrobial Peptides <i>Ankita Arora, Abhijit Mishra</i>	57
278	Applicability of Boltzmann Superposition Principle on Ageing Materials <i>Asheesh Shukla, Manish Kumar, Yogesh M. Joshi</i>	57
279	Enhancement of Polymerase Chain Reaction Efficiency using Graphene oxide <i>Rajveer Singh Rajaura, Ronin Messhugga, Shivdutt Purohit, Vinay Sharma, Rajveer S. Rajaura, Kailash Agrawal</i>	58
284	Structural Effects of ZnO Substitution on Crystallization Characteristics and Microstructure of SiO ₂ -MgO-Al ₂ O ₃ -B ₂ O ₃ -K ₂ O-MgF ₂ Glasses and Glass-Ceramics <i>Mrimoy Garai, Nibedita Sasmal, Basudeb Karmakar</i>	58
285	Ultrafiltration Membrane Over on Low-Cost Porous Clay-Alumina Ceramic Support Tubes and Application for Water Treatment <i>Surajit Dey, Priyankari Bhattacharya, Ganesh .C. Sahoo</i>	59
286	Optimization of polymeric membrane and microspheres morphology using ionic liquid as an additive <i>D.Shanthana Lakshmi, Rene Ruby Figueroa, A.Figoli, L.Giorno</i>	59
287	Size Dependent Cytotoxicity of Silver Nanoparticles using Whole-Cell Based Biosensor Chip <i>Javed H. Niazi, Ashish Pandey, Yasar Gurbuz, Anjum Qureshi</i>	60
289	Study of Dielectric and Magnetic Properties of Polymer Ferrite Nanocomposite <i>S. P. Pareek, S. N. Dolia, P. K. Sharma, Arun S. Prasad, Arvind Samariya, M. S. Dhawan, B. L. Prashant, K. B. Sharma</i>	60
293	A Comparative Study of the Effects of Oxygen Ion upon the Free Volume and Physico-chemical Properties of Makrofol (KG & N) Polycarbonate <i>Sanjeev Kumar Gupta, Paramjit Singh, D. Das, Rajesh Kumar</i>	60
296	Luminescent Nanoparticle: Quantum-Sized Carbon Dots from Sugar Cane Straw <i>Nidhi Rani Gupta</i>	61
297	Fabrication and Characterization of Thin Films of Aluminium Antimonide (AlSb) <i>Y. C. Sharma, A. Purohit, A. K. Sharma, A. Dixit, U. Kumawat, S. Ojha, Y. K. Vijay</i>	61
298	Validation of Force field of Rubber by Investigating Glass Transition Temperature from Molecular Dynamics Simulations <i>Pragati Sharma, Sudip Roy</i>	61
299	Structure of Nanorod Assembly in the Gyroid Phase of Diblock Copolymer <i>Souvik Chakraborty, Sudip Roy</i>	62
300	Synthesis, Magnetic and Dielectric properties of Nanocrystalline CoDy _x Fe _{2-x} O ₄ Ferrite <i>B. L. Prashant, Arvind Kumar, M. K. Gora, Priya Jadoun, S. N. Dolia</i>	62
301	Intracellular Transport on Multi filament Tracks <i>Subhadip Ghosh, Sudipto Muhuri, Ignacio Pagonabarraga</i>	62
302	Synthesis of Noble Metal Quantum Clusters @ Titania Core Shell Materials <i>Gupta Kalpna</i>	63
303	Nano-herbal Drugs for Diabetes Research and Management: A Review <i>Hemant Pareek, Sameer Sharma, G. C. Jain</i>	63

Planery Talk Abstracts

■ ID-PT01

Carbon NEMS and Nanowires in Health, Environment and Energy

Ashutosh Sharma

Department of Chemical Engineering, Indian Institute of Technology Kanpur, INDIA

*Email: ashutos@iitk.ac.in

This talk will summarize some of our recent results on novel meso-fabrication techniques and the resultant functionalities and applications of micro/nano polymeric and carbon structures in environmental remediation, energy storage devices and MEMS. The major emphasis is to fabricate functional structures and interfaces with applications that range from microfluidics, micro-batteries, tissue scaffolds to the bulk-nano materials for optical and functional coatings, bio-mimetic adhesives, super-wetting and structural colors.

References:

1. Highly sensitive biofunctionalized mesoporous electrospun TiO₂ nanofiber based interface for biosensing, *ACS Applied Materials & Interfaces* 6, 2516-2527 (2014).
2. Synthesis of phenolic precursor-based porous carbon beads in-situ dispersed with copper-silver bimetal nanoparticles for antibacterial applications, *J. Colloid Interface Sci.* 418, 216224 (2014).
3. Vertical electric field stimulated neural cell functionality on porous amorphous carbon electrodes, *Biomaterials* 34, 92529263 (2013).
4. Self-organized macroporous thin carbon films for supported metal catalysis, *Colloids & Surfaces A* 427, 83-94 (2013); Fabrication of polymer-modified monodisperse mesoporous carbon particles by template-based approach for drug delivery applications, *RSC Advances* 3, 2008-2016 (2013).
5. Surfactant-enhanced multiscale carbon webs including nanofibers and Ni-nanoparticles for the removal of gaseous persistent organic pollutants, *Ind. & Eng. Chem. Res.* 51, 2104-2112 (2012).
6. Improved graphitization and electrical conductivity of suspended carbon nanofibers derived from carbon nanotube/polyacrylonitrile composites by directed electrospinning, *Carbon* 50, 1753-1761 (2012).
7. Increased graphitization in electrospun single suspended carbon nanowires integrated with carbon-MEMS and carbon-NEMS platforms, *ACS Applied Materials & Interfaces* 4, 34-39 (2012).
8. One-step grayscale technique for the fabrication of 3-dimensional structures, *Sensors and Actuators B* 153, 125-134 (2011).

■ ID-PT02

Multi-responsive Hydrogels Formed by Interpenetrated Self-Assembled Polymer Networks

Anna Klymenko, Olivier Colombani, Christophe Chassenieu, Erwan Nicol, Lazhar Benyahia, Taco Nicolai*

LUNAM Universite, Universite du Maine, IMMM - UMR CNRS 6283, Departement Polymeres, Colloides, Interfaces, av. O. Messiaen, 72085 Le Mans cedex 9, FRANCE

*Email: Taco.Nicolai@univ-lemans.fr

BAB triblock copolymers with hydrophobic end blocks and a hydrophilic central block form a network in aqueous solution by self assembly of the B-blocks into multiplets that are bridged by the A blocks. The dynamics of the network depends on the exchange time of the B-blocks between multiplets. In some cases the dynamics can be controlled by external parameters, which renders the systems stimulus responsive. We have studied in our group two such systems. One system (tPEO) was based on a neutral central PEO block for which the B-blocks could be covalently crosslinked within the multiplets by UV irradiation[1]. The other system (TH50) was based on a charged polyacrylic acid central chain[2]. In this case the B-blocks consisted of random copolymers of acrylic acid and n-butyl acrylate, which rendered the exchange dynamics highly sensitive to the pH.

More recently, we have explored the possibility to form interpenetrated self assembled networks (IPSAN), by mixing the two types of triblock copolymers. The advantage of this approach over current methods to form an IPN, is that the procedure is very simple and that the system is in thermodynamic equilibrium. In addition, one can potentially combine in this way the various functionalities of triblock copolymers that have been reported in the literature. We will show that for the IPSAN studied by us, the two networks our formed more effectively in combination than separately and that the response of each network to the external stimuli is preserved.

References:

1. V. S. Kadam, T. Nicolai, E. Nicol and L. Benyahia, *Macromolecules*, 2011, 44, 8225-8232.
2. C. Charbonneau, C. Chassenieu, O. Colombani and T. Nicolai, *Macromolecules*, 2011, 44, 4487-4495.

■ ID-PT03

Structure Formation of Integral Asymmetric Block Copolymer Membranes

Volker Abetz^{1,2*}

¹*Helmholtz-Zentrum Geesthacht, Institute of Polymer Research, Max-Planck-Str. 1, 21502 Geesthacht, GERMANY*

²*University of Hamburg, Institute of Physical Chemistry, Grindelallee 117, 20146 Hamburg, GERMANY*

*Email: volker.abetz@uni-hamburg.de

Block copolymers offer the possibility to prepare isoporous membranes, if the self-assembling process in a solution is combined in a suitable way with a freezing step, as it can be achieved by precipitating an appropriately designed block copolymer solution into a nonsolvent bath. This can lead to highly regular membrane surfaces which have open pores of very narrow size distribution. These selective layers are supported by a less regular, more porous sub structures of the same material functioning as a mechanical support. Both flat sheet membranes and hollow fibre membranes will be discussed in terms of preparation conditions. Characterisation is carried out by scanning electron microscopy, small angle X-ray

scattering and water flux measurements.

References:

1. S. Rangou, K. Buhr, V. Filiz, J. I. Clodt, B. Lademann, J. Hahn, A. Jung, V. Abetz. Self-organized isoporous membranes with tailored pore sizes. *Journal of Membrane Science* 2014, 451:266.
2. M. Radjabian, J. Koll, K. Buhr, U. A. Handge, V. Abetz. Hollow Fibre Spinning of Block Copolymers: Influence of Spinning Conditions on Morphological Properties. *Polymer* 2013, 54:1803.

■ ID-PT04

Critical Casimir Forces

S. Dietrich

Max Planck Institut fur Intelligente Systeme, Germany, and Institut fur Theoretische Physik IV, Universitt Stuttgart, GERMANY

*Email: dietrich@mf.mpg.de

Long-ranged correlations in a fluid near its critical point lead to clearly identifiable effective forces acting on confining walls. The corresponding universal scaling functions are discussed for different boundary conditions and geometries. The theoretical predictions are compared with high precision experimental data for He⁴ and He³/He⁴ wetting films near the superfluid phase transition as well as with synchrotron scattering data from classical binary liquid mixtures. Direct measurements and applications for colloidal suspensions are discussed.

■ ID-PT05

Functional Coatings with Polymer Brushes

Manfred Stamm

Leibniz Institute of Polymer Research Dresden, Hohe Strasse 6, 01069 Dresden, GERMANY

*Email: stamm@ipfdd.de

Functional polymer brushes may be used at surfaces for functional coatings with adaptive properties and in connection with inorganic nanoparticles can serve as responsive and versatile functional layers. A fairly robust way for the generation of such nanoscopic coatings is the attachment of polymer chains to the surface by covalent bonding. Nanoparticles are attached by adsorption or covalent binding at the end of the chains. At high grafting density a brush-like layer will be formed, and surface properties can be changed significantly while bulk properties are largely unchanged. Utilizing mixed polymer brushes the surface properties can be switched between different states[1], and it is even possible to switch between ultra-hydrophobic and ultra-hydrophilic behavior[2].

Depending on solvent conditions, one or the other polymer chain occupies the surface layer and thus determines surface properties, which depend on the outermost surface layer. The properties depend also on glass transition and mobility in the layer, where in particular the switching and responsive behavior is influenced. This effect can be used to control the location of nanoparticles at the top or inside the layer. Layers are characterized in different ways including contact

angle measurements, X-ray-photoelectron-spectroscopy, ellipsometry, quartz-crystal-microbalance and scanning force microscopy. Depending on the degree of swelling of the brush layer, fluorescent nanoparticles attached to the polymer brush chains[3] will be close to the surface or further away and may serve as a sensitive optical sensor for the degree of swelling. By surface enhanced Raman scattering a chemical sensing is achieved[4]. Similarly the hydrophobic nature of a mixed brush layer can be changed by pH, ion strength or temperature, which allows to control the adsorption of polyelectrolytes and protein molecules depending on the state of the brush[5,6]. Similarly the catalytic activity of nanoparticles depends on the position in the layer which can be varied[7]. We acknowledge support by DFG/NSF and BMBF for this work.

References:

1. S. Minko, M. Muller, D. Usov, A. Scholl, C. Froeck, M. Stamm, *Phys. Rev. Let.* 88 (2002) 35502; M.A. Cohen Stuart, W.T.S. Huck, J. Genzer, M. Muller, C. Ober, M. Stamm, G. B. Sukhorukov, I. Szleifer, V. V. Tsukruk, M. Urban, F. Winnik, S. Zauscher, I. Luzinov, S. Minko, *Nature Materials* 9 (2010) 101.
2. M. Motornov, S. Minko, K.-J. Eichhorn, M. Nitschke, F. Simon, M. Stamm, *Langmuir*, 19 (2003) 8077.
3. L. Ionov, S. Sapra, A. Synytska, A. L. Rogaci, M. Stamm, S. Diez, *Advanced Materials* 18 (2006) 1453.
4. R. Contreras-Caceres, C. Dawson, P. Formanek, D. Fischer, F. Simon, A. Janke, P. Uhlmann, M. Stamm, *Chemistry of Materials*, 25 (2013) 158.
5. O. Hoy, B. Zdyrko, R. Lupitskyy, R. Sheparovych, D. Aulich, J. Wang, E. Bittrich, K.-J. Eichhorn, P. Uhlmann, K. Hinrichs, M. Mller, M. Stamm, S. Minko, I. Luzinov, *Advanced Functional Materials* 20 (2010) 2240.
6. E. Bittrich, KB Rodenhausen, K.J Eichhorn, T. Hofmann, M. Schubert, M. Stamm, P. Uhlmann, *Biointerphases* 5 (2011) 159; E. Bittrich, S. Burkert, M. Muller, K.-J. Eichhorn, M. Stamm, P. Uhlmann, *Langmuir*, 28 (2012) 3439.
7. M. Koenig, F. Simon, P. Formanek, M. Muller, S. Gupta, M. Stamm, P. Uhlmann, *Macromol. Chem. Phys.* 214 (2013) 2301; M. Konig, D. Magerl, M. Philipp, K.J. Eichhorn, M. Muller, P. Muller-Buschbaum, M. Stamm, P. Uhlmann, *RSC Advances* 4 (2014) 17579.

■ ID-PT06

Inorganic and Hybrid Nanomembranes: From Flexible Magnetoelectronics to Micro-biorobotics

Oliver G Schmidt

Leibniz Institute for Solid State and Materials Research Dresden, GERMANY

*Email: o.schmidt@ifw-dresden.de

Nanomembranes are thin, flexible, transferable and can be shaped into 3D micro- and nanoarchitectures. This makes them attractive for a broad range of applications and scientific research fields ranging from flexible magnetoelectronic devices to ultra-compact autonomous micro- and micro-biorobotic systems. If nanomembranes are differentially strained they deform themselves and roll-up into tubular structures upon release from their mother substrate. Rolled-up nanomembranes can be exploited to rigorously compact electronic circuitry, energy storage units and novel optical systems.

If appropriate materials are chosen, rolled-up tubes act as tiny catalytic jet engines which in the ultimate limit may drive compact multifunctional autonomous systems for medical and environmental applications. If magnetic

tubes are combined with flagella-driven sperm cells, such hybrid micro-biorobots offer new perspectives towards artificial reproduction technologies.

■ ID-PT07

Functional Nanocomposites From Fabrication to Function

Franz Faupel

Chair for Multicomponent Materials, Christian-Albrechts University at Kiel, Kaiserstr. 2, 24143 Kiel, GERMANY

*Email: ff@tf.uni-kiel

Nanocomposite films consisting of metal nanoparticles in a dielectric organic or ceramic matrix have unique functional properties with hosts of applications[1]. The present talk demonstrates how vapor phase deposition techniques can be employed for tailoring the nanostructure and the resulting properties. Vapor phase deposition, inter alia, allows excellent control of the metallic filling factor and its depth profile as well as the incorporation of alloy nanoparticles with well-defined composition. The metallic nanoparticles typically form via a self-organization during co-deposition of the metallic and matrix components due to the high cohesive energy of the metals and the low metal-matrix interaction energy. Various methods such as sputtering, evaporation, and plasma polymerization have been applied for the deposition of the matrix component, while the metallic component has mostly been sputter-deposited or evaporated. Moreover, gas aggregation cluster sources were utilized to obtain independent control of filling factor and size of the embedded nanoparticles. Examples presented include optical composites with tuned particle surface plasmon resonances for plasmonic applications[2], magnetic high frequency materials with cut-off frequencies well above 1 GHz[3], sensors that are based on the dramatic change in the electronic properties near the percolation threshold[4], and biocompatible antibacterial coatings with tailored release rate[5].

References:

1. F. Faupel, V. Zaporozhchenko, T. Strunskus, M. Elbahri, *Adv. Eng. Mater.* 12, 1177 (2010).
2. M. Elbahri, M. K. Hedayati, V. S. K. Chakravadhanula, M. Jamali, T. Strunskus, V. Zaporozhchenko, F. Faupel, *Adv. Mater.* 23 1993 (2011).
3. H. Greve, C. Pochstein, H. Takele, V. Zaporozhchenko, F. Faupel, A. Gerber, M. Frommberger, E. Quandt, *Appl. Phys. Lett.* 89, 242501 (2006).
4. C. Hanisch, N. Ni, A. Kulkarni, V. Zaporozhchenko, T. Strunskus, F. Faupel, *J. Mater. Sci.* 46, 438 (2010).
5. T. Hrkac, C. Rohl, R. Podschun, V. Zaporozhchenko, T. Strunskus, H. Papavlassopoulos, D. Garbe-Schonberg, F. Faupel, *Mater. Sci. Eng. C* 33, 2367 (2013).

■ ID-PT08

Active Motion: From Single Microswimmers to Their Emergent Collective Behavior

Holger Stark

Institute of Theoretical Physics, Technical University Berlin, D-10623 Berlin, GERMANY

*Email: Holger.Stark@tu-berlin.de

Active motion of artificial and biological microswimmers is relevant in microfluidics and biological applications but also poses fundamental questions in nonequilibrium statistical physics. Mechanisms of single microswimmers need to be understood and a detailed modeling of microorganisms helps to explore their complex cell design and their behavior. The collective motion of microswimmers generates appealing dynamic patterns.

In this talk I review some of our work modeling biological microswimmers such as *E. coli*[1] and the African trypanosome[2], the causative agent of the sleeping sickness, in order to contribute to their better understanding. Using simpler model microswimmers such as active Brownian particles, I will also demonstrate their emerging collective behavior. Hydrodynamic interactions lead to a clustering transition dependent on swimmer type[3] or to the formation of fluid pumps in 3D harmonic traps[4], while self-phoretic active colloids show biomimetic auto-chemotactic behavior, which can induce dynamic clustering or a chemotactic collapse[5].

References:

1. R. Vogel and H. Stark, Rotation-induced polymorphic transitions in bacterial flagella, *Phys. Rev. Lett.* 110, 158104 (2013).
2. S. B. Babu and H. Stark, Modeling the locomotion of the African trypanosome using multi-particle collision dynamics, *New Journal of Physics* 14, 085012 (2012).
3. D. Alizadehrad, T. Kruger, M. Engstler, and H. Stark, Simulating the Complex Cell Design of *Trypanosoma brucei*, submitted to *PLOS Comp. Biol.*
4. A. Zottl and H. Stark, Hydrodynamics determines collective motion and phase behavior of active colloids in quasi-two-dimensional confinement, *Phys. Rev. Lett.* 112, 118101 (2014).
5. M. Hennes, K. Wolff, and H. Stark, Self-induced polar order of active Brownian particles in a harmonic trap, *Phys. Rev. Lett.* 112, 238104 (2014).
6. O. Pohl and H. Stark, Dynamic clustering and chemotactic collapse of self-phoretic active particles, *Phys. Rev. Lett.* 112, 238303 (2014).

■ ID-PT09

Aquaporin Z Embedded Biomimetic Membrane for Low Energy Water Purification

Tong, Y. W.

Division of Bioengineering, National University of Singapore 21 Lower Kent Ridge Road, 119077 SINGAPORE

*Email: chetyw@nus.edu.sg

The regulation of intracellular water activity is a necessary characteristic of many physiological functions in all living organisms. The high water transport rate across cell membranes is due to a type of water channel protein, aquaporin. The Nobel Prize in Chemistry 2003 was awarded to Prof. Agre due to the discovery of aquaporins. The unique selectivity, high water transport capability, and low activation energy of aquaporins have garnered strong scientific interests with many studies concentrating on the fabrication of biomimetic membranes based on the reconstitution of aquaporins into self-assembled amphiphilic lipid or polymer bilayers. Aquaporin-incorporated biomimetic membranes possess an extremely high potential for water purification and

desalination. It has been estimated that the permeability of an aquaporin Z (AqpZ) reconstituted biomimetic membrane is $167 \mu\text{m/s/bar}$, which is by two orders of magnitude greater than the commercial polymeric membranes. However, limitations of the biomimetic membrane lie in that the ultrathin biomimetic bilayers are too fragile to withstand high hydraulic or osmotic pressure in the water purification application. The objective of our study is to design and fabricate aquaporin embedded membranes with excellent water purification performance. We have carried out scientific study on the mechanism of water transport through membrane-embedded aquaporin Z and preliminarily established a relationship between membrane tension and osmotic permeability of an amphiphilic block copolymer bilayers. Moreover, we have developed several innovative yet simple and easy-to-implement methods to incorporate water-channel proteins into pre-fabricated membranes to develop advanced membrane materials for purifying water at low pressures and low energy. According to our results, the pore-suspending biomimetic membrane exhibits high water permeability as well as high salt rejection during forward osmosis, while the AqpZ-vesicle imprinted membrane exhibits high mechanical strength and stability during nanofiltration process.

■ ID-PT10

Innovation in Science and Technology of Polymer-Composite Membranes

Y K Vijay

Vivekananda Global University, Jaipur-313020 INDIA

*Email: vijayk@gmail.com

The large variety of modern composite materials and products existing nowadays in the construction market provides multiple and convenient possibilities to use them as building material in both structural and nonstructural industrial construction elements. The main advantages of modern composite materials such as: corrosion resistance, high strength and modulus values compared to their density, acceptable deformability, tailored design and excellent formability enable the fabrication of new elements and the structural rehabilitation of the existing parts made of traditional materials. The high potential of the applicability of polymeric composites in new industrial construction correlated with fabrication procedures as well as the use of composites in modern strengthening solutions.

Apart from polymer-polymer, polymer-metal, polymer-nonmetal, the Polymer-CNT, Polymer-nano phosphor and Polymer-PANI composites wonderful materials in thin film and thick film form show interesting properties variation in passive polymers. The talk covers properties of polymer-composites as controlled porous membrane to be used as nano-filter, gas sensor and photonic material.

Invited Talk Abstracts

■ ID-IT01

10.1002/pola.27340.

From Metallic Gyroid Structures to Piezoelectric Nanoporous Networks

Katja Loos

Department of Polymer Chemistry & Zernike Institute for Advanced Materials University of Groningen, Nijenborgh 4, 9747 AG, Groningen, THE NETHERLANDS

*Email: k.u.loos@rug.nl

In this study we present two approaches to obtain nanoporous materials from block copolymer precursors. A supramolecular complex of PS-b-P4VP diblock copolymer and amphiphilic PDP was used as a precursor for the nanoporous template for subsequent metal plating. PDP molecules interact via hydrogen bonds with the pyridine rings to form a PS-b-P4VP(PDP)_x complex. The block lengths of the block copolymer and the amount of PDP were selected in such a way that the self-assembly gave rise to a bicontinuous gyroid morphology with a PS network in a matrix of P4VP(PDP)_x. The PDP side chains were selectively removed in ethanol, after which the P4VP chains collapsed onto the PS, thus forming a polar corona around the PS network struts. Subsequently, electroless deposition was performed such that the metal was distributed uniformly throughout the macroscopic thickness of the template (50100 μm). The metal nanofoam, obtained after the removal of polymer template, preserved the well-defined gyroid structure with long range order. Nanoporous metal foams represent a new, very promising class of materials that combine the properties of metals, such as catalytic activity, thermal and electrical conductivity, and the properties of nano-porous materials: low relative density and high specific surface area. These unique properties allow nano-porous metal foams to be used for a large number of possible applications as, for example: high power-density batteries, substitutes for platinum-group catalysts, hydrogen storage materials, actuators etc.

As a second example, we present the use of poly(vinylidene fluoride) containing block copolymers as precursors for nanoporous networks. PVDF is well-known for its excellent piezoelectric behavior, and therefore an interesting material to apply in nanofabrication.

References:

1. Vukovic, I.; Punzhin, S.; Vukovic, Z.; Onck, P.; de Hosson, J.T.M.; ten Brinke, G.; Loos, K. *ACS Nano* 2011, 5, 6339.
2. Vukovic, I.; Voortman, T.P.; Hermida Merino, D.; Portale, G.; Hiekkataipale, P.; Ruokolainen, J.; ten Brinke, G.; Loos, K. *Macromolecules* 2012, 45, 3503.
3. Vukovic, I.; ten Brinke, G.; Loos, K. *Macromolecules* 2012, 45, 9409.
4. Voet, V. S. D.; Tichelaar, M.; Tanase, S.; Mittelmeijer-Hazeleger, M. C.; ten Brinke, G.; Loos, K. *Nanoscale* 2013, 5, 184.
5. Voet, V. S. D.; Hermida Merino, D.; ten Brinke, G.; Loos, K. *RSC Advances* 2013, 3, 7938.
6. Voet, V.S.D.; Alberda van Ekenstein, G. O.R.; Meereboer, N.; Hofman, A.; ten Brinke, G.; Loos, K. *Polymer Chemistry* 2014, 5, 2219.
7. Voet, V.S.D.; ten Brinke, G.; Loos, K. *Journal of Polymer Science Part A: Polymer Chemistry* 2014. DOI:

■ ID-IT02

Functional Nanostructures for Energy and Health Applications

Sanjay Mathur

Director, Institute of Inorganic Chemistry Chair, Inorganic and Materials Chemistry University of Cologne Greinstrasse 6, D-50939 Cologne, GERMANY

*Email: sanjay.mathur@uni-koeln.de

Chemical nanotechnologies have played, in the past few decades a major role in the convergence of life, physical and engineering sciences leading not only to simple collaboration among the disciplines but to a paradigm shift based on true disciplinary integration. The successful synthesis, modification and assembly of nanobuilding units such as nanocrystals and wires of different materials have demonstrated the importance of chemical influence in materials synthesis, and have generated great expectations for the future. Implications of chemistry as an innovation motor are now visible for knowledge leap forward in various sectors such as materials engineering for energy, health and security.

Inorganic nanostructures inherit promises for substantial improvements in materials engineering mainly due to improved physical and mechanical properties resulting from the reduction of microstructural features by two to three orders of magnitude, when compared to current engineering materials. This talk will present how chemically grown nanoparticles, nanowires and nanocomposites of different metal oxides open up new vistas of material properties, which can be transformed into advanced material technologies. The examples will include application of superparamagnetic iron oxide nanoparticles for magnetic resonance imaging (MRI) and drug delivery applications, vapour phase synthesis and electrospinning of nanowires for application as electrode materials and in water splitting reactions (for solar hydrogen production). A novel sensing concept based on the integration and correlation of complementary functionalities originating from multiple junctions in a singular nanostructure to palliate the current issues in gas sensor technologies such as low power consumption, low operating temperature and cost effective production will be elaborated. Finally, the current challenges of integration of nanomaterials in existing device concepts will be discussed.

■ ID-IT03

New Generation Transparent Conducting Electrodes

Giridhar U. Kulkarni

Chemistry & Physics of Materials Unit and Thematic Unit of Excellence on Nanochemistry Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, INDIA

*Email: kulkarni@jncasr.ac.in

Transparent conductors are ubiquitous among optoelectronic devices. Tin doped indium oxide (ITO) has been the material of choice due to its high transmittance in the visible range and high conductivity. However, there are many concerns around its continued usage- limited supply and high cost of In, brittleness of the oxide, low thermal and chemical stability etc[1]. While many oxide formulations have been proposed as possible alternative ITO, none have come closer to ITO performance. Accordingly, there is increasing activity worldwide in the last few years among industry and academic researchers, to employ nanomaterials such as graphene, which exhibits exceptional transmittance. However, producing good quality graphene over large area reproducibly is a difficult task. Alternatively, carbon nanotubes and Ag nanowires in the form of wire networks distributed sparsely, have been tried out such that transmittance associated with the substrate (glass, PET etc) is not much hindered while electrical conduction is enabled through the network. The downside is that wires tend to stack randomly forming innumerable crossbar junctions leading to undesirable sheet resistance values.

Our efforts in the recent past have been to develop new generation transparent conductor in the form of highly interconnected metal (Au, Ag, Cu etc.) wire network, invisible to the naked eye, on common substrates such as glass. Unlike the conventional method of dropping nanowires on a substrate, these conducting electrodes (TCEs) are produced employing a newly developed recipe termed as “crackle lithograph”. The TCEs thus formed exhibit optoelectronic properties that are superior in many ways, to those of conventional ITO films and other alternate materials[2-7]. In this presentation, the crackle lithography method will be described while addressing current issues in the literature. The performance characteristics of the TCEs as well as of devices- solar cells, transparent heaters, transparent capacitor and transparent strain sensor fabricated using the TCEs, will be presented. Finally, futuristic usage of wire network based TCEs in transparent electronics will be discussed.

References:

1. R. Gupta and G.U. Kulkarni, Holistic Method for Evaluating Large Area Transparent Conducting Electrodes, ACS Appl. Mater. Interfaces, 5, (2013) 730-736.
2. S. Kiruthika, R. Gupta, K. D. M. Rao, S. Chakraborty, N. Padmavathy and G. U. Kulkarni, Large area solution processed transparent conducting electrode based on highly interconnected Cu wire network, J. Mater. Chem. C, 2, (2014) 2089-2094.
3. S. Kiruthika, K. D. M. Rao, A. Kumar, R. Gupta and G. U. Kulkarni, Metal wire network based transparent conducting electrodes fabricated using interconnected crackled layer as template, Mater. Res. Express, 1, (2014) 026301.
4. K. D. M. Rao and G. U. Kulkarni, Highly crystalline single Au wire network as high temperature transparent heater,

Nanoscale, 6, (2014) 5645-5651.

5. R. Gupta, K. D. M. Rao, K. Srivastava, A. Kumar, S. Kiruthika and G. U. Kulkarni, Spray Coating of Crack Templates for the Fabrication of Transparent Conductors and Heaters on Flat and Curved Surfaces, ACS Appl. Mater. Interfaces, (2014), DOI: 10.1002/admi.201400090.

■ ID-IT04

Do Ring Polymers Form a Topological Glass

D. Michieletto¹, W. C. Lo², D. Marenduzzo³, E. Orlandini⁴, G. P. Alexander¹, M. S. Turner^{1*}¹Department of Physics and Centre for Complexity Science, University of Warwick, Coventry CV4 7AL, UK²Department of Physics, National Central University, Zhongli, Taiwan 32001, Republic of CHINA³School of Physics and Astronomy, University of Edinburgh, Mayfield Road, Edinburgh EH9 3JZ, UK⁴Dipartimento di Fisica e Astronomia, Sezione INFN, Università di Padova, Via Marzolo 8, 35131 Padova, ITALY

*Email: m.s.turner@warwick.ac.uk

A case can be made that ring polymers represent one of the last major theoretical challenges facing polymer physics. The essential difficulty lies in the non-local nature of the topological constraint associated with polymers of fixed topology, such as rings (unknots), that cannot cross one-another[1].

For many years various authors have speculated on the possibility that rings may thread through one-another, forming extremely long-lived entanglements[1-2]. However, these comments have remained at the level of speculation and no convincing evidence has yet been found of such slow dynamics in the melt.

Here we report on molecular dynamics and Monte Carlo simulations of ring polymers embedded in a gel[3-4]. We propose a scheme that allows us to identify inter-ring threadings, or penetrations, for the first time. This allows us to monitor their statistical properties and lifetimes. We find evidence of the emergence of a percolating cluster of inter-ring penetrations and argue that, for longer rings, a jammed state that we call a topological glass should arise, even for $T \gg T_g$, the classical glass transition for the polymer itself. In order to further explore this we carry out Monte Carlo simulations on an idealised system in which the rings are assumed to compactify into linear duplex structures. Here we find a clear signature of exponential relaxation, characteristic of such a topological glass.

References:

1. J. Klein, Dynamics of entangled linear, branched, and cyclic polymers. Macromolecules 1986, 118:105.
2. S. Obukhov, M. Rubinstein. Dynamics of a ring polymer in a gel. Phys. Rev. Lett. 1994, 73:1263.
3. W. C. Lo, M. S. Turner. The topological glass in ring polymers. Europhys. Lett. 2013, 102:58005.
4. D. Michieletto, D. Marenduzzo, E. Orlandini, G. P. Alexander, M. S. Turner. Threading dynamics of ring polymers in a gel. ACS Macro. Lett. 2014, 3:255.

■ ID-IT05

Ion Beams Based Research in Polymers at IUAC

D.K. Avasthi

Inter University Accelerator Centre, Post Box 10502, Aruna Asaf Ali Marg, New Delhi 110067, INDIA

*Email: dka@iuac.res.in

Ion beams in different energy regimes play crucial role in nanostructuring. Low energy (in keV regime) ion and atom beams have potential in synthesis of meal polymer nanocomposites[1,2]. Swift heavy ions (SHI) have typical energies of 1 MeV/nucleon or higher, can create ion tracks, having diameters upto 10 nm in insulating materials like polymers. By virtue of creating track of nano dimensions, the SHI offers a potential possibility in creating nanostructures in materials in controlled manner. The C clusters aligned along the beam direction[3, 4] can be created by SHI irradiation of Si based polymers. On-line elastic recoil detection (ERDA) and on-line QMA experiments[5] have given a rough idea of the diameter within which hydrogen is released as a consequence the passage of a SHI through the polymer. Etched ion tracks having sub micron diameters have different possible applications such as controlled drug delivery[6], field emitters, efficient handling of biological cells[7] etc.

References:

1. D. K. Avasthi, *Nanotechnology*18(2007)125604.
2. Jai Prakash et al., *J. Phys. D: Applied Physics* 44 (2011) 125302.
3. S. K. Srivastava et. al., *Nanotechnology* 17 (2006) 2518.
4. Amit Kumar et al., *Jl. of Appl. Phys. D*, 40 (2007) 2083.
5. G.B.V.S. Lakshmi et al., *Science of Advanced Materials* 4 (2012) 1024-1030.
6. V. Rao, J.V. Amar et al., *Radiation Measurements* 36(2003)585.
7. Y.K. Vijay et al., *Jl. of Biomedical Nanotechnology* 2(2006)1.

■ ID-IT06

VEGF Cancer Biomarker Protein Detection in Real Human Serum Using Capacitive Label-free apta-immunosensorAnjum Qureshi^{1*}, Yasar Gurbuz², Javed H. Niazi^{1*}¹*Sabancı University Nanotechnology Research and Application Center, Orta Mahalle 34956, Tuzla, Istanbul, TURKEY*²*Faculty of Engineering and Natural Science, Sabancı University, Orhanli 34956, Tuzla, Istanbul, TURKEY*

*Email: javed@sabanciuniv.edu, anjum@sabanciuniv.edu

Vascular Endothelial Growth Factor (VEGF) is a signalling protein known as a serum biomarker for a number of diseases including cancer. Therefore, it is necessary to develop a label-free, rapid and sensitive method for detecting VEGF in its native forms in human serum. In this work, we have demonstrated the proof-of-concept of a sensitive label-free biosensor (apta-immunosensor) based on capacitance changes induced by capturing of VEGF in human serum using anti-VEGF aptamers functionalized on interdigitated (IDE) capacitor arrays (aptasensors). Primary complex of aptamer-VEGF formed on aptasensors was further sandwiched with VEGF antibody-coupled magnetic beads (MB-Abs) which mediated the formation

of an aptamer-VEGF-antibody-MB secondary complex that induced an enhanced capacitance response and validated the signal. Targeting of MB-Abs through VEGF-specific binding on aptasensor surfaces induced enhanced charge distribution and thus increased 3-folds sensitivity with a dynamic detection range from 5 pg mL⁻¹ to 1 ng mL⁻¹ of VEGF in human serum. This strategy provides a simple, reliable and effective biosensing of VEGF in human serum for early cancer diagnosis.

■ ID-IT07

Free Volume and Positron Annihilation in Membrane MaterialsK. Raetzke^{1*}, S. Harms¹, T. Koschine¹, F. Faupel¹, L. Ravelli², W. Egger², M. M. Khan³, T. Emmeler³, V. Filiz³, V. Abetz³¹*Materials Science, Technical Faculty, University of Kiel, Kiel, GERMANY*²*University of Armed Forces, Munich, GERMANY*³*Helmholtzzentrum Geesthacht, Geesthacht, GERMANY*

*Email: kr@tf.uni-kiel.de

Polymers are widely used nowadays, from simple plastic bags via insulating materials to high tech applications like adhesives or gas separation membranes. Important for properties like diffusion, viscosity, and permeability of membranes is the free volume, which is, to a first approach, the unoccupied space between the atoms. This free volume can be probed by positron annihilation lifetime spectroscopy, in particular, as a simple quantum mechanical model allows semi-quantitative calculation of average hole size from measured o-Ps lifetime.

In the present talk, selected applications of positron annihilation lifetime spectroscopy to various problems of polymeric membrane materials will be presented. We extended earlier measurements on bulk samples of [1] polymer of intrinsic microporosity (PIM-1) to thin films as these are relevant for real applications. However, they are more difficult for experiments, and, aging, i.e. the reduction of permeability and selectivity with storage or operation time has to be taken into account. We have measured the change in free volume during aging of thin films of a polymer of intrinsic microporosity (PIM-1) by depth resolved positron annihilation lifetime spectroscopy[2]. Aging is thickness and time dependent and the free volume diffuses through the film to the free surface. This can be described by a mathematical model. A recent investigation[3] shows that aging can be partially reduced by incorporating carbon nanotubes without reducing membrane performance.

On the other hand, the substrate might affect the free volume due to restrictions in alignment of polymer chains or interaction. First, we performed positron annihilation lifetime spectroscopy experiments at Teflon AF/silicon interfaces from the polymer side as function of the positron implantation energy. Thus, we determined the free volume hole size distribution in the interfacial region and investigated the width of the interphase[4]. While no interphase was detected in very short chained, solvent-free, thermally evaporated Teflon AF, an interphase of some tens of nm in extension was observed for

high molecular weight spin-coated Teflon AF films. To improve depth resolution, recently experiments on the same Teflon AF samples with a focussed beam through a hole in the substrate side were performed. These show even larger reduction in free volume at the interface.

References:

1. R. De Miranda, J. Kruse, K. Rtzke, F. Faupel, D. Fritsch, V. Abetz, P. M. Budd, J. D. Selbie, N. B. McKeown, B. S. Ghanem. *Phys. Stat. Sol. Rapid Res. Lett.*, 5 (2007) 190.
2. S. Harms, K. Rtzke, F. Faupel, N. Chaukura, P. M. Budd W. Egger, L. Ravelli. *The Journal of Adhesion* 88, (2012) 608-619.
3. T. Koschine, K. Rtzke, F. Faupel, M. M. Khan, T. Emmler, V. Filiz, V. Abetz, L. Ravelli, W. Egger. In preparation for *J Phys. Chem. Lett.*
4. S. Harms, K. Rtzke, V. Zaporojtchenko, F. Faupel W. Egger, L. Ravelli. *Polymer*, 52 (2011) 505.

■ ID-IT08

Cooperative Motion of Active Brownian Spheres in Three-dimensional Dense Suspensions

Roland G. Winkler

Theoretical Soft Matter and Biophysics, Institute for Advanced Simulation (IAS-2) Forschungszentrum, JlichD-52425 Jlich, GERMANY

*Email: r.winkler@fz-juelich.de

Assemblies of intrinsically active objects, sometimes called living fluids, represent an exceptional class of non-equilibrium systems. Examples range from the macroscopic scale of human crowds to the microscopic scale of cells and motile microorganisms such as bacteria. A generic phenomenon of dense living fluids is the emergence of self-organized large-scale dynamical patterns like vortices, swarms, networks, or self-sustained turbulence. This intriguing dynamical behavior is a consequence of the complex interplay of self-propulsion, internal or external noise, and many-body interactions.

In order to elucidate the emergent collective behavior of microswimmers without any alignment rule in three-dimensional space, we performed large-scale molecular dynamics simulations of self-propelled Brownian particles of spherical shape[1]. Our simulations reveal a phase separation into a dilute and a dense phase, above a certain density and strength of self-propulsion. The packing fraction of the dense phase approaches random close packing at high activity, yet the system remains fluid. Although no alignment mechanism exists in this model, we find long-lived cooperative motion of particles in the dense regime. This behavior is probably due to an interface-induced sorting process. Spatial displacement correlation functions are nearly scale free for systems with densities close to or above the glass transition density of passive systems.

References:

1. A. Wysocki, R. G. Winkler, G. Gompper, *EPL* 104, 48004 (2014).

■ ID-IT09

Multi-scale Simulation of Structure and Dynamics of Polymer-Nanotube Composites

Sudip Roy*, Souvik Chakraborty

Physical Chemistry Division National Chemical Division Dr. Homi Bhabha Road, Pune 411008, INDIA

*Email: s.roy@ncl.res.in

Particle based multiscale simulations are performed on pure monomer, trimer[1] and polymer of polycarbonate (PC) and their mixtures with different molecular weight percentages of embedded single walled carbon nanotubes (CNT) at different temperatures. We have performed detailed analysis on structural and dynamical properties of the composite system including local structuring of PC around CNT, diffusion of CNT in the polymer matrix. Both structural and dynamical properties indicate the weak interaction between the nanotubes and PC matrix molecules. There are high tendency of nanotubes to form bundles which is observed during simulations. The bundle formation free energies are calculated from the potential of mean force calculations. The mechanism and energetics of bundle formation is explored from the atomistic scale simulations. The formation of the CNT bundle is a favorable process in the oligomeric PC matrix. Percolation pathway formation by CNT in the polymeric matrix at larger time and length scales has been explored in details from mesoscale[2] dissipative particle dynamics simulations. From mesoscale simulations we have calculated the CNT bundle size distribution, shape and their diffusion in the matrix. As an extension of above work we have studied di-block polymers doped with nanorods of different flexibility. I am going to discuss in details the competition between phase separation of blocks of polymer and formation of bundle of nanorods and its shape and dynamics.

References:

1. S. Chakraborty and S. Roy, *J. Phys. Chem. B*, 2012, 116 (10), 30833091.
2. S. Chakraborty, C. K. Choudhury and S. Roy, *Macromolecules*, 2013, dx.doi.org/10.1021/ma302425s.

■ ID-IT10

Building with Colloids: Directing the Self-Assembly of Hybrid (Bio)Nanoparticles

Alexander Boker*, Patrick van Rijn, Stephanie Hiltl, Patrick Wunnemann, Marco Schurings

Leibniz-Institut für Interaktive Materialien, Lehrstuhl für Makromolekulare Materialien und Oberflächen, RWTH Aachen University, GERMANY

*Email: boker@dwi.rwth-aachen.de

This presentation deals with the use of different interfaces guiding the self-assembly of various soft colloidal particles[1]. First, we describe classical oil/water emulsion systems, the so-called Pickering emulsions. Here, the controlled assembly of protein-polymer conjugate nanoparticles (Ferritin-PNIPAAm) followed by crosslinking the polymer matrix leads to permeable, yet highly flexible and stable membranes and capsules[2,3]. The particles exhibit an unusually high interfacial activity and

can even self-assemble to form hierarchical networks composed of capsules in fibres[4,5]. Moreover, we demonstrate that nanostructured substrates produced from wrinkling instabilities with wavelengths on the order of only a few hundred nanometers, effectively guide the self-assembly of various well-defined organic nanoparticles (e.g. proteins or microgels)[6, 7]. This process allows the creation of anisotropic large scale particle arrays and supramolecular constructs like composite particulate nanoscale fibres.

References:

1. P. van Rijn, M. Tutus, C. Kathrein, L. Zhu, M. Wessling, U. Schwaneberg, A. Boker Chem. Soc. Rev., 2013, 42, 6578.
2. N.C. Mougín, P. van Rijn, H. Park, A.H.E. Müller, A. Boker, Adv. Funct. Mater. 2011, 21, 2470.
3. P. van Rijn, N.C. Mougín, D. Franke, H. Park, A. Boker, Chem. Commun., 2011, 47, 8376.
4. P. van Rijn, N.C. Mougín, A. Boker, Polymer, 2012, 53, 6045.
5. P. van Rijn, H. Park, K. Özlem Nazli, N.C. Mougín, A. Boker, Langmuir, 2013, 29, 276.
6. A. Horn, S. Hiltl, A. Fery, A. Boker, Small 2010, 6, 2122.
7. S. Hiltl, M.-P. Schriings, A. Balaceanu, V. Mayorga, C. Liedel, A. Pich, A. Boker, Soft Matter, 2011, 7, 8231.

■ ID-IT11

Maintaining the Shape: How do Biological Membranes do it ?

P. B. Sunil Kumar

Department of Physics, Indian Institute of Technology Madras, Chennai 600036, INDIA

*Email: sunil@physics.iitm.ac.in

The organelles of a biological cell have membranes with highly curved edges and tubes, as seen in the endoplasmic reticulum, the golgi and the inner membrane of mitochondria. It has been shown that macromolecules, which constitute and decorate the membrane surface and the transport in and out of these membranes strongly influence the morphology of membranes. While the molecular players involved, and their influence on the local structural details of these membranes, are quite well studied, the factors leading to the large scale morphological properties of these intracellular compartments are still unknown.

We investigate, through Dynamical Triangulation Monte Carlo simulations, the role that the active processes of membrane fission-fusion and protein induced anisotropic elasticity play in determining the morphology and composition segregation in closed membranes. We show that the state shapes obtained as a result of such processes, bear a striking resemblance to the ramified morphologies of organelles in-vivo.

■ ID-IT12

Flame Transport Synthesized ZnO Nano- and Microstructures for Multifunctional Applications: From Advance Linker Elements to 3D Hybrid Flexible Networks

Yogendra K. Mishra*, Soren Kaps, Jorit Grottrup, Tim Reimer, Arnim Schuchardt, Ingo Paulowicz, Xin Jin, Dawit Gedamu, Oleg Lupan, Rainer Adelung

Functional Nanomaterials, Institute for Materials Science, University of Kiel, Kaiser Str. 2, D-24143, Kiel, GERMANY

*Email: ykmnsc@gmail.com

fabrication of metal oxide nano- and microstructures and their large interconnected networks[1]. As an example, the family of ZnO nano- and microstructures grown by FTS approach and corresponding applications will be demonstrated and discussed. The tetrapod shaped structures synthesized by FTS approach exhibit interesting applications in different directions[2,3]. In a single step growth process, tetrapods, hexagonal needles from ZnO were integrated in the chip and into the Si trenches which have demonstrated interesting UV photodetection and photocatalysis applications respectively[4,5]. The potential of ZnO tetrapods against blocking the viral entry into the cells will be discussed[6,7]. Porous three-dimensional (3D) interconnected networks are going to be important materials in future and possibility of fabricating 3D hybrid networks from several metal oxide nano- and microstructures by FTS approach will be presented.

References:

1. Particle & Particle Systems Characterization 30, 2013, 775-783.
2. Advanced Materials 24, 2012, 5676-5680.
3. Advanced Materials 25, 2013, 1342-1347.
4. Advanced Materials 26, 2014, 1541-1550.
5. ACS Applied Materials & Interfaces 6, 2014, 78067815.
6. Antiviral Research 92, 2011, 305-312.
7. Antiviral Research 96, 2012, 363-375.

■ ID-IT13

Collective Response and Emergent Structures in Active Suspensions

Ignacio Pagonabarraga

University of Barcelona, SPAIN

*Email: ipagonabarraga@ub.edu

Active systems generate motion due to energy consumption, usually associated to their internal metabolism or to appropriate, localized, interfacial chemical reactivity. As a result, these systems are intrinsically out of equilibrium and their collective properties result as a balance between their direct interactions and the indirect coupling to the medium in which they displace. Therefore, a dynamical approach is required to analyze their evolution and quantify their self-assembly and ability to generate intermediate and large scale stable structures. In this presentation I will discuss the relevant physical mechanisms underlying the specific properties of the collective behaviour of model active suspensions. By focusing on simplified models, it is then possible to identify the relevant parameters which control such behaviour. Understanding the mechanical principles which determine the emergence of cooperatively will help to clarify the role of physical coupling in active materials and understand how to combine them with biochemical interactions to control their properties and behaviour. Since these systems are out of equilibrium, their mechanical balance is very sensitive to external disturbances. Therefore, once the basic principles which control the intrinsic activity of these systems has been clarified, it is interesting to analyze how do they react to externally applied fields or to geometric confinement.

■ ID-IT15

Liquid Crystals for Driving, Steering and Reporting in Actuated or Active Soft Matter Systems

Francesc Sagues^{1,3*}, Sergi Hernandez¹, Pau Guillamat¹, J. Ignes-Mullol^{1,3}, Pietro Tierno^{2,3}

¹*Department of Physical Chemistry, University of Barcelona, Barcelona 08028, Catalonia, SPAIN*

²*Department of Structure and Constituents of Matter, University of Barcelona, Barcelona 08028, Catalonia, SPAIN*

³*Institut of Nanoscience and Nanotechnology, IN²UB, University of Barcelona, Barcelona 08028, Catalonia, SPAIN*

*Email:

Liquid crystals (LCs), as pure component systems, are largely recognized for their potential in basic Physics science as well as for their technological applications. More recently new possibilities have been unveiled when such anisotropic liquids constitute a distinct phase of more complex soft matter systems. In the first part of the presentation, we will refer to dispersions of colloids, both in the form of aqueous droplets and solid particles, suspended in nematic liquid crystals. Emphasis will be devoted to analyse striking examples of phoresis which is driven non-linearly by alternating electric currents[1,2]. A further development will be presented to prove the steering capability of actuated LCs to dynamically assemble large clusters of aggregated inclusions by employing the principle of photoelastic modulation from conveniently functionalized boundary conditions[3]. In the second part, a complementary use of nematic LCs as reporters of static motifs or dynamical flows in soft matter composite systems will be explored. Static patterns of functionalized surfaces will be demonstrated to be nicely imprinted in thin films of a nematic material[4]. The possibilities that simple nematics offer to track flow distributions of ATP-active gels prepared from tubulin/kinesin components will be finally discussed[5].

References:

1. Particle & Particle Systems Characterization 30, 2013, 775-783.
2. O. D. Lavrentovich, I. Lazo, O. P. Pishnyak. Nonlinear electrophoresis of dielectric and metal spheres in a nematic liquid crystal. Nature 2010, 467:947.
3. S. Hernandez-Navarro, P. Tierno, J. Ignes-Mullol, F. Sagues. Of micro-droplets in anisotropic liquids: transport, assembling and reaction. Soft Matter 2013, 9:7999.
4. S. Hernandez-Navarro, P. Tierno, J. A. Farrera, J. Ignes-Mullol, F. Sagues. Reconfigurable swarms of nematic colloids commanded by photoactivated surface patterns. Angewandte Chemie (in press). DOI: 10.1002/anie.201406136 and 10.1002/ange.201406136.
5. N. Petit-Garrido, R. P. Trivedi, J. Ignes-Mullol, J. Claret, C. Lapointe, F. Sagues, I. I. Smalyukh. Healing of defects at the interface of nematic liquid crystals and structured Langmuir-Blodgett monolayers. Physical Review Letters 2011, 107:177801.
6. P. Guillamat, J. Ignes-Mullol, F. Sagues, in preparation.

■ ID-IT16

Many-body Microhydrodynamics of Active Colloidal Particles

Ronojoy Adhikari

Bio Soft Jülich, GERMANY

*Email: ronojoy.adhikari@gmail.com

Bodies that translate and rotate in viscous fluids in the absence of externally applied forces and torques appear in many chemical, biological and technological contexts. In every case, the body is endowed with a mechanism by which it can transmit stresses across its boundary to the surrounding fluid. Such active stresses generate fluid flow and induce motion in other bodies suspended in the fluid. This flow-mediated interaction between active bodies is both long-ranged and instantaneous at micron scales. Here we develop a method to study the many-body microhydrodynamic interaction of active bodies, abstracted as finite-sized, spherical, active colloidal particles, using an integral formulation of Stokes equation. The bulk fluid flow is obtained as integrals of the active boundary condition over the surfaces of the colloidal spheres. The integral equation that relates the active surface velocities to the active surface stresses is solved in an infinite-dimensional basis of irreducible Cartesian tensors. A finite-dimensional truncation, suitable for numerical computation, is then developed by retaining terms necessary and sufficient to generate active translations and rotations. The truncated theory is used to parametrize the oscillatory flow around swimming microorganisms, to obtain the motion of a pair of active colloidal spheres, and to derive dynamical equations for active colloids that are hierarchically assembled into filaments, sheets or crystals. Our method provides a description of microhydrodynamic phenomena in active colloidal matter that is resolved at the scale of the particle and can thus be used to delineate the limits of kinetic and hydrodynamic approximations in continuum theories of active matter and to study phenomena inaccessible within such approximations.

■ ID-IT17

Synthesis of Tunable Nanomaterials and Core-shell Multifunctional Nanomaterials through Simple Chemistry

S.R. Vadera

Defence Laboratory, Jodhpur-342011, INDIA

*Email: svadera59@gmail.com

Nanomaterials and Nanotechnology are today the most studied multidisciplinary area of research with a potential for their number of applications in practically all walks of life. Because of their very small size, approaching almost to molecular level, they have fascinated both the scientists who pursue basic research to explain their new and unique physical and chemical properties and the technologists to exploit these interesting properties for various applications. The research in the field of nanomaterials has made great impact in medical science also both for diagnostic and therapeutic applications.

While nanomaterials and nanotechnology present great potential for applications, there are certain challenges related to synthesis and characterization of nanomaterials. One of the biggest challenges is to synthesize nanomaterials in bulk with reproducible properties. Both physical and chemical methods have been reported in the literature for the synthesis of nanomaterials. The physical methods normally require costly process equipments and can generate small quantities of nanomaterials which may limit their applications in certain specific areas. However, for most of the applications there is a requirement of bulk synthesis of nanomaterials. The chemical methods not only can generate nanomaterials in bulk but can be utilized to synthesize a variety of nanomaterials with tunable properties. The present paper gives a brief account of R & D work carried out in authors laboratory in developing simple routes for the synthesis of tunable and core-shell nanomaterials.

■ ID-IT18

Irreversible and Reversible Deformations of Cellular Surfaces

Pierre Sens

ESPCI FRANCE

*Email: pierre.sens@espci.fr

The mechanical and dynamical behaviour of cellular interfaces is controlled by the physical properties of the plasma membrane, which acts as a semi-permeable barrier allowing a selective control of inward and outward fluxes, and the physical properties of the cytoskeleton, responsible for the mechanical integrity of the cell and allowing shape changes through energy-consuming processes. In this talk, I will discuss two examples of cellular response to external perturbations that illustrate the interplay between these two components. I will discuss the response of Red Blood Cells to cycles of polymerisation and depolymerisation of hemoglobin fibers. In this case, the relatively static nature of the cytoskeleton may lead to irreversible deformation and the permanent loss of membrane area, a phenomenon of direct relevance to a pathology called sickle cell anaemia. I will then discuss the response of an amoeba to micropipette suction. In this case, the permanent turnover of the cytoskeleton allows the cell to adapt to the perturbation, but leads to interesting dynamical features, including permanent cellular oscillations under constant suction pressure.

■ ID-IT19

Active Computational Fluids

Madan Rao

TIFR Mumbai, INDIA

*Email: rao.madan@gmail.com

The surface of living cells is a composite of an active fluid juxtaposed with the cell membrane. The active fluid comprises dynamic actomyosin which interacts with components of the cell membrane. We classify cell membrane molecules as inert, passive and active, depending on the

nature of their interaction with the active fluid. We show that this active composite provides a natural medium for signal optimization and high fidelity computation. Our work also suggests possible strategies to chemically engineer active chemotactic gels which are infused with computational abilities.

■ ID-IT20

Recent Advances in Nanoparticle Synthesis and Electron Microscopy

Cathal Cassidy

OIST, JAPAN

*Email: c.cassidy@oist.jp

Nanoparticles are interesting structures for scientific study and industrial applications, given their enhanced surface/volume ratio, size-dependent properties, and suitability for functionalization with, or embedding in, soft organic materials. While nanoparticles may be synthesized via a number of methods, physical vapor deposition offers excellent control and versatility in nanoparticle structure and composition. In order to understand growth mechanisms and behavior in these synthesized hybrid nanostructures, Transmission Electron Microscopy is an invaluable technique to obtain structure and compositional information with atomic resolution. In this talk, I will discuss our advanced nanoparticle synthesis technology, giving examples of the structure and growth mechanisms of various hybrid nanoparticle systems. Furthermore, I will introduce recent results and new possibilities for situ electron microscopy, involving in situ heating, electrical bias and exposure to gas atmospheres, allowing fundamental physical and chemical processes to be explored, live and in real time, at the nanoscale.

References:

1. Inoculation of silicon nanoparticles with silver atoms C. Cassidy, V. Singh, P. Grammatikopoulos, F. Djurabekova, K. Nordlund, and M. Sowwan *Scientific Reports* 3 (2013)
2. Endotaxially stabilized B2-FeSi nanodots in Si(100) via ion beam co-sputtering C. Cassidy, J. Kioseoglou, V. Singh, C. Lal, P. Grammatikopoulos, M. Sowwan *Applied Physics Letters* 104 (2014)
3. Assembly of tantalum porous films with graded-oxidation profile with size-selected nanoparticles V. Singh, P. Grammatikopoulos, C. Cassidy, M. Benelmekki, M. Bohra, Z. Hawash, K. Baughman, M. Sowwan *Journal of Nanoparticle Research* 16 (2014)
4. Heterogeneous Gas-phase Synthesis and Molecular Dynamics Modeling of Janus and Core-satellite Si-Ag Nanoparticles V. Singh, C. Cassidy, P. Grammatikopoulos, F. Djurabekova, K. Nordlund, M. Sowwan *J Phys Chem C* 118 (2014) 13869-13875.
5. Coalescence-induced crystallisation wave in Pd nanoparticles P. Grammatikopoulos, C. Cassidy, V. Singh, M. Sowwan *Scientific Reports* 4 (2014) 5779.
6. Coalescence behaviour of amorphous and crystalline tantalum nanoparticles: a molecular dynamics study P. Grammatikopoulos, C. Cassidy, V. Singh, M. Benelmekki, and M. Sowwan *Journal of Materials Science* 1-8 (2013)
7. Surface morphology of films grown by size-selected Ta nanoparticles V. Singh, C. Cassidy, M. Bohra, A. Galea, Z. Hawash, and M. Sowwan *Advanced Materials Research* 647, 732-737 (2013)
8. Size-controlled deposition of Ag and Si nanoparticle structures with gas-aggregated sputtering C. Cassidy, V. Singh, Z. Hawash, M. Bohra, J. Kim, M. Sowwan *MRS Proceedings*

1546 106 (2013).

■ ID-IT21

Correlation of Plasma Process Parameters to Tailor Surface Chemistry of Polymeric Materials for Application in Life Science

Marshal Dhayal

Clinical Research Facility, CSIR- Centre for Cellular and Molecular Biology, Uppal Road, Hyderabad, INDIA

*Email: dhayalmarshal@yahoo.com

Identifying the role of ions and their flux variations in plasma discharges for modification of polymeric materials is a very complex phenomenon. Hence, to have better undersigning about the role of plasma ion, plasma radiation and radicals, to tailor surface chemistry of polymeric material, a correlation of plasma process parameters in a two-chamber discharge was investigated and compared with standard plasma reactors. The surface chemistry of low-pressure argon plasma treated polymeric materials has been studied by X-ray photo-electron spectroscopy and atomic force microscopy. The relative oxygen to carbon ratio at surface of polymeric materials, before and after plasma modification, was measured. A very significant enhancement in oxygen incorporation in the form of acid anhydride functionalities was observed and the level of surface modification depends on relative flux of plasma ions in the plasma discharge. These plasma modified polymeric surfaces were used to grow different types of cells and cell viability, adhesion and proliferation were measured. The findings indicate a very good correlation between surface functionalities generated by plasma modification and their corresponding biological responses.

■ ID-IT22

Lipid Nanocapsules: A New Platform of Drug Delivery System

Emilie Roger

University of Angers, Inserm Mint 1066, FRANCE

*Email: Roger@univ-angers.fr

Nanomedicine, nanotechnology applied to medicine, is one of the most promising pathways for the development of new targeted therapies. Indeed, new drug are now required not only to demonstrate a medical benefit but also to enhance targeted mechanism of action with better personalized of the treatments. Thus, nanocarriers can be used to achieve these requirements. Our laboratory is specialized in the design and characterization of new nanocarriers such as lipid nanocapsules (LNCs), which are demonstrated interesting properties to improve the selectivity of administered drug[1]. The lipid nanocapsules (LNCs) have been prepared according to an original method based on a phase-inversion temperature process recently developed and patented[2]. Their structure is a hybrid between polymeric nanocapsules and liposomes because of their oily core which is surrounded by a tensioactive rigid membrane. Their size can be adjusted below 100nm with a narrow distribution and they are stable for at least one

year in suspension. LNCs provide an opportunity to encapsulate various kinds of molecules (paclitaxel, ibuprofen, etoposide, doxorubicin, etc.) with an efficient drug loading. Because of the presence of PEG (polyethyleneglycol) at the surface, after systemic administration, LNCs are potential carriers for drug delivery to the sites of action due to their long vascular residence time. Moreover, immuno-LNCs could be design for the active targeting of drug delivery to tumor cells by grafting antibodies at their surfaces. Preclinical studies on cell cultures and animal models have been performed, showing promising results.

This lecture will show how this breakthrough approach allows to design efficient and no toxic nanomedicines. Special attention is given to the ability of those lipid nanocapsules to encapsulate efficiently lipophilic drugs and their applications.

References:

1. Huynh NT, Passirani C, Saulnier P, Benoit JP. Lipid nanocapsules: A new platform for nanomedicine. *Int. J. Pharma.* 2009;379(2):2019.
2. Heurtault B, Saulnier P, Pech B, Proust J-E, Benoit J-P. A novel phase inversion-based process for the preparation of lipid nanocarriers. *Pharma. Res.* 2002;19(6):87580.

■ ID-IT24

EUV- Resists Changing the Integrated Circuits Fab. Landscape for Next Generation Technology Node

Satinder K. Sharma

School of Computing and Electrical Engineering, Indian Institute of Technology (I.I.T.)-Mandi, Mandi-175001 HP, INDIA

*Email: satinder@iitmandi.ac.in

The trend of Moores law has been maintained using the current semiconductor technology of the ultra large scale integration, as well as economic success which produces integrated circuits (ICs) for next generation technology node. This has been made possible by the ability of sub nano meter lithography, by the design of next generation resists operating at extreme ultra violet wavelengths (13.5 nm). The major issues for the sub 22-nm half-pitch node remain simultaneously meeting resolution, line-edge roughness (LER), and sensitivity requirements which is known as RLS or the triangle of death of this technology. It is expected that EUV resists must simultaneously pattern 20-nm half-pitch and below, with an lower LWR and a high sensitivity. Therefore, to make a resist perform optimally, new resist chemistry is required. One such approach being investigated for the development of polymeric non-CAR negative photo resists for sub 16 nm technology which is directly sensitive to radiation without utilizing the concept of chemical amplification (CARs). The resist microstructures are accomplished by homopolymers and copolymers that are prepared from monomers containing sulfonium groups which are directly highly sensitive to radiation. These recently reported non-chemically amplified resist materials for EUVL, demonstrated the potential in patterning down to 16 nm and below and having low LER. The n-CAR, MAPDST-MMA copolymer, can image down to 20 nm and below and it was observed that its sensitivity is

molecular weight dependant (For MW-17,000 sensitivity is approx. 10 mJ/cm^2 and for MW 30,000 around 5 mJ/cm^2). Here we will discuss in detail process parameters such as: spinning conditions for film thicknesses $< 50 \text{ nm}$ and resulting surface topographies, baking regimes, exposure conditions and protocols on sensitivity, contrast, resolution and LER/LWR. These new negative tone resist provide a viable path forward for designing non-chemically amplified resists that can obtain higher resolutions than current chemically amplified resists at competitive sensitivities.

References:

1. Vikram Singh, V. S. V. Satyanarayana, Satinder K. Sharma, Subrata Ghosh, Kenneth E. Gonsalves, Towards Novel non-Chemically Amplified (n-CARS) Negative Resists for Electron Beam Lithography Applications. *J. Mater. Chem. C*, 2014, 2, 2118-2122.
2. V. S. V. Satyanarayana, Felipe Kessler, Vikram Singh, Francine R Scheffer, Daniel E Weibel, Subrata Ghosh, Kenneth E Gonsalves, Radiation Sensitive Novel Polymeric Resist Materials: Iterative Synthesis and Their EUV Fragmentation Studies. *ACS Appl. Mater. Interfaces*, 27, 2014.

Abstracts

■ ID-101

Amino acid regulated green synthesis and bioactivity of polymer stabilized silver nanoparticles

Bishnupada Roy^{1,2*}, Suprabhat Mukherjee³, Pranesh Chowdhury², Santi P. Sinha Babu³

¹Bankura Unnayani institute of Engineering, Pohabagan, Bankura, WB., INDIA

²Synthetic Polymer Laboratory, Department of Chemistry, Visva-Bharati University, INDIA

³Parasitology Laboratory, Department of Zoology, Visva-Bharati University, INDIA

*Email: roy.chem85@gmail.com

Through a complete green process, polymer stabilized silver nano particles (AgNPs) were synthesized. Formation of AgNP (transparent pale yellow to brown yellow) was observed spectroscopically (UV-Vis) both in presence and absence of biocompatible polymers. The yield and stability of AgNPs was regulated by concentration level of amino acid tyrosine.

Biochemical effects of the polymer stabilized metal nano particles were studied in terms of antiparasitic (antifilarial), antibacterial and antifungal activities. The particles were found to be strongly interactive with the principle cellular bio-molecule (viz. DNA) and protein, which might be the reason of their bioactivity. Particularly against parasites, the synthesized AgNPs were able to induce apoptosis through increasing the level of key regulator of cell death and fragmentation of genomic DNA.

Molecular level studies, which were carried out by Circular Dichorism (CD) spectroscopic analysis, showed the interaction of AgNPs with principal biomolecules (DNA & Protein). That interaction changes the structure of DNA and protein which might be the reason behind their biochemical activity.

References:

1. B.Baruah, G.B. Gabriel, M.J. Akbashev, M.E. Booher, Langmuir,
2. R.A. Cross, B. Kalra, Science 297(2002)803.
3. P. Raveendran, J. Fu, S.L. Wallen, J. Am. Chem. Soc., 125(2003)13940.

■ ID-103

Structural, optical, electrical and magnetic properties of PVA: Gd³⁺ and PVA: Ho³⁺ polymer films

M. Obula Reddy^{1*}, L. Raja Mohan Reddy¹, P.Bayapu Reddy² and K.V.Ramana Reddy³

¹Department of Physics, Loyola Degree College (YSRR), Pulivendla-516390, A.P., INDIA.

²Department of Physics, SCNR Degree College, Proddatur-516502, INDIA.

³Department of Chemistry, Loyola Degree College (YSRR), Pulivendla-516390, A.P., INDIA.

The present paper brings out the results concerning the preparation and optical, electrical and magnetic properties of Gd³⁺ and Ho³⁺ each ion separately doped (1 mol%

Dy³⁺+x mol% Sm³⁺): PVA Polymer films by a solution casting method. The semi-crystalline nature of the polymer films has been confirmed from XRD analysis[1]. The FTIR analysis confirms the complex formation of the polymer with the metal ions. Temperature dependent-impedance spectroscopy analysis in the frequency range 100 Hz to 1MHz reveals a single conduction mechanism for these films[2]. The dc electrical conductivity increases with an increase in the temperature and it could be due to high mobility of free charges (polarons and free-ions) at higher temperatures. The conductivity trend follows the Arrhenius equation for PVA: Gd³⁺ and for PVA: Ho³⁺ polymer films. PVA: Gd³⁺ polymer films shows ferromagnetic nature, while PVA: Ho³⁺ polymer films have revealed paramagnetic nature based on the trends noticed in the magnetic characteristic profiles.

References:

1. Ding, B., E. Kimura, T. Sato, S. Fujita & S. Shiratori. 2004 Fabrication of blend biodegradable nanofibers non-woven mats via multi-jet electrospinning. *Polymer* 45(6):1895-1902.
2. Hema, M., S. Selvasekarapandian, G. Hirankumar. 2007 Vibrational and impedance Spectroscopic analysis of Poly(vinyl alcohol)-based solid polymer electrolytes. *Ionics*, 13:483-487.

■ ID-104

Development of Novel Biological Soft Tissue Materials for Regenerative Medicine

Naveen Kumar

Division of Surgery, Indian Veterinary Research Institute, Izatnagar-243122, Uttar Pradesh, India.

*Email: naveen.ivri1961@gmail.com

The clinical need for strong, biocompatible materials that encourage integration while minimizing adverse reaction, such as tissue reaction and adhesion formation in regenerative medicine, is apparent. Yet, the design and development of optimal biological soft materials for surgical repair to reinforce or replace soft tissue remains problematic. A variety of scaffold materials are available, each with different physical properties and each associated with a specific and unique host response. Scaffold materials can be either synthetic or naturally occurring. The most commonly used naturally occurring scaffold material has been the structural protein collagen. Collagen is a naturally occurring, highly conserved protein that is ubiquitous among mammalian species and accounts for approximately 30% of all body proteins. Natural collagenous materials are being investigated in regenerative medicine because of inherent low antigenicity and their ability to integrate with surrounding tissue.

The biological soft tissue materials have been developed using abattoir waste materials, from tissues which are rich in collagen. The materials used include diaphragm, pericardium, blood vessels, skin, intestines and gall bladder. The techniques were developed for making acellular matrix from the skin collected from different species of animals (rabbit, rat, goat and pig). Hypertonic (50mM Tris Hcl, 1M NaCl, 10mM EDTA) and hypotonic

(10mM tris Hcl, 0.5M NaCl, 5mM EDTA) solutions were used for optimizing procedure. Skin pieces of 2 x 2 cm^2 size were continuously agitated in these solutions on orbital shaker. It was observed that continuous agitation of these tissue samples for 6 to 8h resulted in complete de-epithelialization. De-epithelialized samples were subjected to 1% ionic and non-ionic biological detergents along with 0.1% sodium azide for the preparation of acellular dermal matrices. Complete decellularization was observed between 24 to 48h of treatment depending upon the thickness of skin tissue samples. These developed acellular matrices were used as scaffolds to attain 3-D growth of primary fibroblasts cells. Morphological assessment, cell proliferation and viability were done for their in-vitro biocompatibility evaluation. The result shows that treatment with hypertonic solution results in earlier de-epithelialization as compared to hypotonic solution. Ionic detergent were found better than non-ionic biological detergents in preparing acellular matrices and have better 3-D growth in these matrices.

■ ID-105

Interaction of an antimicrobial peptide, NK-2 on phospholipid membranes

Sanat Karmakar^{1*}, Rumiana Dimova²

¹Department of Physics, Jadavpur University, Kolkata 700 032, INDIA.

²Theory of Biosystems, Max Planck Institute of Colloids and Interfaces, Potsdam, GERMANY.

*Email: sanat@phys.jdvu.ac.in

NK-2, an antimicrobial peptide, derived from cationic core region of NK-lysin, displays antimicrobial activity towards negatively charged membranes. We have studied the interaction of NK-2 with various phospholipid membranes using a variety of experimental techniques to obtain insight into the kinetics and mechanism of pore formation induced by NK-2. As model membranes, we have chosen large unilamellar vesicles (LUV) and giant unilamellar vesicles (GUV) composed of lipid mixtures which mimic the bacterial membrane.

The binding affinity of NK-2 to negatively charged lipids was determined from isothermal titration calorimetry (ITC) and zeta potential measurements. Our results of ITC suggests that NK-2 strongly interacts with negatively charged membranes, whereas, interaction is weak in the case of neutral membranes. This result is consistent with those obtained from zeta potential. Presence of large aggregates, as found from dynamic light scattering of LUV dispersions, suggests the membrane-membrane interaction mediated by NK-2 bridges. Finally, the evidence of trans-membrane pores has been revealed using optical microscopy on GUVs exposed to NK-2 solution. The present study suggests that NK-2 is a pore-forming peptide and does not cause detergent-like membrane destabilization as known for other AMP[2].

References:

1. T. Jacobs, H. Bruhn, I. Gaworski and B. Fleischer, M. Leippe, *Antimicrob. Agents Chemother.*, 2003, 47:607.
2. E. E. Ambroggio, F. Separovic, J. H. Bowie, G. D. Fidelio, L. A. Bagatolli, *Biophys. J.* 2005, 89:1874.

■ ID-108

Polymer Electrolyte Membrane: Regulates Reaction Environment for CO₂ electroreduction to Fuel

L. M. Aeshala, A. Verma*

Department of Chemical Engineering, Indian Institute of Technology Guwahati, Guwahati 39, INDIA

*Email: anil.verma@iitg.ernet.in

Carbon dioxide is one of the main contributors to the global warming[1]. The efforts to minimize generation and sequestration of CO₂ are of great importance. It has been found that the electrochemical reduction technique may not only convert CO₂ from the environment but the products of electrochemically reduced CO₂ can be used as fuel. Some of the main reaction products of electrochemical reduction of CO₂ (ERC) are formic acid, methanol, hydrocarbons, and oxalic acid. Moreover, the synthesis of fuels (value added products) by the conversion of CO₂ is of special interest for the storage of renewable energy like solar energy, which may be supplied for the conversion of CO₂. In this research work, electrochemical reduction of carbon dioxide in the gaseous phase is investigated using cationic and anionic solid polymer electrolytes. Influence of solid polymer electrolyte medium on electrochemical reduction of gaseous CO₂ into fuel is studied, in view of the surplus thermodynamic energy of the generated fuel. The electrodeposited Cu₂O on porous carbon paper is used as cathode whereas Pt/C on the carbon paper is used as anode. The products formed after the electrochemical reduction of carbon dioxide are analyzed by gas chromatography and high performance liquid chromatography[2]. ERC experiments are carried out at room temperature and atmospheric pressure. Mainly methane, ethylene and methanol are formed as products apart from the undesired hydrogen gas as a by-product. It has been found that anionic solid electrolyte is more favorable than cationic solid electrolyte. Faradaic efficiency for the conversion of CO₂ into products is more than 45% using anionic solid polymer electrolyte at 2.5V and 5.4 mA.cm⁻².

References:

1. M. I. Hoffert, K. Caldeira, A. K. Jain, E. F. Haites, L. D. D. Harvey, S. D. Potter, M. E. Schlesinger, S. H. Schneider, R. G. Watts, T. M. L. Wigley and D. J. Wuebbles. Energy implications of future stabilization of atmospheric CO₂ content. *Nature*, 1998, 395:881.
2. L. M. Aeshala, S. U. Rahman and A. Verma. Effect of Solid Polymer Electrolyte on Electrochemical Reduction of CO₂. *Separation and Purification Technology*, 2012, 94: 131.

■ ID-113

Nanoscale Effects on four Channel Drop Filter based on 2-D Dual Photonic Crystal Ring Resonator Heterostructure

Mayur Kumar Chhipa^{1*}, Ekta Rewar²

¹Department of Electronics and Communication, Government Engineering College, Ajmer, Rajasthan 305002, INDIA

²Department of Electronics and Communication, Malaviya National Institute of Technology, Jaipur 302017, INDIA

*Email: mayurchhipa1@gmail.com

■ ID-117

In this paper, we propose a heterostructure four channel drop filter based on 2-D dual photonic crystal ring resonator in which, wavelength drop operations are accomplished by coupling between two waveguides.

The structure is devised in 2-D square lattice which contains circular material rods in air host. Furthermore, nanoscale effects on the filters performance including wavelength spacing and dynamic response are considered.

The designed filter comprises of three dual ring resonators with four different values of refractive index that can be used to drop four channels centred at 1558nm, 1568nm, 1578nm and 1588nm. The designed filter gives 98% dropping efficiency for first channel, 82% for second channel, 74% for third channel and 70% for fourth channel whose corresponding refractive indices are 3.49, 3.59, 3.69 and 3.79, respectively. Simulations are performed using 2-D finite-difference time-domain calculations.

The suggested heterostructure based channel drop filter is compact and the overall size of the chip is in μm . So, such kind of devices would be more useful for the realization of integrated optic circuits for CWDM systems and, future access and metro networking applications.

References:

1. S. Robinson, R. Nakkeeran. Add drop filter for ITU-T G.694.2 CWDM systems. ICECT2011, pp. 1-4, 2011.
2. M. Djavid, A. Ghaffari, F. Monifi, M. S. Abrishamian. A new broadband photonic crystal add drop filter. Journal of Applied Sciences. Vol. 8, no.11, pp. 2178-2182, 2008.

■ ID-115

Thermal Stability and Electrical Properties of Polyaniline Synthesized by Oxidative Polymerization Method

Anil Kumar^{1,2}, Amit Kumar¹, Ornav Maulik¹
Kamlendra Awasthi², Vinod Kumar^{1*}

¹Department of Metallurgical and Materials Engineering, Malaviya National Institute of Technology, Jaipur 302017, INDIA

²Department of Physics, Malaviya National Institute of Technology, Jaipur 302017, INDIA

*Email: vkt.mnit@gmail.com

Conducting Polyaniline (PANI) was prepared using oxidative polymerization method by using surfactant SDS, DBSA with dopant HCl. Samples were characterized by XRD, Raman Spectroscopy, TGA and Electrical conductivity. XRD shows the crystalline nature of PANI as well as conformation of its formation. Raman spectroscopy results conforms emeraldine oxidation state. Thermal degradation of synthesized materials starts after 100°C. Electrical measurements indicate conducting nature of PANI.

Electrostatic interaction between colloids trapped at an electrolyte interface

Arghya Majee^{1,2*}, Markus Biero^{1,2}, S. Dietrich^{1,2}

¹Max-Planck-Institut für Intelligente Systeme, Heisenbergstr. 3, 70569 Stuttgart, GERMANY

²Theoretische Physik IV, Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart, GERMANY

*Email: majee@is.mpg.de

Self-assembly of stably trapped colloidal particles at electrolyte interfaces has attracted much interest in recent years. For charge stabilized colloids at the interface, the attractive part of the interaction is dominated by strong van der Waals force which is balanced by a repulsive part coming from the electrostatic repulsion between the colloids. For large separations between the particles, this repulsive part of the interaction can be compared to a dipole-dipole interaction. However for distances close to the particle this simple dipolar picture cannot be applied. In this contribution we will consider the case of colloids situated very close to each other (inter-particle distance small compared to the size of the particles) at an electrolyte interface by going beyond the superposition approximation [1]. Within an appropriate model exact analytic expressions for the electrostatic potential as well as for the surface and line interaction energies are obtained. They demonstrate that the widely used superposition approximation, which is commonly applied to large distances between the colloidal particles, fails qualitatively at small distances and is quantitatively unreliable even at large distances. Our results contribute to an improved description of the interaction between colloidal particles trapped at fluid interfaces.

References:

1. A. Majee, M. Bier, and S. Dietrich. Electrostatic interaction between colloidal particles trapped at an electrolyte interface. J. Chem. Physics 2014, 140:164906.

■ ID-118

Green Synthesis of Polymer Inspired Gold Nanoparticles for the Evaluation of Their Biochemical Potency

Bishnupada Roy^{1,2*}, Niladri Mukherjee³, Pranesh Chowdhury², Santi P. Sinha Babu³

¹Bankura Unnayani institute of Engineering, Pohabagan, Bankura, WB, INDIA

²Synthetic Polymer Laboratory, Department of Chemistry, Visva-Bharati University, WB, INDIA

³Parasitology Laboratory, Department of Zoology, Visva-Bharati University, WB, INDIA

*Email: roy.chem85@gmail.com

Among the noble metal Nanoparticles, gold nanoparticles (AuNPs) has gained special attention due to their unique shape and size dependent properties, which has application in various fields including catalysis, biotechnology, optics and electronics. An interesting feature of these nanoparticles is the possibility of tuning their properties

by surface modification with suitable functional molecules such as organic thiol compounds, surfactants, long chain amine, and carboxylates. Various nontoxic polymers (engineering polymers, carbohydrates, biopolymers and dendrimers) have also been successfully used as functional molecules.

Biopolymer inspired gold nano particles (AuNPs) were synthesized through ultrasound assisted green process. The synthesis was carried out by reducing Au³⁺ to Au⁰ in presence of aqueous solution of chitosan, a biocompatible, biodegradable and nontoxic biopolymer in an ultrasonic bath. Formation of AuNP was observed both visually and spectroscopically (UV-Vis). The synthesized nanocomposite was further characterized by TEM, SEM, EDAX, DLS techniques. Zeta potential measurements, Mass spectrometry studies were also carried out. Circular Dichroism (CD) spectroscopy pointed out the AuNP-Protein and AuNP-DNA interactions.

Biochemical potency of the polymer stabilized gold nanocomposite was studied in terms of antiparasitic (antifilarial), antibacterial and antifungal activities. The nanocomposite was found to be very efficient against pathogenic bacteria and fungus and filarial parasites.

References:

1. G.D. Carlo, A. Curulli, R.G. Toro, C. Bianchini, T.D. Caro, G. Padeletti, D. Zane, G.M. Ingo, Langmuir, 28 (2012) 5471-79.
2. H. Huang, Q. Yuan, X. Yang, Colloids and Surfaces B: Biointerfaces, 39 (2004) 31-37.

■ ID-121

Transport Properties OF Thermally Rearranged (TR) HAB-6FDA/Silica Nanocomposite Polymeric Membranes

N.K. Acharya

Applied Physics Department, Faculty of Technology and Engineering, The M S University of Baroda, Vadodra, 390 001, India

*Email: sarnavee@gmail.com

Thermally rearranged (TR) polymers have shown good combinations of gas permeability and selectivity in recent years[1]. Polyimides containing ortho-positioned functional groups (PIOFGs) have better applications for gas separation in contrast to conventional glassy PIs after thermally rearrangement[2,3]. Introduction of nanoparticles into the polymer matrix has been shown to modify transport properties in polymeric membranes[4]. In present work it is propose to examine the effect of thermal rearrangement on the nanocomposite polymer in contrast to the pure polymer. The polymeric membranes were placed in a carbolite tube furnace at higher temperature of 350⁰C -450⁰C under N₂ atmosphere. Initially the samples were heated to 300⁰C with heating rate 5⁰C /min and held at 300⁰C for 60 min to ensure complete imidization, the polymers were then heated to 350⁰C-450⁰C with the same heating rate and held for 30-60 min and then cooled at room temperature with cooling rate 10⁰C /min. The permeability of H₂, CO₂, O₂, N₂ and CH₄ was measured using the constant volume/variable pressure method[5] for pure, nanocomposite and thermally rearranged polymer membrane.

Transport properties of a thermally rearranged polyimide nanocomposite membrane compared with a neat thermally rearranged polymer membrane using H₂, CO₂, N₂, O₂ and CH₄ have been reported.

References:

1. Park, H.B.; Jung, C.H.; Lee, Y.M.; Hill, A.J.; Pas, S.J.; Mudie, S.T.; Wagner, E.V.; Freeman, B.D.; Cookson, D.J. Science 2007, 318, 254.
2. Han, S.H.; Misdan, N.; Kim, S.; Doherty, C.M.; Hill, A.J.; Lee, Y.M. Macromolecules 2010, 43, 7657.
3. David F. Sanders, Zachary P. Smith, Cludio P. Ribeiro Jr., Ruilan Guo, James E. McGrath, Donald R. Paul, Benny D. Freeman, J. of Membr. Sci. 2012, 409 410, 232.
4. S Suryani; Liu, Y.L. Journal of Membrane Science 2009, 332, 121.
5. Bondar, V.I.; Freeman, B.D.; Pinnau, I. Journal of Polymer Science Part B:Polymer Physics 2000, 38, 2051.

■ ID-122

Optical Studies of Zinc Oxide Nanoparticles filled Poly (ethylene terephthalate)

Harshita Agrawal^{1*}, Kamlendra Awasthi ², Vibhav K. Saraswat¹

¹*Department of Physics, Banasthali University, Rajasthan, INDIA*

²*Department of Physics, Malaviya National Institute of Technology Jaipur, Rajasthan (India)*

*Email: harshi22101989@gmail.com

The present study reveals the optical properties of PET-ZnO nanocomposites. The ZnO nanoparticles have been prepared by chemical route. The spherical shape and average size of nanoparticles have been found as 16 nm from TEM studies. This result has also been supported by XRD patterns, where particle size has been calculated using Debye-Scherrers formula. With the help of Raman spectroscopy, the molecular vibrations in PET-ZnO nanocomposites have been analyzed. The band gap and extinction coefficient have been calculated using absorption spectra. The UV- Vis results show that band gap decreases with the increase of wt% of nanoparticles in the nanocomposites due to less band gap of ZnO nanoparicles where as extinction coefficient decreases with the increase in wavelength due to increase of charges carries.

References:

1. H. Agrawal, K. Awasthi, V.K. Saraswat. Non-isothermal crystallization kinetics of TiO₂ nanoparticle-filled poly (ethylene terephthalate) with structural and chemical properties. Polymer Bulletin 2014, 71: 1539-1555.
2. J. Tao, T. Wang, X. Dong, S. Xiaoqian. Mechanical properties and crystallization behavior of nanostructured-ZnO/PET In-Situ composites. Journal of Nanoscience and nanotechnology 2006, 6: 1-4.

■ ID-123

NEXAS Study of Pulsed Laser Deposited La_{1-x}Ca_xMnO₃ (x=0.0, 0.3, 0.5 and 0.7) Thin Films on Si(100)

M. Ikram^{1*}, Khalid Sultan ¹, Sajad Ahmad Mir¹, Mir Zubida Habib^{1,2}

¹Department of Physics, National Institute of Technology Hazratbal, Srinagar, J & K-190006, INDIA

²Department of Chemistry, National Institute of Technology Hazratbal, Srinagar, J & K-190006, INDIA

*Email: ikram@nitsri.net

La_{1-x}Ca_xMnO₃ (x=0.0, 0.3, 0.5 and 0.7) LCMO thin films on Si (100) were prepared by the pulsed laser deposition method. An investigation of Ca-doped LaMnO₃ was made to understand the element specific characterization, electronic structure and chemical environment of ions (La³⁺, Ca²⁺Mn³⁺/Mn⁴⁺, and O²⁻) in the compound La_{1-x}Ca_xMnO₃. Electronic structure of these samples has been studied by near-edge X-ray absorption spectroscopy (NEXAS) at K-edge of oxygen, L_{3,2} edge of Mn. The spectra observed in the O K-edge probes the unoccupied density of states with the O 2p symmetry due to dipole selection rules which arise mainly from the hybridization of O 2p states with various states of neighboring atoms, 3 d states of Mn and also the d states or rare earth La. These studies indicate lower Mn 3d-state occupancy, i.e. higher Mn valency. These studies also confirm that the samples contain a mixture of Mn²⁺ and Mn³⁺ and also suggest that the density of states increases with Ca doping. Due to this mixed valence state of Mn brought about by the introduction of Ca in the LCMO system, multi channel double exchange mechanism (Mn²⁺-O- Mn³⁺, Mn³⁺-O- Mn⁴⁺) is favored. Hence the mixed valence state of Mn is responsible for modifying the magnetic and other transport properties of the LCMO system.

References:

1. M. F. Hundley and J. J. Neumeier, Phys. Rev. B 55, 11511 (1997).
2. M. P. de Jong, I. Bergenti, V. A. Dediu, M. Fahlman, M. Marsi, and C. Taliani, Phys. Rev. B 71, 014434 (2005).
3. L. A. J. Garvie and A. J. Craven, Phys. Chem. Minerals 21, 191 (1994).
4. J. Kawai, Y. Mizutani, T. Sugimura, M. Sai, T. Higuchi, Y. Harada, Y. Ishiwata, A. Fukushima, M. Fujisawa, M. Watanabe, K. Maeda, S. Shin, and Y. Gohshi, Spectr. Acta B 55, 1385 (2000).

■ ID-125

Fabrication and Magnetic Properties of α -Fe₂O₃/SnO₂ Heterostructures

C. S. Biju¹, D. Henry Raja², D. Pathinettam Padiyan^{1*}

¹Department of Physics, Manonmaniam Sundaranar University, Tirunelveli 627012, INDIA

²Department of Physics, Scott Christian college, Nagercoil 629003, INDIA

*Email: dppadiyan@msuniv.ac.in

The novel α -Fe₂O₃/SnO₂ semiconductor nanoheterostructures (NHS) were fabricated by a facile hydrothermal process. The weight ratio of SnO₂ to α -Fe₂O₃ was varied as 1:2, 1:1 and 1:0.5 respectively during hydrothermal reaction at 160°C for 3 h. The structural, elemental composition, morphology and magnetic properties of the samples have been examined by means of XRD, EDAX, high resolution transmission electron microscopy and vibrating sample magnetometer. XRD patterns of the NHS reveal that, all the diffraction peaks corresponds

to the hexagonal phase of α -Fe₂O₃. Four broad and distinct humps appeared in the XRD indicates that, SnO₂ quantum dots (SQDs) were adhered on the surface of α -Fe₂O₃ and they were amorphous in nature. TEM images confirm the adhesion of SQDs on the surface of α -Fe₂O₃ and the size of SQDs was 5 nm. It also shows that α -Fe₂O₃ nanoparticles have a hexagonal morphology. From the hysteresis measurements a decrease of saturation magnetization from 1.5632 emu/g to 0.0239 emu/g was observed when the weight ratio of SnO₂ increases. This can be attributed to the breakage of super-exchange bonds between the non-magnetic SQDs core and the α -Fe₂O₃ surface. An enhancement of Morin transition temperature from 230 K to 240 K was observed when the weight of SnO₂ increases.

■ ID-126

Control of Droplet Size in Pickering Emulsions using Oppositely Charged Particles

Trivikram Nallamilli*, Ethayaraja Mani, Basavaraj Madivala

Polymer Engineering and Colloid Science Laboratory, Department of Chemical Engineering, Indian Institute of Technology, Chennai 600 036, INDIA

*Email:ntr1985@gmail.com

Colloidal particles irreversibly adsorb at fluid-fluid interfaces stabilizing Pickering emulsions[1] and foams. Highly charged particles cannot stabilize emulsions due to image charge effect[2]. Electrolyte or surfactant is used to suitably screen the charge on particles thus enabling them to stabilize emulsions. However, this problem of using electrolyte/surfactant etc. can be circumvented by using oppositely charged particles (OCPs) where they form charge neutral aggregates and thus stabilize emulsions which are truly electrolyte free. A majority of work done so far in this field is limited to emulsions/foams which are made with single type of particles.

In recent years, there has been an increasing interest in understanding nature and mechanism of formation of Pickering emulsions/foams with oppositely charged particles. Estimation of droplet size is of particular interest in emulsion science, since many properties like stability, shelf life, rheological properties, texture and aesthetic appeal are intimately connected to it. In case of conventional Pickering emulsions, Limited coalescence model[3] provides a theoretical model to understand and estimate droplet size. However, a similar frame work is missing in case of Pickering emulsions with oppositely charged particles.

In standard limited coalescence model the droplet diameter is inversely proportional to particle concentration. In this model the droplet size is estimated based on the assumption that all the particles go and adsorb at the droplet interface created during emulsification. However, in case of emulsions made with oppositely charged particles it is experimentally observed that the relative proportion of positive to negative particles sensitively affects the final droplet size. So, there is a need to suitably modify the Limited coalescence model to make it applicable to mixed particle systems.

In this study, We present a theoretical model, to quantitatively estimate droplet sizes in such emulsions

and also experimentally show that w/o emulsions with precise control on droplet size can be made by carefully tuning the relative proportion of oppositely charged particles at constant particle loading. This technique provides an additional handle on control of droplet size in Pickering emulsions which will be of crucial importance for applications ranging from paints, food emulsions, foams to oil recovery, pharmaceuticals and cosmetics.

References:

1. Pickering, S. U. Cxvii.emulsions. Journal of the Chemical Society, Transactions 1907, 91, 2001-2021.
2. Wang, H.; Singh, V.; Behrens, S. H. Image Charge Effects on the Formation of Pickering Emulsions. The Journal of Physical Chemistry Letters 2012, 3 (20), 2986-2990.
3. Wiley, R. Limited coalescence of oil droplets in coarse oil-in-water emulsions. Journal of Colloid Science 1954, 9 (5), 427-437.

■ ID-127

Control of Droplet Size in Pickering Emulsions using Oppositely Charged Particles

N. Kumar^{1*}, P. L. Meena¹, A. S. Meena¹, K. S. Meena²

¹Department of Chemistry, M. L. S. University, Udaipur, Rajasthan-313001, INDIA

²Department of Chemistry, L. V. Govt. College, Bhilwara, Rajasthan-311001, INDIA

*Email: nitinkumariitkgp@gmail.com

Curing is the process of applying pressure to the green tire in a mold in order to give it its final shape, and applying heat energy to stimulate the chemical reaction between the rubber and other materials. In this process the green tire is automatically transferred onto the lower mold bead seat, a rubber bladder is inserted into the green tire, and the mold closes while the bladder inflates. As the mold closes and is locked the bladder pressure increases so as to make the green tire flow into the mold, taking on the tread pattern and sidewall lettering engraved into the mold. The bladder is filled with a re-circulating heat transfer medium, such as steam .

The study of the flow of matter, primarily in the liquid state or solids under conditions in which they respond with plastic flow rather than deforming elastically in response to an applied force. The recent change in world scenario in shifting towards restriction on PCA rich extender oils leads to search for naturally occurring oils and low PCA Oil.

Present study is focused on curing properties of SSBR rubber based truck tyre tread cap compound with different eco-friendly oils. These oils are found to be suitable on the basis of low PCA content. As the presently available low PCA oil in the market in the form of MES & TDAE and naphthenic oil are comparatively costly. This paper deals with the curing behavior of different low PCA oils base formulation in Tyre tread cap compound.

References:

1. N.Kumar ,R.K.Khandelwal, P.L.Meena, K.S.Meena ,T.K.Chaki and D.K. Mahala, Rheological analysis on different oils use in tyre tread capcompound J.Chem. Bio. Phy. Sci. 2011, 1: 83-87.
2. N. Kumar, R.K. Khandelwal, P.L. Meena, K. S. Meena, T.K. Chaki , D.K. Mahla and S. Dasgupta , Chemical Analysis on Different Oils Use in Tyre Tread Cap Compound International

Journal of Chemical, Environmental and Pharmaceutical Research 2011 1: 12-19.

3. N. Kumar, P. L. Meena ,A. S. Meena and K. S. Meena, physico-mechanical properties of ssbr styrene 40%, vinyl content 46% based truck tyre tread cap compounds with lpc and hpca oils International Journal of Advanced Research in Engineering and Technology 2014 5: 2 121-127.

■ ID-128

Sensing Applications of Liquid Crystal Films

Siddharth Kulkarni, Aditya Samant, Shaurya Seth, Prachi Thareja*

Department of Chemical Engineering, Indian Institute of Technology (I.I.T) Gandhinagar, Ahmedabad-382424, INDIA

*Email:prachi@iitgn.ac.in

Liquid crystals (LCs) have been employed in myriad applications ever since this state of matter was discovered by an Austrian Botanist Friedrich Reinitzer in 1888[1]. In recent times, LCs have been reported to be used for sensing of various chemical species and monitoring biological events[2-6]. The sensing ability of the LCs is attributed to the transition in their original molecular configuration on exposure of the chemical or biological components[3,4]. The ordering transition can be traced with the help of cross polarized microscopy[3,6].

In this work, it is proposed that a more efficient sensing protocol can be built by forming a uniform LC (5CB:4-Pentyl-4-cyanobiphenyl) film on a microscopic glass slides using a fixed blade coating device. This device is capable of spreading LC emulsions in ethanol and heptane over a significant portion of the glass surface at user-defined coating speeds[7]. Two types of substrates are utilized: acid-cleaned and Octadecyl Trichloro Silane (OTS).

It is shown that the hydrophilic acid-cleaned glass substrates serve as a more reliable sensing platform for detecting aqueous surfactant solutions. The optical textures so developed are utilized for the detection of anionic (Sodium Dodecyl Sulphate (SDS)), cationic (Hexadecyltrimethyl Ammonium Bromide (CTAB)) and non-ionic surfactant (Nonaethylene monodecyl glycol ether (C₁₂E₉)) solutions, at concentrations below and above critical micelle concentration (cmc). We further show by measuring the solid surface energy of 5CB and surfactant adsorbed surfaces that the transition observed are indeed due to the interaction of surfactant molecules with 5CB.

Hydrophobic OTS treated glass substrates, on the other hand are found to effectively detect vapours of many organic species. Our experiments show that the non-polar species such as pentane, hexane, heptane etc. are detected slightly faster (response time less than 10 s) as compared to the polar species like ethanol, iso-propanol, acetone (response time greater than 10 s). We hypothesize that this observed effect is due to the stronger hydrophobic interaction between the head group of 5CB and alkyl chain of the non-polar component. The same interaction is thought to be hindered in case of the polar components.

In conclusion, 5CB droplet decorated surfaces can function as sensing platforms for aqueous surfactant, glucose solutions and organic vapors. These surfaces have very low limit of detection and hence even small quantities of external analyte can be detected. Further, solid surface energy measurements can be a simple tool

for verifying that the observed optical transitions are actually due to the interaction of external analyte with 5CB molecules.

References:

1. S. Saliba, C. Mingotaud, M. Kahn, J. Marty. Liquid crystalline thermotropic and lyotropic nanohybrids. *Nanoscale* 2013, 5: 6641.
2. F. Kahn, G. Taylor, H. Schonhorn. Surface-produced alignment of liquid crystals. *Proceedings of the IEEE* 1973, 61: 823.
3. D. Miller, R. Carlton, P. Mushenheim, N. Abbott. Introduction to Optical Methods for Characterizing Liquid Crystals at Interfaces. *Langmuir* 2013, 29: 3154.

■ ID-129

Colloidal Self-Assembly in Hexagonal Liquid Crystalline Phase

Prachi Thareja*, Siddharth Kulkarni, Nidhi Mishra
Department of Chemical Engineering, Indian Institute of Technology (I.I.T) Gandhinagar, Ahmedabad-382424, INDIA
 *Email:prachi@iitgn.ac.in

Liquid crystals (LCs) are found to play a vital role in many applications such organic transistors, sensory, liquid crystal devices (LCDs) and bio-medical applications etc.[1,2]. This state of matter is found to exhibit various phases which can be tuned by either temperature (thermotropic) or both temperature and surfactant concentration (lyotropic)[3]. Colloidal particles in LC composites have gained attention as interactions between particles and LCs can lead to variety of microstructure with superior electrical and magnetic properties [4].

In this work, rheological properties resulting from adding colloidal rhombohedral and acicular/elongated shaped iron oxide colloidal particles in lyotropic hexagonal liquid crystal are reported. Effect of particle concentration, shape and cooling rate on the composite system is studied. Hexagonal liquid crystal phase is formed by non-ionic surfactant Nonaethylene glycol monodecyl ether (C₁₂E₉) in water system on cooling from 65-250^oC.

The sample is a low viscosity liquid above the LC transition temperature and becomes a soft solid as the temperature is lowered to 250^oC. This is consistent with the rheological data where the storage modulus (G) showed an enormous increase as the temperature is cooled to 250^oC. The systems with acicular/elongated shaped iron oxide colloidal particles exhibited an almost linear increase in storage modulus with particle loading at all the cooling rates whereas the rhombohedral shaped particle systems showed a monotonic increase in G only upto 1.5 wt % particle concentration, beyond which a nearly plateau region is observed. This difference in trend is attributed to the faster packing of the rhombohedral shaped particles in comparison to the elongated shaped particles within the LC domains.

The cross polarized microscopy results are also found to be concurrent with the rheological observations- The microscopy images revealed that the increase in G was accompanied by corresponding decrease in the average LC domain sizes. This is thought to be due to slowing down of the nucleation rate of LC domains from the particle networks formed after elimination of colloidal particles.

Furthermore, on increasing the particle concentration and cooling rates, the rhombohedral shaped nanoparticle systems showed a comparatively faster decrease in LC domain size upto 1.5 wt % as compared to the elongated shaped particles system.

In conclusion, our study shows that the morphology and mechanical strength of the colloidal particles-hexagonal liquid crystal composites can be tuned by controlling the colloidal particle concentration, shape and cooling rate.

References:

1. S. Saliba, C. Mingotaud, M. Kahn, J. Marty. Liquid crystalline thermotropic and lyotropic nanohybrids. *Nanoscale* 2013, 5: 6641.
2. I. Musevic, M. Skarabot. Self-assembly of nematic colloids. *Soft Matter* 2008, 5: 195.
3. D. Jurasin, M. Vincekovic, A. Pustak, I. Smit, M. Bujan, F. Vincekovic. Lamellar to hexagonal columnar liquid crystalline phase transition in a catanionic surfactant mixture: dodecylammonium chloride-sodium bis (2-ethylhexyl) sulfosuccinate. *Soft Matter* 2013, 9: 3349.
4. D. Vollmer, G. Hinze, B. Ullrich, W. Poon, M. Cates, A. Schofield. Formation of self-supporting reversible cellular networks in suspensions of colloids and liquid crystals. *Langmuir*, 2005, 21:4921

■ ID-130

Electrohydrodynamics of Surfactant-Laden Drop

Purushottam Soni*, Vinay A. Juvekar, Vijay M. Naik
Department of Chemical Engineering, Indian Institute of Technology Bombay, Mumbai 400076, INDIA
 *Email:puru85@iitb.ac.in

The effect of surface active agents on deformation and breakup of conducting drop placed in viscous dielectric fluid subjected to externally applied electric field is studied experimentally. In presence of electric field drop deforms to a steady state shape till electric stresses and viscous stresses balances out, and will break in smaller droplets if the field strength increases beyond critical capillary number (Ca). The presence of surfactants in one of the phase reduces the interfacial tension between two liquids. It alters the surface properties, e.g. interfacial elasticity and interfacial viscosity, also induces the interfacial flow which can change the mode of breakup. The breakup generally takes place via two mechanisms, tip-streaming and end pinch-off. When the interface is clean or contaminated by very little amount of surfactant, the drop ruptures into smaller droplets via the end pinch-off mechanism. A second mode of drop breakup, tip streaming occurs for certain intermediate concentration range. If the surfactant concentration exceeds this range, the breakup mode goes back to end pinch-off mechanism. A third mode of breakup has recently been observed. With the addition of an appropriate surfactant and under proper choice of operating conditions, the drop ruptures via a catastrophic mode wherein the drop breaks up instantaneously into very tiny droplets without undergoing either of the aforementioned breakup mechanisms. Therefore; the emulsion produced would be highly stable. From our investigations as shown in figure, we have observed that the drop undergoes elongation, similar to the other modes of deformation, and then exhibits a series of different kind of instabilities similar to Saffman Taylor, Kelvin Helmholtz and Taylor

Plateau and finally burst into a fine mist. It is also observed that when the stretched water drop shorts the electrodes there is another mode of drop breakup, possibly involving dielectric breakdown of the liquids. Based on the experimental results the phase diagram for mode of breakup is found out. The use of this new mechanism is being explored in the chemical processing industry for the bulk production of fine water drop in oil emulsions.

References:

1. J. S. Raut, S. Akella, A. K. Singh, V. M. Naik. Catastrophic drop breakup in electric field. *Langmuir* 2009, 25(9), 4829-4834.
2. J.-W. Ha, S.-M. Yang. Effect of nonionic surfactant on the deformation and breakup of a drop in an electric field. *Journal of Colloid and Interface Science* 1998, 206, 195-204.
3. J.-W. Ha, S.-M. Yang. Effect of surfactant on the deformation and stability of a drop in a viscous fluid in an electric field. *Journal of Colloid and Interface Science* 1995, 175, 365-385.

■ ID-131

Pulling DNA : The Effect of Chain Length on the Mechanical Stability of DNA Chain

Amar Singh*, Navin Singh

Department of Physics, Birla Institute of Technology & Science, Pilani - 333 031, INDIA

*Email: amar.singh@pilani.bits-pilani.ac.in

We have investigated the effect of chain length on the thermal denaturation as well as on mechanical unzipping of double stranded DNA (ds-DNA) molecule. We use a simple nonlinear Peyrard Bishop and Dauxois (PBD) model and calculate the melting temperature as well as the critical force as a function of chain length for different heterogeneous chains. We found that in mechanical unzipping, when a force is applied on an end, there is a length up-to which the effect of applied force sustains. After that the base pairs have no information about the applied force. By comparing the force require to unzip chain open end and restricted end, we found a critical length above which the ends play no role in opening of the chain. For shorter chain, the end entropy contribute to the forced opening from the other end. We consider chains of different length and found minimum length where the end entropy does not contribute significantly in the opening of chain.

References:

1. M. Peyrard, A.R. Bishop, *Phys. Rev. Lett.*, 1989 62:2755.
2. A. Singh, N. Singh, *Physica A*, 2013 392:2052.
3. M. Zoli, *J. Chem. Phys.*, 2011 135:115101; M. Zoli, *Phys. Rev. E*, 2010 81:051910.

■ ID-133

Thin Films of Graphene Oxide- Cholesterol Biomolecules at Air-Water, Air-Solid Interfaces

A. Sarkar, K. A. Suresh, A. Sarkar*

Centre for Nano and Soft Matter Sciences , P.B. No. 1329, Jalahalli ,Bangalore - 560 013, INDIA

*Email: arupsarkar.katwa@gmail.com

Self-organization of organic molecules at air-water interface is very useful to get controlled two dimensional

systems with unique physical and chemical properties. Cholesterol and its esters are well known biological molecules self-organizing into monolayers and bilayers at air-water interface. Recently, graphene oxide(GO) monolayer has drawn lot of attention due to its unique properties. Though GO is a hydrophilic material because of its colloidal stability in water, recently its amphiphilic nature that depends the size of the GO sheets has been reported. Here we report our studies on the variation of surface pressure-area isotherm with subphase pH. We have prepared alternative layers of cholesterol and GO by Langmuir-Blodgett method and studied them by ellipsometry and atomic force microscopy. We find individual big sheets of GO at air-water interface by Brewster angle microscopy. Our study has relevance to technological applications in biosensor and bioelectronics applications.

■ ID-134

Entropic Electrokinetics

Paolo Magaretti^{1*}, Ignacio Pagonabarraga², J.Miguel Rubi²

¹*Max Planck Instut for Intelligent Systems, Stuttgart 70569, GERMANY*

²*Universitat de Barcelona, Departament de Fisica Fonamental, Barcelona 08028, SPAIN*

*Email: magaretti@is.mpg.de

The presence of geometrical confinement can strongly affect the net displacement of particle. Such situation arise in very different scenarios ranging from the nano-emtric scale such as for ion-channels to the micrometric scale as is for porous media, multidisperse colloidal suspension, cellular cytoplasm just to mention a few.

When such systems are active or under an external forces, the different exploration of the phase space can lead to new dynamical regimes[1,2]. In the present contribution, we study the motion of charged and neutral tracers, in a z-z electrolyte embedded in a varying section channel. Making use of systematic approximations, we map the convection diffusion equation governing the motion of tracers density in an effective 1D equation describing the dynamic along the channel where its varying-section is encoded as an effective entropic potential. We describe the onset of a novel electro-osmotic flow velocity pattern with regions of the channel in which the electrolyte moves against the average fluid flow.

Such recirculating regions lead to novel transport regimes for suspended charged as well neutral colloids. This novel dynamical regime allows for a geometrically-controlled mass as well electric current control. For higher values of the channel corrugation some tracers move against the average fluid flow hence leading to an alternative device for particle separation. Finally negative mobility of neutral tracers, optically trapped along the longitudinal axis of the channel, spontaneously arises as the net effect of the geometrically-modulated fluid flux.

References:

1. P. Magaretti, I.Pagonabarraga, J.M. Rubi. Confined Brownian Ratchet *Journal Chemical Physics* 2012, 138:194906.

- P. Margaretti, I.Pagonabarraga, J.M. Rubi. Entropic transport in confined media: a challenge for computational studies in biological and soft-matter systems. *Frontiers in Physics* 2013, 1:21.

■ ID-135

Structural Transitions of Simple Liquids in Contact with Solid Surfaces Textured with Nanoscale Pits

Swarn Lata Singh^{1,2*}, Lothar Schimmele^{1,2}, Siegfried Dietrich^{1,2}

¹Max-Planck Institute for Intelligent Systems, Heisenbergstr. 3, 70569 Stuttgart, GERMANY

²Institut für theoretische Physik, University of Stuttgart, GERMANY

*Email: swarn@is.mpg.de

Liquid-solid interfaces play an important role in a number of physical, chemical and biological processes such as adsorption, adhesion, tribology and electrochemistry. Changes in the structure of liquid in close vicinity of a solid surface, penetration of liquid into pores and adsorption are common phenomenon that occur when a liquid comes into contact with a solid substrate. A microscopic understanding of the processes occurring at the liquid-solid interface is of fundamental importance in order to understand processes like wetting and behavior of liquids in confined environment.

We studied the structure of a Lennard-Jones type liquid in contact with a hard solid wall which is weakly attractive at short distances and is endowed with nanopits of square cross section. We used Modified Rosenfeld Functional to study the structure of the liquid deep in the liquid regime at nanoscale. Inside the nanopits 3d-type localization of liquid may be observed with high density spots separated from each other in all spatial directions by regions with considerably lower liquid density. The onset of this localization is already at a packing fraction much lower than that of the liquid at liquid-solid coexistence. For suitably chosen widths and depths of the pits commensurate with packing requirements the high density spots are compact and form nice cubic lattices or are at least ordered in some planes on square lattices. The number of spots (lattice sites) depends on width and depth of the pit. Deviating too much from the commensurate widths leads to smearing and to the formation of bridges between high density spots. We followed the evolution of the structures as the width of the pit was changed from one commensurate value to the next and we also studied the effect of packing fraction on localization. Above the pits mainly layering is observed. The layers are distorted above the pit opening, but these distortions die out within some molecular diameters.

References:

- Y. Rosenfeld. Free-energy model for the inhomogeneous hard-sphere fluid mixture and density-functional theory of freezing. *Phys. Rev. Lett* 1989, 63:980.
- Y. Rosenfeld et.al. Fundamental-measure free-energy density functional for hard spheres: Dimensional crossover and freezing. *Phys. Rev. E* 1997, 55:4245.

■ ID-136

Self Assembled Monolayer Modified SU8 Surface for Electrowetting-on-Dielectric Application

Vijay Kumar*, Nitinipun Sharma

Nanomaterials and National MEMS design centre, Mechanical Engineering Department, Birla Institute of Technology and Science, Pilani-333031, INDIA

*Email: cirivijaypilani@gmail.com

Electrowetting on dielectric (EWOD) which originates from the phenomenon of electrowetting has been extensively investigated since the last decade as promising technology for liquid manipulation actuation[1]. EWOD is usually taken to control directly the wettability of liquid on the surface of the hydrophobic layer by changing the electric potential between the liquid and the microelectrode array beneath the dielectric layer. In EWOD microfluidics flow microchannel normally has Teflon/parylen as hydrophobic and dielectric layer; we previously presented a EWOD based open microchannel in which SU8 was used as hydrophobic and dielectric layer[2].

The present work investigates the surface modification of SU8 surface achieved by functionalization the Octadecyltrichlorosilane (OTS, $\text{Cl}_3\text{Si}(\text{CH}_3)_{17}$) self assembled monolayers (SAM) for electrowetting application. OTS, self assembled monolayer deposition is one of the most extensively known and widely used ways to influence the chemical and physical properties of various surfaces[3]. The surface topography, wetting properties of modified SU8 surfaces were characterized using the contact angle goniometry, atomic force microscopy (AFM) and FTIR spectra. The SU8 surface exhibits the hydrophobic nature with contact angle $\leq 90^\circ \pm 2^\circ$. The investigation shows the obtained hydrophobic surface was contact angle $\approx 127^\circ \pm 2^\circ$ by applying the OTS self assembly monolayer on SU8 surface.

References:

- R.B.Fair. Digital microfluidics: is a true lab-on-chip possible. *Journal of Microfluid Nanofluid* 2007, 3:245.
- V.Kumar, N.N.Sharma. SU-8 as hydrophobic and Dielectric Thin Film in Electrowetting-on-dielectric based Microfluidics device. *Journal of Nanotechnology* 2012, 2012:1.
- C. Haensch, S.Hoepfener, U.S.Schubert. Chemical modification of self-assembled silane based monolayers by surface reactions. *Journal of chemical Society Reviews* 2010, 39:2323.

■ ID-137

Self-Assembled Monolayer for Dielectric Materials

Vijay Kumar*, Nitinipun Sharma

Nanomaterials and National MEMS design centre, Mechanical Engineering Department, Birla Institute of Technology and Science, Pilani-333031, INDIA

*Email: cirivijaypilani@gmail.com

Treatment of surfaces to change the interaction of fluids with them is a critical step in constructing useful microfluidics devices; especially those used in biological applications. Selective modification of inorganic materials such as Si, SiO_2 and Si_2N_4 is great interest in research and technology. Such materials have shown to

possess a great potential in microelectronics and microfluidics applications[1-2]. Typically, Octadecyltrichlorosilane (OTS) self assembled monolayers are used for surface modification of such materials[3].

We evaluated the chemical formation of OTS self-assembled monolayers on silicon substrates with a different dielectric material. Our investigations were focused on surface modification of formerly used common dielectric materials SiO₂, Si₃N₄, a-poly. The deposition of dielectric materials was carried out using different chemical vapour deposition methods and thermal oxidation to achieve the desired thickness. The piranha cleaned silicon substrate is used for deposition of dielectric materials. After dielectric deposition the samples were dipped in to a toluene/OTS solution to allow the OTS to uniformly self assemble on the sample surfaces, and held in the glove box for two hour without any disturbance. After SAM formation, the samples were rinsed sequentially with toluene, dried by argon flow.

The OTS SAM modification to improve hydrophobic characteristic of dielectric materials reported in the present work. We performed contact angle measurement, atomic force microscope and scanning electron microscope (SEM) for to characterize the wetting behaviour after OTS SAM deposition. The SEM images of OTS modified dielectric materials surface are shown in Figure1. The water contact angle (WCA) with modification of dielectric surface using silanization process improves to $> 110^\circ$ in comparison to less than 90° for unmodified surface of dielectric materials.

References:

1. R.P.Ortiz, A.Facchetti, T.J.Marks. High-k Organic, Inorganic and Hybrid dielectrics for low-voltage organic Field-effects transistors. *Journal of Chemical Review* 2010, 110:205.
2. H.Liu, S.Dharmatileke, D.K.Maurya, A.O.Tay. Dielectric materials for electrowetting on dielectric actuation. *Journal of Microsystems Technology* 2010, 16:449.
3. A.Ulman. Formation and structure of Self-Assembled Monolayers. *Journal of chemical Reviews* 1996, 96:1533.

■ ID-138

Mechanically Switchable Wetting from Optical Discs Patterned Topological Polydimethyl siloxane (PDMS) Film

Pratibha Goel¹, Samir Kumar¹, Raman Kapoor², J. P. Singh^{1,2*}

¹*Department of Physics, Indian Institute of Technology Delhi, Hauz Khas, New Delhi-110016, INDIA*

²*Nanoscale Research Facility (NRF), Indian Institute of Technology Delhi, Hauz Khas, New Delhi-110016, INDIA*

*Email: jpsingh@physics.iitd.ac.in

Smart surfaces which can dynamically tune the surface properties (such as wetting, adhesion and friction) under external stimuli have received significant attention in recent years. Such surfaces find application in microfluidics, robotics, micro- and nanofabrication of complex structures[1]. Generally, wetting behavior is strongly dependent on both surface topography (i.e. physical roughness) and surface chemistry[2] (i.e. surface energy). Dynamic tuning of anisotropic wetting on surface is of great interest. Patterned surfaces with varying topology have been

shown to influence anisotropic wetting. These surfaces are generally realized by a range of micro- and nanofabrication techniques such as photolithography, chemical etching, e-beam lithography and laser induced cutting method.

In this work, we demonstrate a method of tuning the anisotropic wetting of a surface by mechanically stretching a topologically patterned elastic PDMS film. The alternating step profile of optical discs such as compact disc (CD) and digital versatile disc (DVD) was replicated on PDMS by imprint lithography[3].The film was mechanically strained to vary its periodicity and groove height. The degree of wetting anisotropy was found to tune in accordance with the change in mechanical strain. Surface roughness and energetic barrier were found to be responsible for the tunable wetting. The tuning of surface wetting was found to be reversible and repeatable owing to the robust microstructure and excellent elasticity of PDMS. This work provides a new insight into smart anisotropic surfaces with tunable wetting for microfluidic devices because mechanical strain is a highly versatile stimulus which can be easily applied to a wide range of elastic materials[4].

References:

1. J. Y. Chung, J. P. Youngblood and C. M. Stafford. Anisotropic wetting on tunable micro-wrinkled surfaces. *Soft matter* 2007, 3:1163.
2. S. Kumar, P. Goel, D. P. Singh and J. P. Singh. Highly sensitive superhydrophobic Ag nanorods array substrates for surface enhanced fluorescence studies. *Applied Physics letters* 2014, 104:023107.
3. P. Goel, K. Singh and J. P. Singh. Polarization dependent diffraction from anisotropic Ag nanorods grown on DVD grating templates by oblique angle deposition. *RSC Advances* 2014, 4:11130.
4. K. Ariga, T. Mori and J. P. Hill. Mechanical control of nanomaterials and nanosystems. *Advanced materials* 2012, 24:158.

■ ID-140

Electric Field induced Indulations in Lipid Membranes: A MARTINI Simulation Study

K. R. Prathyusha^{1*}, Ignacio Pagonabarraga², P. B. Sunil Kumar³

¹*TIFR Centre for Interdisciplinary Sciences, 21-Brundavan Colony, Narsingi, Hyderabad, INDIA*

²*Department de Física Fonamental, Universitat de Barcelona, SPAIN*

³*Department of Physics, Indian Institute of Technology Madras, Chennai, INDIA*

*Email: prathyusha.kr@tifrh.res.in

Lipid molecules, having two hydrophobic hydrocarbon tails, spontaneously self-assemble in aqueous environment to form bilayer membrane. Because of high difference in dielectric constant, between the membrane and the solvent, lipid membranes are strongly influenced by the action of an electric field. In electroformation technique, the application of AC electric field induces swelling of lipid membrane from the substrate on which they are deposited, and finally result in the formation of giant unilamellar vesicles (GUV). The origin of this swelling and peeling mechanism remains elusive. We carry out a coarse-grained (CG) molecular dynamic simulation of lipid membranes in the presence of static electric-field

to investigate this mechanism. We use MARTINI[1] force field to model the CG DPPC lipids and water molecules. We found that electric-field generates large amplitude undulations in membrane. The mechanical parameters of the membrane are found to be un-affected by the electric field. The area compressibility modulus shows a non-monotonic behaviour with increase in the electric-field. For sufficiently large electric field the membrane stretching instability leads to poration and thereby breakage of the membrane.

References:

1. S. J. Marrink, H. J. Risselada, S. Yefimov, D. P. Tieleman and A. H. de Vries. The Martini force field: coarse grained model for biomolecular simulations . J. Phys. Chem. 2007, 111:7812.

■ ID-141

Flow Induced Structure Formation in a Gel Forming System

K. R. Prathyusha^{1*}, Srikanth Sastry², P. B. Sunil Kumar³
¹TIFR Centre for Interdisciplinary Sciences, 21-Brundavan Colony, Narsingi, Hyderabad, INDIA

²Theoretical Sciences Unit, Jawaharlal Nehru Centre for Advanced Scientific Research Bangalore, INDIA

³Department of Physics, Indian Institute of Technology Madras, Chennai, INDIA

*Email: prathyusha.kr@tifrh.res.in

We study the shear induced structure formation in a gel forming system, whose interaction potential is obtained by modifying the three body Stillinger-Weber model potential for silicon[1], using Langevin dynamics simulations. The simulations are carried out at low density. At low shear rates, particles arrange as a single thread of beads along the flow direction and coarsening of these threads occur along the vorticity direction. At higher shear rates, vorticity banding happens in the system.

References:

1. Shibu Saw, Neils L. Ellegard, Walter Kob and Srikanth Sastry. Structural Relaxation of a Gel modeled by three body interactions. Phys. Rev. Lett. 2009, 103:248305.

■ ID-144

Dynamics of Loop Closure in a Chemically Active Polymer

Debarati Sarkar*, Snigdha Thakur

Indian Institute of Science Education and Research, Bhopal 462066, INDIA

*Email: debarati@iiserb.ac.in

Looping dynamics of polymer in which two monomers along the chain approach each other within a small distance, is a very active research topics because of some real life examples like the cyclization in DNA which is important in gene expression, RNA and protein folding etc. Large amount of experimental as well as theoretical literature is available for the closure time calculations in sticky ended polymers. However, not much has been done so far for a more general situation of polymer with long-range interactions. The knowledge of chain closure dynamics in

presence of long-range interaction may provide some hint about the factors behind the protein folding. In our work we investigate the loop closure dynamics of a chemically active polymer having long-range attractive interaction between two ends. The origin of the attractive interaction in our case is diffusiophoretic in nature, which is due to the chemical activity on one part of the polymer. We have investigated the loop formation in both flexible and semi-flexible polymer with the end, which attract each other due to diffusiophoretic forces. We employ the hybrid MD-MPCD model to study the polymer dynamics.

References:

1. A. Szabo, K. Schulten, Z. Schulten, J. Chem. Phys. 72, 4350 (1980).
2. G. Wilemski, M. Fixman, J. Chem. Phys. 60, 866 (1974) .
3. Doi M. Chem. Phys. 9 455 (1975).
4. Ngo Minh Toan, Greg Morrison, Changbong Hyeon and D. Thirumalai, J. Phys. Chem. B 112, 6094 (2008).

■ ID-145

Charge Carrier Controlling in Dual Gated Graphene Based Field Effect Transistors

Mahesh Soni^{1*}, Satinder K. Sharma ¹, Ajay Soni²

¹School of Computing & Electrical Engineering, IIT MANDI (H.P.) 175001, INDIA

²School of Basis Sciences , IIT MANDI (H.P.) 175001, INDIA

*Email: mahesh_soni@students.iitmandi.ac.in

The down scaling of Si (Silicon) based MOSFET (metal oxide semiconductor field-effect-transistor) and CMOS (complementary metal oxide semiconductor) has led to higher and higher packing density, increased performance, optimum power consumption and more complex functioning. However, the down scaling is approaching to the ballistic limits of electron transport for channel lengths of nanodevice[1]. At present, the semiconductor industry is looking extensively for new materials that can surpass the existing Si based technology[2]. In this context, the semi metallic Graphene (Gr) is one of the most talked candidates among others. For a very small applied voltage, Gr can carry a current density with very high mobility of charge carriers in comparison with than existing Si based technology. In other words the charge carriers simply move faster in the Gr than in Si. The replacement of existing Si technology with Gr is possible only; if the later can exhibits properties like current saturation and existence of a band gap. Normally, Gr based field effect transistors (Gr-FET) shows three regions of operation, for instance one linear region and two saturation regions, which means both unipolar and ambipolar saturation regions[2]. In present work we present our results on simulation for a dual gate control Gr-FET. The advantage of using dual gate control is the conduction in the channel is controlled by single type of charge carriers, thereby forcing the device characteristics (drain current, I_{ds}) to stick into saturation region rather than moving into second saturation region[3,4]. The simulation results for the current saturation in Gr-FET for different readings of back gate voltage will be discussed.

References:

1. D.J Frank, R.H. Dennard, E. Nowak, P.M. Solomon, Y. Taur, H. S. P. Wong. Device scaling limits of Si MOSFETs and their application dependencies. Proceedings of the IEEE 2001, 89:259.
2. F. Xia, D. B. Farmer, Y. Lin, P. Avouris. Graphene Field-Effect Transistors with High On/Off Current Ratio and Large Transport Band Gap at Room Temperature. Nano Lett. 2010, 2:715.
3. Umoh, Ime, Kazmierski, Tomasz and Al-Hashimi, Bashir. A dual-gate graphene FET model for circuit simulation - SPICE implementation. IEEE Transactions on Nanotechnology 2012, 12:247.
4. F. Schwierz. Graphene Transistors Nature Nanotechnology 2010, 5:487.

■ ID-149

Synthesis and Characterization of ZnO Nanostructures with Block copolymer Templates

Lokesh Kumar, Yogita Kumari, Manoj Kumar, K C Swami, Kamalendra Awasthi*

Soft Materials Lab, Department of Physics, Malaviya National Institute of Technology Jaipur 302017, INDIA

*Email: kamalendra.awasthi@gmail.com

Zinc oxide (ZnO) in its nanostructured form is emerging as a promising material with great potential for the development of many smart electronic devices. Zinc oxide nanoparticles were synthesized by chemical precipitation method by using Zinc Chloride as a precursor in methanol medium. X-ray diffraction (XRD) and Transmission electron microscopy (TEM) results confirm the nanostructure of ZnO nanoparticles. Thin film of block copolymer (PS-b-P4VP) solution with an additive HABA was deposited on a glass substrate by spin coating. ZnO nanoparticles are deposited in the nanotemplates with different concentration. Their morphology were examined by atomic force microscopy (AFM) and scanning electron microscopy (SEM). The optical properties were examined by UV-Visible Spectroscopy and Photoluminescence (PL).

■ ID-150

Dynamics of the Critical Casimir Effect in a Binary Fluid

Sutapa Roy*, Felix Hofling, Siegfried Dietrich

Max-Planck-Institut für Intelligente Systeme, Stuttgart and Institut für Theoretische Physik IV, Universität Stuttgart, GERMANY

*Email: sutapa@is.mpg.de

A binary fluid mixture near its consolute point exhibits critical fluctuations of the local composition. While the static properties of the mixture are well described by the 3D Ising universality class[1], the dynamic properties involving conservation of particles, energy, and momentum are classified as model H[2]. Confinement of critical fluctuations in such a mixture leads to critical Casimir forces[3,4] acting on the confining surfaces. We present results for collective transport quantities for a symmetric binary Lennard-Jones fluid, confined in a slit pore, close to its bulk critical point. Comprehensive results for the bulk phase behavior and static & dynamic properties in

bulk are also presented. Our results from the state-of-the-art molecular dynamics and Monte Carlo simulations, for both bulk as well as confinement, are compared to theory and experimental observations.

References:

1. S. K. Das, J. Horbach, K. Binder, M. E. Fisher, and J. V. Sengers, J. Chem. Phys. 125, 024506 (2006).
2. P.C. Hohenberg, and B.I. Halperin, Rev. Mod. Phys. 49, 435 (1977).
3. C. Hertlein, L. Helden, A. Gambassi, S. Dietrich and C. Bechinger, Nature 451, 172-175 (2008).
4. M. Trndle, O. Zvyagolskaya, A. Gambassi, D. Vogt, L. Harnau, C. Bechinger and S. Dietrich, Mol. Phys. 109, 1169 (2011).

■ ID-151

Two-Dimensional Aggregates from Competing Interactions: Dynamics and Morphology

Tamoghna Das*, Mahesh M. Bandi

Collective Interactions Unit, Okinawa Institute of Science and Technology Graduate University, 1919-1, Tancha, Onna-son, Kunigami-gun, Okinawa, 9040495, JAPAN

*Email: tamoghna.das@oist.jp

A two dimensional system of mono-disperse particles with competing short range attraction and long range repulsion is numerically investigated. Keeping the competing interaction strength fixed at low temperature and density, a dynamical transition from an exponential to power-law behaviour of self-fluctuations has been observed as a function of the repulsive screening length alone. This is accompanied by a structural transition from non-compact to compact aggregates. Whereas strong bonding is responsible for non-compact cluster formation, caging dynamics in compact clusters result in non-exponential relaxation characteristic of glassy behaviour. With increasing temperature, the non-equilibrium aggregation gives way to an ergodic liquid. With increasing density, the system undergoes a geometric transition into a percolating gel state, independent of temperature and repulsion length.

■ ID-155

Silver nanoparticles and carbon nanotubes induced DNA damage in mice evaluated by single cell gel electrophoresisKumud Kant Awasthi^{1*}, Anjali Awasthi¹, Rajbala Verma¹, Kamalendra Awasthi², P. J. John¹¹*Department of Zoology, University of Rajasthan, Jaipur 302004, INDIA*²*Department of Physics, Malaviya National Institute of Technology, Jaipur 302017, INDIA*

*Email: kkantawasthi@gmail.com

The broad applications of silver nanoparticles (Ag NPs) and multi walled carbon nanotubes (MWCNTs) increase human exposure and thus the potential risk associated to their toxicity. Therefore, the genotoxic effects of these nanomaterials toward hepatic cells of mice were investigated. Ag NPs of size $10.0 \pm 2.0 \text{ nm}$ having spherical shape were synthesized by the chemical route has confirmed

the formation of silver nanoparticles by attaining UV-Vis absorption maxima at 406 nm and structural analysis by TEM. MWCNTs of diameter 20-30 nm and length 5-50 μm , obtained by chemical vapor deposition method and characterized by SEM and XRD were acid functionalized and solubilized with water. This aqueous solution applied intraperitoneally to mouse at two dose levels 50 and 100 mg/kg body weight led to oxidative DNA damage in liver cells as comet tail length, tail moment and percent DNA in tail were found to be increased in dose dependent manner in both the nanomaterial groups. In summary, the results suggest that Ag NPs and MWCNTs of smaller size at low concentration cause cytotoxicity and genotoxicity leading to damage to DNA and other cellular components.

■ ID-158

Effect of Mn and Cu Doping on the Electrical Properties of CdS Nanoparticles

K.S. Rathore*, Deepika, N.S. Saxena

Semi-conductor & Polymer Science Laboratory, 14-15, Deptt. of Physics, University of Rajasthan, Jaipur - 302004, INDIA

*Email: kuldeep_ssr@yahoo.com

Nanoparticles of CdS:Mn and CdS:Cu has been prepared by chemical precipitation method. The structural characterization has been carried out using XRD, TEM and EDAX measurements. The dc conductivity measurements are carried out to see the effect of transition metal ion doping in CdS matrix. The dc electrical conductivity of all the sample has been determined by I-V measurement using the electrometer at room temperature as well as at elevated temperatures. The electrical conductivity of doped samples suggest that in case of CdS:Mn nanoparticles, conductivity increases by an order of 10^3 as compared to the undoped CdS, while in case of CdS:Cu samples, the increase in conductivity is by an order of 10^4

■ ID-159

Highly Sensitive Bragg Grating Refractive Index Sensor based on Plasmonic MIM Waveguide

Shikha Gaur*, Rukhsar Zafar

Swami Keshvanand Institute of Technology, Management and Gramothan, Jaipur, 302017, INDIA

*Email: shikha.gaur5@gmail.com

We propose and numerically analyze an ultra high sensitive refractive index sensor based on plasmonic Bragg grating by using the finite difference time domain method under a perfectly matched layer absorbing boundary condition. MIM (Metal insulator metal) waveguide geometry is used with silver as metal whose frequency dependent permittivity is characterized by Drude model. Structure is analyzed by tailoring the defect length of the waveguide and a sensitivity of ($S = 624nm$ for per change in refractive index unit) is obtained for defect length ($l = 0.5$) an improved value of quality factor ($Q = 296$) is also reported. The proposed design can be a suitable choice for refractive index sensor.

References:

1. K. Ogawa, et al.: New design and analysis of Bragg grating waveguides, *Opt. Express*, Vol. 18, No. 3, pp. 2002-2009, 2010.
2. Xianfeng Chen, Chi Zhang, David J. Webb, Kyriacos Kalli, and Gang-Ding Peng, Highly Sensitive Bend Sensor Based on Bragg Grating in Eccentric Core Polymer Fiber, *IEEE Photonics Technology Letters*, VOL. 22, NO. 11, JUNE 1, 2010.
3. ZHU Jia-Hu, HUANG Xu-Guan, MEI Xian High-Resolution Plasmonic Refractive-Index Sensor Based on a Metal-Insulator-Metal Structure, *Chinese Physics Letter*, Vol.28,No.5(2011) 054205.
4. Wu, Q.; Semenova, Y.; Yan, B.; Ma, Y, Wang, P., Yu, C, Farrell, G. Fiber refractometer based on a fiber Bragg grating and single-mode-multimode-single-mode fiber structure. *Opt. Lett.* 2011, 36, 21972199.
5. Wu, D.; Zhu, T.; Deng, M.; Duan, D.; Shi, L.; Yao, J.; and Rao, Y.J. Refractive index sensing based on Mach-Zehnder interferometer formed by three cascaded single-mode fiber tapers. *Appl. Opt.* 2011, 50, 15481553.
6. H. Y. Au, Sunil K. Khijwania, H. Y. Fu, W. H. Chung, and H. Y. Tam, Temperature-Insensitive Fiber Bragg Grating Based Tilt Sensor With Large Dynamic Range, *Journal of Lightwave Technology*, Vol. 29, No. 11, June 1, 2011.

■ ID-160

Synthesis and Characterization of TiO₂ Nanostructures with Block copolymer Templates

Yogita Kumari, Lokesh Kumar, Manoj Kumar, K C Swami, Kamalendra Awasthi*

Soft Materials Lab, Department of Physics, Malaviya National Institute of Technology Jaipur 302017, INDIA

*Email: kamalendra.awasthi@gmail.com

Titanium dioxide nanostructures have attracted a great attention as the promising materials for energy and environmental applications due to their structure versatility and unique physical and chemical properties. Anatase and rutile titanium dioxide nanoparticles were synthesized by chemical precipitation method by using titanium isopropoxide as a precursor. X-ray diffraction (XRD) and Transmission electron microscopy (TEM) results confirm the nanostructure of TiO₂. Thin film of block copolymer (PS-b-P4VP) solution with an additive HABA was deposited on a glass substrate by spin coating. TiO₂ nanoparticles are deposited in the nanotemplates and their morphology were examined by atomic force microscopy (AFM) and scanning electron microscopy (SEM).

■ ID-161

Thermal and Elastic Properties of SrCo_{1-x}Sb_xO_{3- δ}

Rasna Thakur*, Rajesh K. Thakur, N.K. Gaur

Superconductivity Research Laboratory, Department of Physics, Barkatullah University, Bhopal 462026, INDIA

*Email: rasnathakur@yahoo.com

Sb-doped derivatives of the SrCoO_{3- δ} perovskite are characterized as a cathode material for intermediate-temperature solid oxide fuel cells with long-term stability and competitive power performance in the temperature range 750-850°C. In particular, SrCo_{0.95}Sb_{0.05}O_{3- δ} features a number of interesting properties that account for the observed performance: it presents a maximum

electronic conductivity, and low electrode polarization resistance with the $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.83}\text{Mg}_{0.17}\text{O}_{3-\delta}$ electrolyte, the crystal structure adopts a 3C corner-linked perovskite network with a considerable number of oxygen vacancies, the oxygen atoms showing high thermal factors suggesting a significant ionic mobility.

As these compounds are predominantly ionic in nature hence the lattice contributions to the specific heat at constant volume ($C_{cv(\text{lattice})}$) of pure and Sb doped $\text{SrCoO}_{3-\delta}$ has been studied and thereby thermal expansion is computed as function of temperature by means of Modified Rigid Ion Model[1-3]. We have systematically investigated the effect of phonons on thermal properties, Debye temperature (θ_D), molecular force constant (f), Reststrahlen frequency (ν), cohesive energy (ϕ), and Gruneisen parameter (γ) for $\text{SrCo}_{0.95}\text{Sb}_{0.05}\text{CoO}_{3-\delta}$. Also the effect of phonons on the bulk modulus is studied using the atoms in molecules (AIM) theory[4] for $\text{SrCo}_{0.95}\text{Sb}_{0.05}\text{CoO}_{3-\delta}$. We have found that the computed properties reproduce well with the available experimental data, implying that MRIM represents properly the perovskite cobaltate $\text{SrCo}_{0.95}\text{Sb}_{0.05}\text{CoO}_{3-\delta}$.

References:

1. Rasna Thakur and N.K. Gaur, Thermodynamic properties of $\text{La}_{1-x}\text{A}_x\text{CoO}_3$ (A=K, Cd, Pr and Nd). *J. Solid State Chem.* 2013, 201:107.
2. Rajesh K. Thakur, Rasna Thakur, S. Shanmukhrao Samatham, N. Kaurav, V. Ganesan, N.K. Gaur, G.S. Okram, Dielectric, magnetic, and thermodynamic properties of $\text{Y}_{1-x}\text{Sr}_x\text{MnO}_3$ ($x=0.1$ and 0.2). *J. Appl. Phys.* 2012, 112:104115.
3. Rasna Thakur, Rajesh K. Thakur, N.K. Gaur, Thermodynamic properties of $(\text{Pr}_{1-y}\text{Smy})_{0.7}\text{Ca}_{0.3}\text{CoO}_3$ ($0 \leq y \leq 1$). *Mater. Res. Bull.* 2013, 48:2049.
4. A. Martin Pendas, A. Costales, M.A. Blanco, J.M. Recio, V. Luana, Local compressibilities in crystals. *Phys. Rev. B* 2000, 62:13970.

■ ID-162

Study of Structural & Optical Properties of CdS Nanoparticles Prepared by Chemical Precipitation Method

Dinesh Saini*, Rishi Vyas¹, R.K. Duchaniya², K.Sachdev¹
¹*Nanomaterials Research Laboratory, Department of Physics, Malaviya National Institute of Technology, Jaipur 302017, INDIA*

²*Department of Metallurgical & Materials Engineering, Malaviya National Institute of Technology, Jaipur 302017, INDIA*

*Email: dineshsatrawla@yahoo.com

The controlled growth of CdS nanoparticles is demonstrated by precipitation method employing Ethylenediamine-tetra acetic acid (EDTA) as a capping agent. XRD result is suggestive of formation of hexagonal phase of CdS with an average crystallite size of 52 nm. The clusters of CdS nanoparticles are visible in SEM image while elemental analysis by EDS confirms the formation of CdS nanoparticles. A standard peak of Cadmium Sulfide was observed at 640 cm^{-1} in FTIR spectroscopy while band gap calculated using UV-Vis spectroscopy also matches with the standard band gap for CdS.

References:

1. E. Esakkiraj, S.P. Sheik Abdul Kadhar, J. Henry, K. Mohanraj, S. Kannan, S. Barathan, G. Sivakumar. Optostructural and vibrational characteristics of Cu:CdS nanoparticles by precipitation method. *International Journal for Light and Electron Optics* 2013, 124: 5229 5231.
2. G.Z. Wang, W. Chen, C.H. Liang, Y.W. Wang, G.W. Meng, L.D. Zhang. Preparation and characterization of CdS nanoparticles by ultrasonic irradiation. *Inorganic Chemistry Communications* 2001, 4: 208-210.

■ ID-163

Stabilization of Emulsion by Oppositely Charged Colloids: A Monte Carlo Simulation Study

Sam David Christdoss Pushpam*, Basavaraj M. Gurappa, Ethayaraja Mani

Polymer Engineering and Colloidal Sciences Laboratory, Indian Institute of Technology Madras, Chennai 600036, INDIA

*Email: cpsam david@gmail.com

It is known that colloidal- and nano-particles can be used as stabilizers in the preparation of emulsions. Our recent experimental study showed that binary mixture of oppositely charged colloids (OCC) offers better control on average size of the emulsion droplets long-term stability. This formulation also allows many degrees of freedom such as number ratio of colloids, charge ratio, size-ratio and total concentration to control average size of emulsion drops. In this study, we aim to understand the role of charge ratio on the self-organization of OCC, dynamics and coordination number on the emulsion interface. This study would help rational design of experiments for stable emulsions, and preparation of colloidosomes thereof.

■ ID-165

Optical and Structural Study of Polystyrene/Polyaniline Nano-Composites Thin Film

Anil Kumar¹, Yogita Kumari², Lokesh Kumar², Kamlendra Awasthi², Vinod Kumar^{1*}

¹*Department of Metallurgical and Materials Engineering, Malaviya National Institute of Technology Jaipur 302017, INDIA*

²*Soft Materials Lab, Department of Physics, Malaviya National Institute of Technology Jaipur 302017, INDIA*

*Email: vkt.mnit@gmail.com

Polyaniline (PANI) was synthesized by oxidative polymerization method by using Potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$) as an oxidising agent. X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR) results confirm the structure of PANI. Polystyrene and PANI based composites were prepared by solution cast method. UV-Vis results of nanocomposite film in the range of 200-400 nm is due to the interaction between neighbouring phenyl group. The structural properties of the composite films were determined by the Fourier transform infrared spectroscopy (FT-IR) and X-ray diffraction (XRD). Morphological changes of PS-PANI

film were investigated by scanning electron microscopy (SEM) and optical micrograph.

■ ID-166

Molecular Ordering in a Liquid Crystalline Compound from X-ray Studies

M. K. Usha, N. Vinutha, R. Somashekar, D. Revannasiddaiah*

Department of Studies in Physics, University of Mysore, Manasagangothri, Mysore 570006, Karnataka, INDIA

*Email: dr@physics.uni-mysore.ac.in

X-ray diffraction (XRD) technique has been widely used to obtain information about the molecular ordering present in liquid crystalline systems[1]. The molecular ordering in these systems can be quantitatively expressed in terms of pair correlation function (PCF) and as translational order parameter. The compound p-Butoxybenzylidene p-Heptylaniline (40.7) exhibits smectic and nematic liquid crystalline phases. The phase sequence exhibited by the compound has been studied using polarizing optical microscopy and DSC techniques. XRD profiles of the compound have been recorded at different temperatures in smectic and nematic phases. From XRD data, apparent molecular length / layer thickness, inter molecular / inter planar spacing,[1] and microstructural parameters viz., crystallite size and microstrain[2] have been computed. PCF has been computed using simulation technique[3]. Further, translational order parameter has been estimated in smectic phase using the method proposed by Kapernaum and Giesselmann[4]. The results obtained are discussed in terms of molecular ordering present in the smectic and nematic phases.

References:

1. L. V. Azroff. X-ray diffraction by liquid crystals. *Molecular Crystals and Liquid Crystals* 1980, 60: 73.
2. R. Guinebreitire. X-ray diffraction by polycrystalline materials Wiley-ISTE Ltd.: UK 2007.
3. D. Frenkel, B. Smit. *Understanding molecular simulation: from algorithms to applications* Academic Press: San Diego, California 1996.
4. N. Kapernaum, F. Giesselmann. Simple experimental assessment of smectic translational order parameters. *Physical Review E* 2008, 78: 062701.

■ ID-167

Structural and Transport Properties of Ru doped Doped YMnO₃

Rajesh K. Thakur^{1,2*}, Rasna Thakur¹, N. Kaurav³, G.S. Okram⁴, N.K.Gaur¹

¹*Department of Physics, Barkatullah University, Bhopal 462026, INDIA*

²*Sagar Institute of Research Technology & Science, Bhopal 462041, INDIA*

³*Department of Physics, Government Holkar Science College, Indore 452001, INDIA*

⁴*Inter-university Consortium for DAE Facilities, Indore 452001, INDIA*

*Email: thakur.rajesh2009@gmail.com

Strontium doped YMnO₃ compound have been prepared in single-phase form by using high temperature solid state reaction method[1-2]. The structural and dielectric properties of the prepared sample have been carried out in the wide range of temperature and frequency. The low temperature dielectric measurements of the YMn_{0.95}Ru_{0.05}O₃ compound have been carried out at different frequencies with the prime aim to confirm the probable coupling in between the ferroelectric and antiferromagnetic orders at magnetic transition temperature (TN) below 100K. The temperature dependence of the dielectric permittivity (ϵ) of the YMn_{0.95}Ru_{0.05}O₃ compound in the temperature ranges from 20K-250K shows a small inverse S shaped anomaly at 81 K which is consistent for all frequencies. A rapid rise in the dielectric constant (ϵ) as well as loss tangent above 200 K for all the frequencies is clearly evident and consistent with a ferroelectric ordering temperature above 300K.

Further in order to have better clarity of the magnetic transition temperature the first order differential maximum of the ($d\epsilon/dt$) versus T curve reveals that the anomaly has taken place above 80K i.e. the first order minima in the plot. A sharp decrease in the derivative permittivity near about 80 K for all measured frequencies is suggestive of the fact that the compound entered in the antiferromagnetic phase also the rapid increase in the dielectric permittivity with increasing temperature indicates the ferroelectric nature in the high temperature zone.

References:

1. Rajesh K. Thakur, Rasna Thakur, S. Shanmukh Rao Samatham, N. Kaurav, V. Ganesan, N.K. Gaur, G.S. Okram, Dielectric, magnetic, and thermodynamic properties of Y_{1-x}Sr_xMnO₃ (x=0.1 and 0.2). *J. Appl. Phys.* 2012, 112:104115.
2. Rajesh K. Thakur, Rasna Thakur, A. Bharathi, V. Ganesan, N.K. Gaur, Thermal and Magnetic Response of Divalent-Sr Doped Hexagonal YMnO₃. *Mod. Phys. Lett. B* 2012, 26: 1250201.

■ ID-168

Antimicrobial activity of TiO₂ doped Polystyrene membrane

Anjali Awasthi¹, Ankita Dubey¹, Kumud Kant Awasthi^{1*}, Kamalendra Awasthi²

¹*Department of Zoology, University of Rajasthan, Jaipur 302004, INDIA*

²*Department of Physics, Malaviya National Institute of Technology, Jaipur 302017, INDIA*

*Email: anjkam.awasthi@gmail.com

Among various potential metal oxides nanoparticles, TiO₂ has been widely used as photocatalyst due to its chemical stability and availability in commercial. In the present study, the TiO₂ nanoparticles (NPs) have been embedded in Polystyrene (PS) membrane. For this purpose, TiO₂ NPs having a diameter of around 20 nm were made to bind on a 30 μ m thick PS membrane. We obtained NPs-PS complex with various concentrations of TiO₂ viz. 0.5%, 2%, 3%, 5%, and 10%. Keeping in mind large applications of this TiO₂ bound PS, the antimicrobial activity of complex was checked using a Gram negative E. coli bacteria. The bacteria was made to

grow on Nutrient Agar media as well as in broth and after 12 hours of incubation at 37°C, the growth of bacteria was not affected even at high concentration of TiO₂.

■ ID-169

Glass-Glass Transition During Aging of a Colloidal clay

Roberta Angelini^{1,2*}, Emanuela Zaccarelli^{2,3}, Giancarlo Ruocco², Barbara Ruzicka^{1,2}

¹*IPCF-CNR, UOS Roma, P.le Aldo Moro 2, I-00185 Roma, ITALY*

²*Physics Department, University La Sapienza, P.le Aldo Moro 2, I-00185 Roma, ITALY*

³*ISC-CNR, UOS Sapienza P.le Aldo Moro 2, I-00185 Roma, ITALY*

*Email: roberta.angelini@roma1.infn.it

Recent advances in the study of soft materials have led in the last decades to a deeper knowledge of equilibrium and non equilibrium states and to the discovery of new phases besides the ones commonly experienced in atomic or molecular systems. Colloidal suspensions are characterized by a variety of microscopic interactions which generate complex and exotic phase diagrams encompassing fluid, gel and glassy states and offer the possibility to study new phase and/or state transitions. Among these first order liquid-liquid phase transitions as well as glass-glass transitions are quite rare to be found, especially at ambient conditions.

Here we report experimental and numerical evidence of a spontaneous glass-glass transition taking place during aging of a colloidal clay. The investigation of these systems has in fact gained, in recent years, an important role in soft matter science. The anisotropic shape and complex interactions enrich their phase diagram of unconventional phases and make them suitable candidates for self assembly. In this work we investigate the aging behaviour of a colloidal clay through a combination of dilution experiments, X-Ray Photon Correlation Spectroscopy (XPCS)[1], Small Angle X-ray Scattering (SAXS) performed at European Synchrotron Radiation Facility and Monte Carlo (MC) simulations.

Two different glassy states are distinguished with evolving waiting time: a first one, occurring at the arrest transition (after a waiting of the order of hours), is dominated by long range screened Coulombic repulsion (Wigner glass) and a second one, previously unreported and stabilized by orientational attractions between clay platelets (Disconnected House of Cards (DHOC) glass) is found at much longer waiting times (of the order of days).

These findings may have relevance for applications where a fine control of the local order and/or long term stability of amorphous materials are required[2].

References:

1. R. Angelini, L. Zulian, A. Fluerasu, A. Madsen, G. Ruocco and B. Ruzicka. Dichotomic aging behaviour in a colloidal glass. *Soft Matter* 2013, 9:10955.
2. R. Angelini, E. Zaccarelli, F. A. de Melo Marques, M. Sztucki, A. Fluerasu, G. Ruocco. and B. Ruzicka. Glass-glass transition during aging of a colloidal clay. *Nature Communications* 2014, DOI 10.1038/ncomms5049.

■ ID-170

Relaxation Dynamics in a Colloidal Glass

B. Ruzicka^{1,2*}, F. A. M. Marques³, R. Angelini^{1,2}, E. Zaccarelli^{2,4}, G. Ruocco^{2,3}

¹*IPCF-CNR UOS Roma, I-00185, ITALY*

²*Dipartimento di Fisica, Sapienza Universit di Roma, I-00185, ITALY*

³*Center for Life Nano Science, IIT@Sapienza, Istituto Italiano di Tecnologia, 00161 Roma, ITALY*

⁴*ISC-CNR, I-00185 Roma, ITALY*

*Email: barbara.ruzicka@roma1.infn.it

Dynamics of complex fluids has long been the subject of intense research due to its unusual and unexpected behaviours. One important feature of these systems is the slowing down of their dynamics (aging) with waiting time. In this case the dynamics of density fluctuations is described by a double step behaviour characterized by a microscopic, or fast, and a structural, or slow, relaxation. Approaching the glass transition the fast dynamics is mainly invariant while the slow dynamics is strongly increased with waiting time. However it is still not clear how the two relaxation processes behave at the liquid-glass transition.

In the present work the aging dynamics of a colloidal glass[1,2] has been investigated in an unprecedentedly wide range of time and length scales through the combination of laboratory (multiangle Dynamic Light Scattering) and advanced (Neutron Spin Echo and X-ray Photon Correlation Spectroscopy) scattering techniques. Moreover Molecular Dynamics simulations complement the experimental results. In this way we have monitored the waiting time t_w and wavevector Q dependence of microscopic and structural relaxation times covering both ergodic and nonergodic regimes. The evidence of an unexpected complex dynamics is found with two distinct behaviours for the two relaxation times across the glass transition. The microscopic one, characteristic of the short-time diffusion of a particle in the suspending medium, scales as Q^{-2} during both regimes, depicting a diffusive nature of particles motion. On the contrary the structural relaxation time, associated to the structural rearrangement of the system, shows a clear transition from a Q^{-2} diffusive behaviour in the liquid regime to a Q^{-1} activated dynamics in the glass regime, in agreement with recent theoretical predictions[3]. Our results[4] are not specific to the studied colloidal glass but are expected to provide a general description of the complex dynamics occurring at fast and slow timescales in complex fluids and glass-formers.

References:

1. B. Ruzicka et al. *Phys. Rev. Lett.* 2010, 104:085701.
2. B. Ruzicka et al. *Nat. Mater.* 2010, 10:56.
3. S. M. Bhattacharyya, B. Bagchi, and P. G. Wolynes, *J. Chem. Phys.* 2010, 132:104503.
4. F. A. M. Marques et al. submitted to *Phys Rev. Lett.* 2014.

■ ID-171

Elastic Properties of Ca Doped SrCoO₃ Cobaltate

Rasna Thakur^{1*}, Rajesh K. Thakur¹, Archana Srivastava², N.K. Gaur¹

¹*Superconductivity Research Laboratory, Department of Physics, Barkatullah University, Bhopal 462026 INDIA*

²*Department of Physics, Sri Sathya Sai College for Women, Bhopal 462024 INDIA*

*Email: rasnathakur@yahoo.com

Cobaltate perovskites are getting renewed attention due to their specific properties making them promising materials in solid oxide fuel cells, gas separation membranes and many other applications. We have investigated the elastic and thermodynamic properties of the Sr_{1-x}Ca_xCoO₃ ($0 \leq x \leq 0.8$) probably for the first time by the means of modified rigid ion model (MRIM). In this paper we present the elastic constants (C_{11} , C_{12} , C_{44}) and other elastic properties like Bulk modulus (B), Youngs modulus (Y), Shear modulus (G), Poissons ratio (σ), Lames parameter (μ, λ) transverse, longitudinal and average wave velocity (v_t, v_l, v_m) and Anisotropy parameter (A). Here, all C_{ij} constants for Sr_{1-x}Ca_xCoO₃ compounds are positive and satisfy the generalized criteria for mechanically stable crystals: ($C_{11}C_{12}$) > 0, ($C_{11} + 2C_{12}$) > 0 and C_{44} > 0. Therefore, we conclude that Sr_{1-x}Ca_xCoO₃ ($0 \leq x \leq 0.8$) should belong to metallic bonding materials by analyzing their elastic modulus. The Poissons ratio in the present work is less than the critical value, i.e., 1/3. Therefore, Sr_{1-x}Ca_xCoO₃ ($0 \leq x \leq 0.8$) can be considered as brittle materials.

Besides we have reported the thermal properties such as molecular force constant (f), Reststrahlen frequency (ν), cohesive energy (ϕ), Debye temperature (θ_D) and Gruneisen parameter (γ) at room temperature. The lattice contribution to the specific heat and thermal expansion for Sr_{1-x}Ca_xCoO₃ ($0 \leq x \leq 0.8$) has been studied as a function of temperature ($0K \leq T \leq 300K$) by means of a MRIM[1-2]. We have found that the calculated Bulk modulus and Gruneisen parameter reproduce well with the corresponding experimental data, implying that MRIM represents properly the nature of the cobaltate perovskites. To our knowledge some of the properties for Sr_{1-x}Ca_xCoO₃ ($0 \leq x \leq 0.8$) are reported for the first time.

References:

1. Rasna Thakur, Archana Srivastava, Rajesh K. Thakur, N. K. Gaur, Specific Heat of Rare Earth Cobaltates RCoO₃ (R= La, Pr and Nd). *J. Alloys and Compd.* 2012, 516: 58.
2. Rasna Thakur, N.K. Gaur, Rajesh K. Thakur, Effect of cation doping on low-temperature specific heat of LaCoO₃ cobaltate. *J. Magn. Magn. Mater.* 2013, 325: 17.

■ ID-172

Smectic Translational Order in Two Liquid Crystalline Compounds from X-Ray Method

N. Vinutha, R. Somashekar, D. Revannasiddaiah*

Department of Studies in Physics, University of Mysore, Manasagangotri, Mysore, Karnataka 570006, INDIA

*Email: dr@physics.uni-mysore.ac.in

X-ray diffraction technique can be usefully employed to extract information about the degree of ordering present in the liquid crystalline phases[1]. Smectic liquid crystalline phases possess translational order in addition to orientational order exhibited by nematic phases. In the present work, translational order parameter have been computed in the smectic phases of the following two liquid crystalline compounds using X-ray intensity data: i) p-cyanobenzylidene p-nonyloxyaniline (CN.9) and ii) p-decyloxybenzylidene p-butylaniline (10O.4) The computations have been carried out employing theoretical model proposed by Kapernaum and Giesselmann[2].

The temperature variation of the translational order parameter (Σ) in smectic phases of these compounds are discussed in terms of the basic understanding of smectic phases.

References:

1. N.Stribeck, X-Ray Scattering of Soft Matter, 2007, Springer-Verlag, Berlin Heidelberg.
2. N. Kapernaum and Giesselmann, *Phys. Rev. E*, 2008, 78: 062701.

■ ID-173

Structural and Morphological Study of PS-ZnO Nanocomposite Membranes

Lokesh Kumar¹, Anil Kumar², Yogita Kumari¹, Manoj Kumar¹, K C Swami¹, Kamlendra Awasthi^{1*}

¹*Soft Materials Lab, Department of Physics, Malaviya National Institute of Technology Jaipur 302017, INDIA*

²*Department of Metallurgical and Materials Engineering, Malaviya National Institute of Technology Jaipur 302017, INDIA*

*Email: kamlendra.awasthi@gmail.com

Zinc Oxide nanoparticles were synthesized by chemical precipitation method and characterized by X-ray diffraction (XRD) and Transmission electron microscopy (TEM). Their particle size has been found 13 nm. Polystyrene (PS)-ZnO nanocomposite films were prepared by solution cast method with varied content of ZnO nanoparticles powder. Structural behaviour of nanocomposites was investigated by XRD and Fourier transform infrared spectroscopy (FTIR). Morphological behaviour of the composites were examined by optical microscopy as well as Scanning electron microscopy (SEM).

■ ID-174

Dielectric Relaxation in a Newly Synthesized GdMn_{0.9}Cr_{0.1}O₃

Anchit Modi*, Rajesh K. Thakur, Rasna Thakur, N. K. Gaur

Department of Physics, Barkatullah University, Bhopal 462026, INDIA

*Email: anchitmodi87@gmail.com

A systematic investigation of structural and dielectric properties of GdMn_{0.9}Cr_{0.1}O₃ perovskite has been undertaken that prepared by conventional solid state reaction

method. The X-ray diffraction studies shows that reported sample crystallized with orthorhombic symmetry with space group Pbnm without any secondary phase. Upon Cr doping on the Mn site the lattice parameters and unit cell volume were reduced due to slight difference between the ionic radii of Cr_{3+} and Mn_{3+} compare with Pure GdMnO_3 (according to JCPDS: 25-0337). The dielectric constant and tangent loss of reported sample shows strong dispersion in various frequencies are found to be decreasing with an increasing frequency. These results could be attributed to the relaxation behavior of the materials.

■ ID-175

Experimental Study of Water based Al_2O_3 Nanofluid Flow in Direct Absorption Solar Collector

Hemant Kumar Gupta*, Ghanshyam Das Agrawal, Jyotirmay Mathur

¹Department of Mechanical Engineering, Malaviya National Institute of Technology, Jaipur 302017, INDIA

*Email: hemant.rin2001@gmail.com

The most cost effective flat plate solar collectors suffer from low efficiency due to surface based solar absorption and indirect transfer of heat from absorption surface to basic working fluid flowing in tubes. To increase the efficiency, direct absorption solar collectors using base fluid mixed with stable suspension of nanoparticles called nanofluid as heat transfer media flowing as a thin film over the plate under gravity have been proposed. Direct absorption of solar radiation and mixing of nanoparticles in the base liquid improves the optical and thermo physical properties of the liquids, resulting to an increase in the efficiency of direct absorption solar collectors. In the present work the effect of $\text{Al}_2\text{O}_3\text{-H}_2\text{O}$ nanofluid, as heat transfer fluid, flowing as a thin film, on the efficiency of a direct absorption flat-plate solar collector was investigated experimentally. The volume fraction of Al_2O_3 nanoparticles was 0.001%, 0.005%, 0.0% and 0.02% and the particles dimension was 20 nm. The ASHRAE standard was used to calculate the instantaneous efficiency. The results show that, in comparison with water as direct solar absorption medium using nanofluid as working fluid increases the efficiency. For 0.001 vol% the increased efficiency was 12.8%. Results also show that by increasing the volume fraction from 0.001% to 0.01%, there is a continuous increase in the efficiency and beyond that increase in volume fraction values, the solar collector efficiency gets a reverse trend and becomes constant.

References:

1. T.P. Otanicar, P.E. Phelan, J.S. Golden, Optical properties of liquids for direct absorption solar thermal energy systems, *Solar Energ.* 83 (7) (2009) 969977.
2. Natarajan E, Sathish R. Role of nanofluids in solar water heater. *Int J Adv Manuf Technol*; 2009. doi:10.1007/s00170-008-1876-8.
3. H. Tyagi, P. Phelan, R. Prasher, Predicted efficiency of a low-temperature nanofluid-based direct absorption solar collector, *J. Solar Energy Eng.* 131 (4) (2009) 17.
4. Mu L.J, Zhu Q.Z, Si L.L: Radiative properties of nanofluids and performance of a direct solar absorber using nanofluids. 2nd ASME Micro/Nanoscale Heat & Mass Transfer International

Conference 2010, 1:549-553.

■ ID-176

Synthesis of polystyrene nanoparticles by nanoprecipitation from expanded polystyrene wastes

Ashna Rajeev, Madivala G Basavaraj*

Department of Chemical Engineering, Indian Institute of Technology Madras 600036 INDIA

*Email: basa@iitm.ac.in

Expanded polystyrene (EPS) wastes require large landfill volume and high transportation cost because of its low density, making it uneconomical for recycle[1]. We propose a simple and cost effective strategy for the conversion of EPS waste into polystyrene (PS) and multi-functional nanoparticles through nanoprecipitation technique. In the present study, waste EPS was used for the synthesis of PS nanoparticles through nanoprecipitation, in which a solution of EPS in tetrahydrofuran (solvent) was added to water (nonsolvent)[2]. The effect of EPS concentration, and speed of stirring on the size of precipitated PS nanoparticles has been investigated. The solvent type used for the dissolution of EPS was found to influence the morphology of the precipitated PS nanoparticles. The imaging of the precipitated PS nanoparticles was done by scanning electron microscopy (SEM). The size and thermo-physical properties of resulting particles were characterised using dynamic light scattering (DLS), SEM, densitometry, differential scanning calorimetry (DSC) and thermogravimetry (TGA).

References:

1. D. Murugan. Recycling of high volume plastic wastes based on polyolefins and polystyrene. PhD Thesis. Indian Institute of Technology Madras. 2007.
2. C. Zhang, V. J. Pansare, R. K. Prudhomme and R. D. Priestley. Flash nanoprecipitation of polystyrene nanoparticles. *Soft Matter* 2012, 8: 10.1039.

■ ID-177

Dynamics of Passive Triangular Swimmer in a Newtonian Fluid

Priyanka Choudhary¹, Sujin B Babu^{2*}, Shubhayan Mandal¹

¹Department of Physics, Malaviya National Institute of Technology Jaipur, Rajasthan 302017, INDIA

²Department of Physics, Indian Institute of Technology Delhi, New Delhi 110016, INDIA

*Email: sujin@physics.iitd.ac.in

The dynamics of artificial swimmer in a viscous fluid has recently received considerable attention in the physics community. The experimentalists have been able to extract a thin triangular film of the heart cell of mice to make an artificial swimmer. As the heart muscles have the intrinsic property of contraction and extension, these artificial swimmers uses this intrinsic beat mechanism for swimming. To mimic such an artificial swimmer, we introduce a flexible triangular sheet in fluid. The triangular sheet is modeled using bead spring model.

The surrounding fluid is simulated using multi - particle collision dynamics. We will explain how we couple the flexible sheet to the viscous fluid. In this work we will show the effect of finite size effect of the system. We will also show the passive swimmer will undergo Brownian dynamics. The diffusion coefficient of such passive artificial swimmer is calculated and we observe that it is inversely proportional to the length of the sheet as expected.

References:

1. S B Babu, and Holger Stark. Dynamics of semi-flexible tethered sheets 2011 34:136.

■ ID-178

Kinetic Modelling of Growth of Gold Nanorods

Neethu Thomas*, Ethayaraja Mani

Polymer Engineering and Colloid Science Laboratory, Department of Chemical Engineering, Indian Institute of Technology, Chennai 600 036, INDIA

*Email: neethuch2012@gmail.com

Particles having one of their dimensions in the range of 1-100 nm have unique physical and chemical properties that are not exhibited in their bulk state. These particles, collectively known as nanomaterials, of different shapes (nanowires, nanorods, nanobelts and nanotubes) are used for variety of applications[1]. For efficient application of gold nanorods, the aspect ratio and thickness are the main parameters that should be tightly controlled.

Although there are several synthetic routes to produce gold nanorods, seed mediated growth is often preferred because of great control in synthesizing rods of aspect ratio in the range of 1 to 100[2]. In this method, growth process is accomplished by the catalytic action of seed. Cetyltrimethyl ammonium bromide or Sodium Citrate stabilized gold Seed particles ($< 4nm$) synthesized by sodium borohydride reduction of $H AuCl_4$. Growth of nanorod required reduction of gold salt by a weak reducing agent and the presence of a cationic surfactant as a shape directing agent. Silver Nitrate can be used as an additive for controlling aspect ratio of nanorods. Each step and species involved in this synthesis have their own role in attaining the growth as a rod. It was so interesting to mathematically model this synthesis processes.

In this work, we have proposed a mathematical model for the formation of Gold nanorod synthesis in suspension starting from their synthesis conditions. The developed model predicts dependence of aspect ratio of (length to diameter ratio) gold nanorods on experimental variables. The model will also be used to address some of the key roles played by additives and capping agents during the synthesis.

References:

1. Y. Xia, P. Yang, Y. Sun, Y. Wu, B. Mayers, B. Gates, Y. Yin, F. Kim, and H. Yan. One-Dimensional Nanostructures: Synthesis, Characterization and Application, *Adv. Materials*; 2003, 15, No 5, 353-389.
2. J. P. Juste, I. P. Santos, L. M. L. Marzan, P. Mulvaney. Gold Nanorods: Synthesis, Application and Characterization, *Coordination Chemistry Reviews*; 2005, 249, 1870-1901.
3. B. Nikoobakht and M. A. E. Sayed, Preparation and Growth Mechanism of Gold Nanorods (NRs) Using Seed Mediated

Growth Method, *Chem. Mater.*, 2003, 15, 1957-196.

■ ID-179

Nano-mechanical Characterization of Crosslinked Chitosan/Hydroxyapatite Film

Amrita Rath, Pijush Ghosh*

Nanomechanics and Nanomaterial Laboratory, Department of Applied Mechanics, Indian Institute of Technology, Madras, Chennai- 600036, INDIA

*Email: ijush@iitm.ac.in

Biopolymers have been extensively used in the field of tissue engineering as porous scaffold, drug delivery to targeted site through microcapsules, food packaging in the form of edible film etc. Chitosan (CS), a natural biopolymer is one of the most versatile materials that finds application in various fields due to its biodegradability, biocompatibility, non-toxicity etc. However, very low mechanical properties of CS ($E \sim 1.5GPa$) limits its application many a times[1]. The mechanical properties like Young's modulus (E), hardness (H) etc. of these biopolymers can be improved primarily by two ways, i) by crosslinking of the chains and ii) by reinforcing with nanoparticles. However, with a very high degree of crosslinking, the material tends to acquire brittleness. Also, beyond a certain percentage loading (wt %) of nanoparticles, a decrease in magnitude of E and H are observed for nanocomposites[2]. Thus, it becomes extremely essential to optimize the degree of crosslinking and percentage loading of nanoparticles to obtain desired mechanical properties for a specific application.

In this work, as a part of this optimization, an attempt has been made to evaluate the mechanical properties of CS film using crosslinking agent (8% w/w, corresponding to a certain degree of crosslinking) as well as reinforcing (10% w/w) with nanoparticles. It has already been observed that 8% w/w of crosslinking and 10% w/w particle loading, individually show enhancement in mechanical properties compared to pristine and uncrosslinked CS. For this study, tripolyphosphate (TPP) is applied as a crosslinking agent and nano hydroxyapatite (HAp) is used as reinforcement particle. Besides comparing the mechanical properties, it is necessary to understand the mechanism leading to such properties. The study of crystallinity change of CS film due to both the process can give an insight into the possible mechanisms involved in the enhancement of mechanical properties.

The mechanical properties of modified CS film have been studied by using depth sensing nanoindentation technique. The load displacement curves obtained from this technique. X-ray diffraction (XRD) and scanning electron microscopy (SEM) has been performed to understand the mechanism behind mechanical properties improvement. A detailed comparative study of mechanical properties and mechanism will be performed for four cases, a) CS, b) CS with nanoparticles, c) crosslinked CS and d) crosslinked CS with nanoparticles.

References:

1. A. Aryaei, A. H. Jayatissa, and A. C. Jayasuriya. Nano and micro mechanical properties of uncross-linked and cross-linked chitosan films. *Journal of the Mechanical Behavior of Biomedical Materials* 2012, 5:82.

2. H. R. Le, S. Qu, R.E. Mackay, and R. Rothwell. Fabrication and mechanical properties of chitosan composite membrane containing hydroxyapatite particles. *Journal of Advanced Ceramics* 2012, 1:66.

■ ID-180

Study of Bacterial Cell Colonization on Plasma Induced Bio-Adoptable Nanocomposites Polymer Membranes

Narendra Kumar Agrawal^{*1}, Ravi Agarwal², Gautam Aashish Kumar², Y. K. Vijay³, K. C. Swami¹

¹*Department of Physics, Malaviya National Institute of Technology, Jaipur 302017, INDIA*

²*Center for Converging Technology, University of Rajasthan, Jaipur-302004, INDIA*

³*Department of Physics, University of Rajasthan, Jaipur-302004, INDIA*

*Email: research.nka@gmail.com

Polymers are receiving a great interest for the synthesis of biomedical devices. But to use them in any biomedical application they must be biocompatible. In this work we have enhanced the bio-compatibility of polymers by using TiO₂ NPs and plasma irradiation. TiO₂ NPs and plasma irradiation increase the porosity of the polymer material by etching which helps to increase the bacterial Cell Colonization on membranes. Nanoparticles of TiO₂ were synthesized by a chemical method and were used as nanocomposites for polymer membranes. Solution casting method was used for the preparation of nanocomposite polymeric membranes having thickness of 20 micron and these membranes were irradiated by Oxygen (O₂) plasma. The membranes so devised were characterized by different techniques such as Optical Microscopy, SEM- Scanning electron microscope and Atomic force microscope. The plasma irradiation modifies the surface roughness of polymers thus changes the surface energy and surface reactivity; that helps to enhance selective bacterial growth on the surface of the nanocomposite polymer membranes.

■ ID-183

Investigations on Multilayered TCO as Transparent Electrode in Organic Devices

Vikas Sharma*, Pooja Meena, Amena Salim, Kanupriya Sachdev

Department of Physics, Malaviya National Institute of Technology, Jaipur 302017, INDIA

*Email: vikasharma18786@gmail.com

A sandwiched structure with a metal layer embedded between oxide layers was fabricated on glass substrate to be used as transparent electrode in organic devices. The two oxide layers of ZnO were dip coated with a thickness of about 60 nm each and the metal inter layer was sputter coated having a thickness of about 5 nm at room temperature. The deposited films were annealed at 100⁰ C for 2 hrs to remove all additives. Such structures have been found to be suitable for applications in organic solar

cell and OLED. The samples have been characterized using XRD, TEM, SEM and EDAX. Optical properties were measured by UV-VIS and Fluorescence spectroscopy. The XRD result indicates the nearly amorphous structure of the thin film. The size of the particles as given by FESEM ranges from 30-50 nm and EDAX confirms the presence of elements in the three layers. AFM shows the roughness of about 2.40 nm. UV- VIS spectroscopy showed a high transparency of over 87 % in the visible region.

References:

1. T. Dimopoulos a, G.Z. Radnoczi b, B. Pcz b, H. Bruckl a. Characterization of ZnO:Al/Au/ZnO:Al trilayers for high performance transparent conducting electrodes. *Thin Solid Films* 519 (2010) 14701474.
2. C. Guillen , J. Herrero. TCO/metal/TCO structures for energy and exible electronics. *Thin Solid Films* 520 (2011) 117.
3. Huiyong Liu , V. Avrutin, N. Izyumskaya, U. Ozgur, H. Morko. Transparent conducting oxides for electrode applications in light emitting and absorbing devices. *Superlattices and Microstructures* 48 (2010) 458484.

■ ID-184

Structural and Morphological Study of PS-TiO₂ Nanocomposite Membranes

Yogita Kumari¹, Anil Kumar², Lokesh Kumar¹, Manoj Kumar¹, K C Swami¹, Kamlendra Awasthi^{1*}

¹*Soft Materials Lab, Department of Physics, Malaviya National Institute of Technology Jaipur 302017, INDIA*

²*Department of Metallurgical and Materials Engineering, Malaviya National Institute of Technology Jaipur 302017, INDIA*

*Email: kamlendra.awasthi@gmail.com

Inorganic-polymer nanocomposites are of significant interest due to their improved properties and unique combination of properties. Titanium dioxide nanoparticles were synthesized by chemical precipitation method and characterized by X-ray diffraction (XRD) and Transmission electron microscopy (TEM). Polystyrene (PS)-TiO₂ nanocomposite films were prepared by solution casting method with varied content of TiO₂ nanoparticles powder. Structural behaviour of nanocomposites was investigated by XRD and Fourier transform infrared spectroscopy FTIR. Morphological behaviour of the composites were examined by optical microscopy as well as Scanning electron microscopy (SEM).

■ ID-185

Fabrication of Topographic Meso Patterns with Programmable Feature Height using a Single Stamp

Nandini Bhandaru, Rabibrata Mukherjee*

Instability and soft patterning laboratory, Department of Chemical Engineering, Indian Institute of Technology Kharapur 721302, INDIA

*Email: rabibrata@che.iitkgp.ernet.in

New Soft Lithography based Nano-Patterning Techniques are proposed with this work with key focus on the ability

to create patterns of any feature height using a simple stamp, at extremely low cost. In majority of the Soft Lithographic techniques, for every new design of patterns, a new original stamp or mold has to be fabricated by some other lithography methods such as Photolithography or Electron Beam Lithography. The state of art now is to develop methods that are capable of producing structures which are not mere negative replicas of the original stamp. The physics that governs the creation of structures with feature height lower than that of the stamp and higher than that of the stamp is different and this has led to development of two different methods.

While we have developed "Elastic Recovery Lithography" (ERL) that is capable of creating patterns that has feature height lower than that of the original stamp, another method termed as "Elastic Detachment Lithography" (EDL) is capable of generating higher aspect ratio and taller structures from a stamp with lower feature height. The first method combines the widely known physics of stress relaxation in a soft visco-elastic polymer film with the essential concepts of Soft Lithography and the second method is based on contact instability observed in thin elastic films. A combination of the two gives scientists the power to create patterns with any programmable feature height using a single stamp.

References:

1. S. Roy, N. Bhandaru, R. Das, G. Harikrishnan, R. Mukherjee. Thermally Tailored Gradient Topography Surface on Elastomeric Thin Films. *ACS Appl. Mater. Interfaces* 2014, 6(9):6579.
2. N. Bhandaru, S. Roy, Suruchi, G. Harikrishnan, R. Mukherjee. Lithographic Tuning of Polymeric Thin Film Surfaces by Stress Relaxation. *ACS Macro Letters* 2013, 2:195.
3. M. Gonuguntla, A. Sharma, R. Mukherjee, S. A. Subramanian. Control of Self-Organized Contact Instability and Patterning in Soft Elastic Films. *Langmuir* 2006, 22:7066.

■ ID-187

Synthesis of Nanosheets Comprising Boron Honeycomb Lattice: Ultrasonication and Chelation Mediated Strategies

Asha Liza James, Kabeer Jasuja*

Department of Chemical Engineering, Indian Institute of Technology Gandhinagar, Ahmedabad 382424, Gujarat, INDIA

*Email: kabeer@iitgn.ac.in

The discovery of graphene, carbons two-dimensional allotrope, stimulated groundbreaking research in the science of nanomaterials. The unique properties of graphene and its wide and versatile applications, have inspired forays into other two dimensional materials[1]. Boron, carbons first row neighbor in the periodic table, is possibly the second element that can possess multiple low dimensional allotropes. The successful synthesis of single walled and multi walled boron nanotubes has motivated rising interests in seeking new nanostructures of boron[2].

We have recently been able to successfully exfoliate nanostructures comprising boron honeycomb lattice from layered materials which were hitherto little explored in two-dimensional nanomaterial research. In this talk we present a chemical exfoliation method that yields a colloidal dispersion of nanosheets comprising boron honey-

comb lattice. This method combines ultrasonication and chelation to facilitate a functionalization assisted layer-by-layer exfoliation in a parent layered material.

This talk will present the details of the exfoliation methodology and the fundamental physico-chemical properties of the as synthesized boron-based nanosheets. The morphological details (as obtained from FESEM, TEM and AFM), optical properties, surface charge and chemical analysis (by FTIR) will be presented.

This research pursuit holds great promise as it aims to pave the way for unveiling an exciting, yet unexplored family of boron based nanostructures that are expected to possess remarkable properties by facilitating an access to the atomic form of boron.

References:

1. V. Nicolosi, M. Chhowalla, M.G. Kanatzidis, M.S. Strano, J.N. Coleman. Liquid exfoliation of layered materials. *Science* 2013, 340:1226419.
2. X. Wu, J. Dai, Y. Zhao, Z. Zhuo, J. Yang, X. C. Zeng. Two Dimensional Boron Monolayer Sheets. *ACS Nano* 2012, 6(8): 7443-7453.

■ ID-189

Computation of Thermal Conductivity of nanofluid- A Quantum mechanical Approach

S. Devashankar*, N. Gurappa

Department of Physics, Velammal Engineering College, Surapet, Chennai 600 066, Tamilnadu, INDIA

*Email: devashankar.srinivasan@gmail.com

The thermal conductivity of water suspended with spherical nano-particles (nano fluid) at a given temperature and in the presence of external electromagnetic field is computed. The volume fraction of nano-particles in water can be a variable parameter. We set up an interacting quantum many-body Hamiltonian and obtain the ground-state wave function and ground-state energy. Under certain suitable approximation, using this ground-state wave function, some properties of the nano fluid like thermal conductivity, both in the presence and absence of external electromagnetic field, were calculated.

References:

1. Antonis Sergis, Yannis Hardalupas. Anomalous heat transfer modes of nanofluids: a review based on statistical analysis. *Nanoscale Research Letters* 2011, 6:391.
2. D. Hemanth Kumar, Hrishikesh E. Patel, V. R. Rajeev Kumar, T. Sundararajan, T. Pradeep, Sarit K. Das. Model for Heat Conduction in Nanofluids. *Physical Review Letters* 2004. 93:14.

■ ID-190

Brownian Cluster Dynamics with short range patchy interactions

Achutha Prabu^{1,3}, Sujin B. Babu^{2*}, J. S. Dolado³, J. C. Gimel¹

¹*Departement Polymeres Colloides Interfaces, LUNAM Université, Université du Maine, IMMMUMR CNRS 6283, av. O. Messiaen, 72085 Le Mans Cedex 9, FRANCE*

²*Department of Physics, Indian Institute of Technology Delhi, New Delhi 110016, INDIA*

³*Tecnalia Research and Innovation, Derio, SPAIN*

*Email: sujin@physics.iitd.ac.in

We present a novel simulation technique derived from Brownian cluster dynamics used so far to study the isotropic colloidal aggregation. It now implements the classical Kern-Frenkel potential to describe patchy interactions between particles. This technique gives access to static properties, dynamics and kinetics of the system, even far from the equilibrium. Particle thermal motions are modeled using billions of independent small random translations and rotations, constrained by the excluded volume and the connectivity. This algorithm, applied to a single polymer chain leads to correct static and dynamic properties, in the framework where hydrodynamic interactions are ignored. By varying patch angles, various local chain flexibilities can be obtained. We have used this new algorithm to model step-growth polymerization under various solvent qualities. The polymerization reaction is modeled by an irreversible aggregation between patches while an isotropic finite squarewell potential is superimposed to mimic the solvent quality. In bad solvent conditions, a competition between a phase separation (due to the isotropic interaction) and polymerization (due to patches) occurs. Surprisingly, an arrested network with a very peculiar structure appears. It is made of strands and nodes. Strands gather few stretched chains that dip into entangled globular nodes. These nodes act as reticulation points between the strands. The system is kinetically driven and we observe a trapped arrested structure. That demonstrates one of the strengths of this new simulation technique. It can give valuable insights about mechanisms that could be involved in the formation of stranded gels.

References:

1. A Prabu, S B Babu, J. S. Dolado and J.-C. Gimel. Brownian Cluster Dynamics with short range patchy interactions Its application to polymerization and step growth polymerization 2014. 141:24904.

■ ID-191

Flow-induced Non-equilibrium Self-assembly in Suspensions of Stiff, Apolar, Active Filaments

Ankita Pandey^{1*}, P. B. Sunil Kumar¹, R. Adhikari²

¹Indian Institute of Technology, Madras, Chennai 600036, INDIA

²The Institute of Mathematical Sciences, CIT Campus, Chennai 600113,, INDIA

*Email: ankita@physics.iitm.ac.in

Active bodies in viscous fluids interact hydrodynamically through self-generated flows. Here we study spontaneous aggregation induced by hydrodynamic flow in a suspension of stiff, apolar, active filaments. Lateral hydrodynamic attractions in extensile filaments lead, independent of volume fraction, to anisotropic aggregates which translate and rotate ballistically. Lateral hydrodynamic repulsion in contractile filaments lead, with increasing volume fractions, to asters, clusters, and incipient gels where, in each case, filament motion is diffusive. Our results demonstrate that the interplay of active hydrodynamic flows and anisotropic excluded

volume interactions provides a generic nonequilibrium mechanism for hierarchical self-assembly of active soft matter.

■ ID-192

Self Assembly and Template Guided Assembly of Colloidal Particles

Meneka Banik, Nandini Bhandaru, Rabibrata Mukherjee*
Instability and soft patterning laboratory, Department of Chemical Engineering, Indian Institute of Technology Kharagpur, 721302,, INDIA

*Email: rabibrata@che.iitkgp.ernet.in

We present a controlled method for obtaining hexagonal close packed (HCP) ordered monolayer and multilayer of silica and polystyrene colloidal particles on flat substrates as well as non-HCP ordered structures using isotropic and anisotropic topographically patterned substrates. Self organization of colloidal particles has many applications, particularly in fabrication of solar cells with advanced light management strategies. In nanosphere lithography, self-organized layer of colloidal spheres is used as a mask in the lithographic step of illumination, deposition, or etching. We have created two dimensional (2-D) colloidal crystals with monodispersed polystyrene (PS) and silica colloidal particles by simple spin coating technique. Appropriate amounts of surfactant molecules are added to the colloidal dispersion ahead of spin coating to ensure the formation of the HCP patterns. Parameters like coating speed, dilution of the colloids, amount of surfactant added and volume dispensed provide a control over the formation of HCP as well as the number of layers deposited.

Apart from obtaining HCP structures, we have also been working on obtaining ordered colloidal particle arrays with different geometric arrangements. For this purpose, we spin coat the particles onto a topographically patterned substrates, which are fabricated inhouse by soft lithography based techniques. The colloidal particles when spin coated on the patterned substrates, orient as per the confinement and we obtain particle array with non-HCP ordering. We have also attempted to transfer the particle array (both HCP and Non HCP structures) once they are formed onto a flat template. A flexible elastomeric substrate of Sylgard 184 is used in this regard, which after fabrication of the colloidal array is detached from the rigid substrate (while the particle array is still in place) and is then brought in conformal contact with the substrate to which the array is to be transferred. To facilitate the transfer without distorting the arrangement of the particles, the flexible stamp is swelled by exposing to solvent vapor to reduce the adhesion between the particles and the template. Under this condition, the particles detach themselves from the template and adhere to the target substrate. This allows the colloidal structures to be transported across substrates irrespective of their surface energy, wettability or morphology.

References:

1. R. A. Weiss, X. Zhai, A.V. Dobrynin. Nanoparticle-Textured Surfaces from Spin Coating. *Langmuir* 2008, 24:5218.
2. Nina V. Dziomkina, G. Julius Vancso. Colloidal crystal assembly on topologically patterned templates. *Soft Matter* 2005, 1:265.

- Peng Jiang, Tushar Prasad, Michael J. McFarland, Vicki L. Colvin. Two-dimensional nonclose-packed colloidal crystals formed by spincoating. *Applied Physics Letters* 2006, 89:011908.

■ ID-193

Influence of Particle Charge on Pickering Emulsions Stabilized by Shape Anisotropic Particles

T.G. Anjali, Madivala. G. Basavaraj*

¹*Polymer Engineering and Colloid Science Lab Department of Chemical Engineering Indian Institute of Technology Madras, Chennai 600036, INDIA*

*Email: basa@iitm.ac.in

Solid stabilized emulsions commonly known as Pickering emulsions are of great scientific interest because of their wide industrial applicability. The growing interest in such emulsions is because of their importance in pharmaceutical, food, cosmetic, agricultural and paint industries. The emulsification using colloidal particles can be fine-tuned by external factors such as temperature, pH, electric field, magnetic field etc.

In the present work, we investigate the role of surface charge of shape anisotropic particles on the stabilization of emulsions. Hematite particles of peanut and spherocylindrical shapes were synthesized following gel-sol method. The charge on the particles was systematically varying by changing the pH of the suspension from 1 to 12. The surface charge on the particles at different pH was estimated using zeta potential measurements. Decane and aqueous dispersions of different pH were used to prepare the emulsions. A strong dependence of pH on emulsion stability was observed. The characterisation of the oil droplets was done by optical microscopy, scanning electron microscopy (SEM) and environmental - SEM. Depending on the pH of the continuous phase, droplets with different sizes and surface coverage were formed. We present a mechanism to understand the stabilisation of emulsions using interaction potential calculations.

References:

- R. Aveyard.; B. P. Binks; J. H. Clint; Emulsions stabilized solely by colloidal particles. *Adv. Colloid Interface Sci.* 2003, 100, 503-546.
- T. Sugimoto; K. Sakata; Preparation of monodisperse pseudocubic -Fe₂O₃ particles from condensed ferric hydroxide gel. *J. Colloid Interface Sci.* 1992,152, 587-590.

■ ID-194

A Novel Method of Synthesis of Patchy Particles

S Manigandan*, S. Raman, Madivala G. Basavaraj, Ethayaraja Mani

¹*Polymer Engineering and Colloid Science Lab Department of Chemical Engineering, Indian Institute of Technology Madras, Chennai 600036, INDIA*

*Email: smanigandan0110@gmail.com

Structured colloids with regions of differing chemical composition can interact via attractive or repulsive interactions that depend not only on the distance of their separation, but also on orientation[1]. These functionally engineered particles also called "patch" particles are promising

candidates for drug delivery, controlled loading of catalyst, pickering emulsion stabilization, and optical applications. We present here a new method of synthesis of single and multi-patch particles. Thus far, patchy particles are produced by particle lithography[2], masking and glancing angle deposition technique[3]. Most of the techniques available to date consist of three steps 1) particle positioning, 2) functionalization, 3) template removal. We demonstrate for the first time a simple route for the fabrication of particles with single to multiple patches.

Monodisperse silica microspheres of 4 μm are spread over poly methyl methacrylate (PMMA) solution (in toluene) air interface. Upon transferring the particles at liquid/air interface onto glass substrate, hexagonally arranged monolayer of particles connected with polymer bridges is observed. Further, we show that polymer bridge formation can be controlled by concentration of polymer solution and number density of silica particles. This connected bridges form polymer patches when the dip coated substrate is sonicated to separate particles from the substrate. Interestingly, dip coating of particles spread at the polymer solution creates deposition of two layers an initial polymer layer followed by particle monolayer. The scanning electron microscope analysis reveals that the particle monolayer is trapped in polymer film in an orderly manner and this trapped polymer form patch at the bottom part of every particles. In this way, we can achieve maximum of seven such patches on the particles surface. It is also interesting to note that, one can make single patch alone by increasing the particle number density.

The interactions of these particles and their self-assembly in various electrolyte strength have been studied.

References:

- B. S. Jiang, Q. Chen, M. Tripathy, E. Luijten, K. S. Schweizer, S. Granick. *Janus Particle Synthesis and Assembly. Adv. Mater.* 2010, 22:1060.
- A. M. Yake, C. E. Snyder, D. Velegol. Site-Specific Functionalization on Individual Colloids: Size, Control, Stability, and Multilayers. *Langmuir* 2007, 23:9069.
- A. B. Pawar, I. Kretzschmar. Patchy particles by glancing angle deposition. *Langmuir* 2008, 24:355.

■ ID-195

Electronic Properties of Cu-Pd Ordered Alloys

Yamini Sharma^{1*}, Ramesh Sharma², Shalini Dwivedi²

¹*Theoretical Condensed Matter Physics Laboratory, Dept. of Physics Feroze Gandhi College Raebareli-229001 U.P, INDIA*

²*Dept. of Physics, Feroze Gandhi Institute of Engineering and Technology, Raebareli-229001, INDIA*

*Email: sharma.yamini62@gmail.com

Atomically ordered Cu-Pd alloys have received considerable attention due to their promising use as catalysts in many technologically important areas including petroleum refining and automotive emission control, as well as membrane for hydrogen production and purification. These binary metallic systems are characterized by formation of superstructures and development of long-range order in the arrangement of atoms.

The Cu-Pd alloy, for Pd concentration greater than 50 at% has a distorted FCC structure, while for Pd less than

18 at%, has a $L1_2$ type structure. The structural, electric, thermal and magnetic properties have been investigated to some extent, however the transport, optical and vibrational properties have not been investigated. The electronic structure of Cu_3Pd and $CuPd_3$ which are the ordered alloys of the Cu-Pd system, are investigated by the FP-LAPW and PAW methods based on the density functional theory[1,2].

From the calculated energy bands and Fermi surfaces, it is observed that with increasing Pd content, the Fermi surface (FS) of Cu is pulled away from the BZ boundaries which reduces the area of contact between the FS and BZ boundaries, thereby giving rise to increase in density of states at EF. This is in agreement with the theory given by J.C. Slater and J.F. Nicholas. This is verified not only from our calculated DOS, but also from the specific heat calculations.

The temperature dependence of the electrical resistivity and Seebeck coefficient of Cu_3Pd are in good agreement with experimental measurements. It is observed that with increased Pd content there is increase in resistivity, which clearly indicates increase in total scattering of conduction electrons in $CuPd_3$. Similarly, the change in the band structure with increased Pd content brings about a change in the thermopower from $-ve$ to $+ve$ values. Thus, the thermodynamic properties of these alloys can be completely understood in terms of the band structures and density of states.

References:

1. P. Blaha, K.Schwarz, G.K.H. Madsen, D.J. Kuasnicka, & Luitz, WIEN2K, An Augmented Plane Wave + Local Orbitals Program for Calculating Crystal Properties. (2001). K. Schwarz Technical Universitat, Wien, Austria, ISBN 3-9501031-1-2
2. G. Kresse and J. Hafner. Ab initio molecular dynamics for liquid metals. Phys. Rev. B, 47, 558 (1993); G. Kresse and J. Furthmiller. Efficiency of ab-initio total energy calculations for metals and semiconductors using a plane-wave basis set. Comput. Mat. Sci., 6, 15 (1996).

■ ID-196

Counterion Condensation Driven Shape Changes of Fluid Vesicles

Sreeja K. K.^{1*}, John H. Ipsen², P. B. Sunil Kumar¹

¹Department of Physics, Indian Institute of Technology Madras, Chennai 600036, INDIA

²MEMPHYS- Center for Biomembrane Physics, University of Southern Denmark, DENMARK

*Email:

Understanding the effect of electrostatic interactions in shaping interfaces is of fundamental importance in the area of biophysics and soft matter. Soft materials, such as polymers, colloids and membranes can acquire surface charges when dissolved in a polar solvent such as water, due to the dissociation of surface chemical groups. In such systems electrostatic interactions play a decisive role in determining the morphological behavior of the material, with entropy of the mobile ions contributing significantly. Competing interactions between the charged surface and the mobile counterions and coions can lead to condensation of counterions on the surface. In more complex systems, the condensed counter ion itself can induce morphological changes of the surface.

Here we study the counter ion condensation effect on charged deformable fluid interfaces using Dynamically Triangulated Monte-Carlo techniques. In the weak electrostatic coupling regime, surface charges are weakly screened and the conformation of the surface depend on charge-charge interaction on its surface. While in the strong coupling regime counter ion condensation and interaction of CI with the surface can alter the shape of the surface. We investigate the conformation of such a surface, with spherical topology, when the association of counter ion induces a spontaneous curvature on the surface. We show that condensation driven curvature induction plays a dominant role in determining the conformation of these surfaces. Condensation rate itself is observed to be dependent on the induced curvature, with larger curvature favoring increased condensation.

References:

1. P. Blaha, K.Schwarz, G.K.H. Madsen, D.J. Kuasnicka, & Luitz, WIEN2K, An Augmented Plane Wave + Local Orbitals Program for Calculating Crystal Properties. (2001). K. Schwarz Technical Universitat, Wien, Austria, ISBN 3-9501031-1-2
2. G. Kresse and J. Hafner. Ab initio molecular dynamics for liquid metals. Phys. Rev. B, 47, 558 (1993); G. Kresse and J. Furthmiller. Efficiency of ab-initio total energy calculations for metals and semiconductors using a plane-wave basis set. Comput. Mat. Sci., 6, 15 (1996).

■ ID-197

Elastic and Electronic Properties of TiC and TiN Crystals

Jitendra Kumar¹, K.C. Bhamu^{2*}

¹Department of Physics, Govt. Girls P.G. College, Banda, U. P. 210001, INDIA

²Department of Physics, SOET JNU Main Campus, Jaipur National University, Jaipur, Rajasthan 302025, INDIA

*Email: kcbhamu85@gmail.com

A theory for evaluating the temperature variation of second third and fourth order elastic constants for face centred cubic crystal structure solids is developed on the basis of Coulomb and Born-Mayer potential using nearest-neighbour distance and hardness parameter. The theory thus obtained is first applied to get the higher order elastic constants for TiC and TiN crystals at different temperatures. Also the elastic constants accordingly obtained are used to evaluate the first order pressure derivatives of second and third order elastic constants and second order pressure derivatives of second order elastic constants. An investigation of the higher-order elastic constants and their pressure derivatives provides useful information on the inter-atomic forces, inter-ionic potentials and anharmonic properties of crystalline solids. Several physical properties and crystal anharmonicities such as thermal expansion, specific heat at higher temperature, temperature variation of ultrasonic velocity and attenuation, Gruneisen numbers and temperature derivatives of second order elastic constants are directly related to second and third order elastic constants. The graphical representations of results obtained have also been given to understand the effect of temperature on higher order elastic constants and their pressure derivatives.

In addition to elastic properties we have reported electronic properties of these titanium based compounds

using spin polarised relativistic KorringaKohnRostoker (SPR-KKR) method based on Green Function theory. Energy bands are interpreted in term of density of states. A crossover in energy bands predicts that TiC and TiN are metallic in nature which is in tune with available data.

References:

1. R. Joshi, A. Dashora, KC Bhamu, BL Ahuja. High energy Compton scattering study of TiC and TiN. Applied Radiation and Isotopes 2011, 69:756

■ ID-198

Study of Dielectric Properties of Nanocrystalline Cobalt Ferrite upto Microwave Frequencies

Jyoti^{1*}, Jyoti Parashar¹, V. K. Saxena¹, S. N. Dolia¹, D. Bhatnagar¹, K. B. Sharma²

¹Department of Physics, University of Rajasthan, Jaipur 302004, INDIA

²Department of Physics, S. S. Jain Subodh P. G. College, Jaipur, INDIA

*Email: jyotijoshi.phy2008@gmail.com

The dielectric properties of the Cobalt ferrite, prepared by sol-gel auto combustion technique, were studied from radio to microwave frequencies. The single phase cubic spinel structure has been confirmed by using X-ray diffraction. Surface morphology of the sample was obtained by scanning electron microscope (SEM). The parameters like dielectric constant, dielectric loss tangent and a.c. conductivity of the sample were studied in the low frequency range from 20 to 120 MHz as well as in the high frequency range from 2.60 GHz to 5.95 GHz at room temperature. There is a sudden rise in the dielectric loss tangent at 4.53 GHz frequency. A qualitative explanation is given for the frequency dependence of the dielectric constant and dielectric loss. The dielectric dispersion observed at lower frequency region is due to Maxwell-Wagner two layer model, which is in agreement with Koops phenomenological theory. There is a strong co-relation between the conduction mechanism and the dielectric behaviour of ferrites.

References:

1. Ashok R. Lamani, H. S. Jayanna, P. Parameswara, R. Somashekar, Ramachander, Ramachandra Rao, G. D. Prasanna. Dielectric properties of polycrystalline Cu-Zn ferrites at microwave frequencies. Journal of Alloys and Compounds 2011, 509:5692-5695.
2. J. Jacob, M. A. Khadar, A. Lonappan, K. T. Mathew. Microwave dielectric properties of nanostructured nickel ferrite. Indian Academy of Sciences 2008, 31:847-851.
3. Z. Zi, Y. Sun, X. Zhu, Z. Yang, J. Dai, W. Song. Synthesis and magnetic properties of CoFe₂O₄ ferrite nanoparticles. Journal of Magnetism and Magnetic Materials 2009, 321:1251-1255.
4. Martha Pardavi-Horvath. Microwave Applications of soft ferrites. Journal of Magnetism and Magnetic Materials 2000, 215-216:171-183.

■ ID-202

Membrane Elasticity and Polymerization Energy Modulate the Shape of Clathrin Coats

Mohammed Saleem^{1,4*}, Sandrine Morlot¹, Annika Hohendahl¹, John Manzi², Martin Lenz³, Aurelien Roux¹

¹Biochemistry Department, University of Geneva, CH-1211 Geneva, SWITZERLAND

²Institute Curie, CNRS, UMR168 - Physico-Chimie Curie, Paris, FRANCE

³Univ. Paris-Sud; CNRS; LPTMS; UMR 8626, Orsay 91405 FRANCE

⁴current address: Department of Life Sciences, National Institute of Technology, Rourkela, INDIA

*Email: saleemm@nitrkl.ac.in

Clathrin mediated endocytosis is the most widely used means of vesicular trafficking and membrane bending is the first step involved, believed to be facilitated by clathrin polymerization. The polymerization of clathrin is thought to force the membrane to adopt the shape of the clathrin coat by scaffolding mechanism. However the variety of clathrin lattice shapes found in vivo has challenged this model. The mechanism of membrane bending by clathrin is still highly debated[1-3]. Addressing this question, in this study, we have reconstituted clathrin budding in vitro with giant unilamellar vesicles (GUVs), purified adaptors and clathrin. By changing the osmotic conditions, we found that clathrin coats caused extensive budding of GUVs under low membrane tension, while polymerizing as a flat lattice under moderate tension. High tension and bending rigidity of the membrane fully inhibited polymerization. We hypothesize that membrane tension could oppose polymerization energy of clathrin. Using theoretical modeling, we predict that a transition between different shapes of clathrin coats depends on membrane tension and clathrin polymerization energy. We then experimentally validated the theoretical model by estimating the transition values by measuring the polymerization energy of clathrin for the first time. The measured membrane tension and clathrin polymerization energy were found to be of the same order as in vivo tension regimes, suggesting a physiologically critical control of the shape of clathrin mediated budding by membrane elasticity.

References:

1. Ford, M.G., Barbara M.F. Pearse, Mathew K. Higgins, Yvonne Vallis, David J. Owen, Adele G. Colins R Hopkins, Philip R Evans, Harvey T McMahon. Simultaneous binding of Pt-dIns(4,5)P₂ and clathrin by AP180 in the nucleation of clathrin lattices on membranes. Science 2001, 291:1051-1055.
2. Boulant, S., Kural, C., Zeeh, J.C., Ubelmann, F. & Kirchhausen, T. Actin dynamics counteract membrane tension during clathrin-mediated endocytosis. Nature Cell Biol 2011, 13:1124-1131.
3. Dannhauser, P.N. & Ungewickell, E.J. Reconstitution of clathrin-coated bud and vesicle formation with minimal components. Nature Cell Biol 2012, 14:634-639.

■ ID-203

Chemotactic Dynamics of Gradient-sensing Eukaryotic cells

Ankush Sengupta^{1,2*}, Paolo Maiuri³, Matthieu Piel³, Raphael Voituriez², Nir S. Gov¹

¹Department of Chemical Physics, The Weizmann Institute of Science, P.O. Box 26, Rehovot 76100, ISRAEL

²Laboratoire de Physique Theorique de la Matiere Condensee, UMR 7600 CNRS /UPMC, 4 Place Jussieu, 75255 Paris CEDEX

²*Institute Curie, CNRS UMR 144, 26 rue d'Ulm, 75005, Paris, FRANCE*

*Email: ankush.sengupta@gmail.com

Chemotaxis and Brownian Motion belong to the the key processes governing the motility of cells and unicellular microorganisms (e.g., bacteria, amoeba and endothelial cells). Self-organization of cells at the collective level under a chemical cue rely on the individual dynamics of chemotactic cells which in turn depends on their ability to probe the chemical concentration field efficiently[1]. Prokaryotes, like most bacteria, being too small to directly sense chemical differences across their body length, chiefly chemotax by temporal comparisons of chemical concentration in a run-and-tumble motion[2]. By contrast, eukaryotes, like amoeba, yeast cells, white blood cells and glial cells, respond to food and toxins by direct spatial sensing of the local gradient. While biological and physical parameters like coupling strength to chemicals, cell motility, secretion rate and diffusion constant of chemicals are crucial to answer important biological questions like outcome of a chemotactic hunt[3], the details of the nature of the motion induced in taxis is crucial to understand individual response itself and classify cells according to their non-trivial dynamics[4].

Eukaryotic cell motility is based on the ability of cells to polarize their cytoskeleton, forming biased traction forces that move the cells forward along the direction of polarization. In the presence of a chemotactic signal, the cytoskeleton activity tends to polarize along the direction of larger chemical concentration, leading to chemotactic motion up the gradient. Taking into account the internal dynamics of cytoskeleton polarization coupled to cell motility, to describe the effects of the external chemotactic signal, we study the dynamics of chemotactic eukaryotic cells under an external chemical cue and compare to experiments. By comparing the model calculations with the experimental data, we find clear evidence that the chemical signal applies an effective torque on the cell polarization, reorienting it towards the chemical gradient[4].

Our results are important in understanding the novel and non-trivial dynamics actually shown by typical crawling eukaryotes probing chemical signals. While in the simplest approach a cell "smells" a chemical and moves along the gradient of the concentration field in order to reach the secretion source of the chemoattractant, our study suggest that in addition to such a tail-to-head directed motion, the chemical induces an effective torque that further enhance chemotactic efficiency by reorientation of the polarization axis and diminishing dispersion.

References:

1. J. E. Berleman, J. Scott, T. Chumley, J. R. Kirby. PNAS 2008, 105:171207.
2. R. W. Nash, R. Adhikari, J. Tailleur, M. E. Cates. Phys. Rev. Lett. 2010, 104:258101.
3. A. Sengupta, T. Kruppa, H. Lowen. Phys. Rev. E 2011, 83:031914.
4. A. Sengupta, P. Maiuri, M. Piel, R. Voituriez, N. S. Gov. (In Preparation).

■ ID-204

Effect of Substrate Surface Energy on Morphology of As Cast Ultrathin Polymer Blend Film on Flat

Substrate

Sahana Bhattacharyya*, Palash Dhara, Meneka Banik, Rabibrata Mukherjee

Instability and Soft Patterning Laboratory, Department of Chemical Engineering, Indian Institute of Technology, Kharagpur 721302, INDIA

*Email: sahanadas21@gmail.com

Instability related morphological structure is formed on ultrathin polymer blend film. Such a kind of structures depend on various properties of polymers, substrates as well as some external influences during film preparation. The morphology with compositional variation based on the surface energy has been studied here. Possible application of the blends as a reconfigurable low cost mask for fabrication of metallic nano structures necessary for making plasmonic solar cells are proposed.

Phase segregated morphology of thin films of blend consisting of PS/PMMA of different compositions cast on flat substrates of different surface energies have been studied. The Morphology has been characterized using Atomic Force Microscopy Techniques. Application of selective solvent washing technique identifies the blend component forming the continuous or dispersive phases. A further AFM imaging confirms the results. The variation of preferential surface enrichment by the blend-components with variation of compositional ratio on various substrate surface energy have been studied.

References:

1. S. Walheim, M. Boltau, J. Mlynek, G. Krausch and U. Steiner. Structure Formation via Polymer Demixing in Spin-Cast Films. *Macromolecules* 1990, 30:4995.
2. K. Dalnoki-Veress, J. A. Forrest, J. R. Stevens, J. R. Dutcher. Phase Separation Morphology of Thin Films of Polystyrene/Polyisoprene Blends. *Jornal of Polymer Science Part B: Polymer Physics*. 1996, 34:3017.
3. A. Budkowski, A. G. Shard, R. Daley and R. J. Bradley. Substrate-Determined Shape of Free Surface Profiles in Spin-Cast Polymer Blend Films. *Macromolecules* 2003, 36:4060.

■ ID-205

Carbon Nano Dots from Whey Protein: Fluorescent Nanoprobe for Live cell Imaging and Reduced Super Oxide Activity

Bodhisatwa Das, Prabhash Dadheech, Pavan Kumar Srivas, Pallabi Pal, Santanu Dhara*

School of Medical Science & Technology, Indian Institute of Technology, Kharagpur, INDIA

*Email:

Carbon nano dots (CNDs) are highly luminescent carbonaceous nanostructures with average size of 4-6 nm. In current study, carbon dots were synthesized from Whey protein via microwave irradiation at pH 12. The material is characterized by UV-Vis Spectro-photometry, Fluorescence Spectroscopy, XRD, FTIR, TEM and Zeta potential measurements. The material was observed to have significant photoluminescence property. On excitation at 410 nm, a band emission with peak at 525 nm was observed. The average size of the CNDs were 5-8 nm. The CNDs synthesized were highly functionalized with surface active amine and hydroxyl groups. After

exposure to cultured cellular monolayer, the CNs were observed to have entered in to cells cytoplasm. But, the entries towards nuclei were observed to be significantly less. Up to 6 hours exposure in white light, the samples were seen to be unbleached. The CNs were observed to be cyto-compatible and non-haemolytic. From NBT and DCFH assay, it was observed that the CNs could be utilized in reducing cellular oxidative stress and superoxide activity. Therefore, this nanoprobe could be useful for live cell imaging, cellular tracking and reduction of cellular super oxide activity for longer duration without significant photo-bleaching.

■ ID-206

Performance of Polymer Composite Membrane Electrode Assembly using Carbon Alloys as Anode Catalysts in Polymer Electrolyte Membrane Fuel Cell

Sri Mulijani^{1*}, Armi Wulanawati¹, Kiagus Dahlan²

¹Thin Film & Membrane Science Laboratory, Department of Chemistry, Bogor Agriculture University, Bogor, INDONESIA

²Biophysic Laboratory, Department of Physic, Bogor Agriculture University, Bogor, INDONESIA

*Email: janism67@gmail.com

Polymer membrane and composite polymer for membrane electrode assembly (MEAs) are synthesized and studied for usage in direct methanol fuel cell (DMFC). In this study, we prepared 3 type of MEAs, polystyrene (PS), polystyrene sulfonated (PSS) and composite polymer PSS-alginat membrane via catalyst hot pressed method. The performance and properties of prepared MEAs were evaluated and analyzed by impedance spectrometry and scanning electron microscopy (SEM). The result showed that, water up take of MEA composite polymer PSS-alginate was obtained 13.38% and its higher than that PS and PSS. The conductivity of PSS-alginate (0.1423 mS/cm) was also higher than that PS and PSS. SEM characterization revealed that the intimate contact between the carbon catalyst layers (CL) and the membranes, and the uniformly porous structure correlate positively with the MEAs prepared by hot pressed method, exhibiting high performances for DMFC.

References:

1. Q.W.Wu, T.S.Zhao, R.Chen, W.W. Yang. Enhancement of water retention in the membrane electrode assembly for direct methanol fuel cells operating with neat methanol. International Journal of Hydrogen Energy 2010,35:10547-10555.
2. Huaneng,B.J. Bladergroen, P. Sivakumar, V. Linkov, J.Shan. Performance Investigation of Membrane Electrode Assemblies for Hydrogen Production by Solid Polymer Electrolyte Water Electrolysis. International Journal of Electrochemical Science. 2012. 7:4223-4234.

■ ID-207

Orientation Dependence of Ultrasonic Parameters in CdO, CoO and FeO Crystals

Jitendra Kumar^{1*}, K.C. Bhamu², Kailash³, S.K. Srivastava⁴

¹Department of Physics, Govt. Girls P.G. College, Banda, U.

P., 210001, INDIA

²Department of Physics, SOET JNU Main Campus, Jaipur National University, Jaipur, Rajasthan, 302025, INDIA

³Department of Physics, B.N. P.G. College, Rath, Hamirpur, U.P., 210431, INDIA

⁴Department of Physics, Bundelkhand University, Jhansi, U.P., 284128, INDIA

*Email: jkumarsh@gmail.com

Wave velocity is a key parameter in ultrasonic characterization and can provide information about crystallographic texture. The Grneisen parameter is of considerable importance to Earths scientists, because it sets limitations on the thermoelastic properties of lower mantle. The temperature dependence of the ultrasonic parameters like ultrasonic velocities and Grneisen parameters in XO (X: Cd, Co and Fe) have been studied for longitudinal and shear waves along $\langle 100 \rangle$, $\langle 110 \rangle$ and $\langle 111 \rangle$ crystallographic directions in the temperature range 100 K - 500 K. The second and third order elastic constants have also been evaluated for these crystals using Coulomb and Born-Mayer potentials. Obtained results are compared with available results of same type of materials.

References:

1. Devraj Singh, Raj Kumar, Dharmendra Kumar Pandey. Temperature and Orientation Dependence of Ultrasonic Parameters in Americium Monopnictides. Advances in Materials Physics and Chemistry 2011, 1: 31.

■ ID-209

Study of TCO/metal/TCO Structure Prepared by Chemical Route

Vikas Sharma, Amena Salim, Pooja Meena, Kanupriya Sachdev*

Department of Physics, Malaviya National Institute of Technology, Jaipur 302017, INDIA

*Email: sachdevk67@gmail.com

Tri-layer structure of ZnO/Au-Pt/ZnO has been coated on the glass (soda lime) substrate using spin and sputter coater to develop Indium free transparent conducting oxide for its application in display technology. Optimum thickness of the metal layer is approximately 5 nm while the covering oxide layer on both sides is about 70 nm each. The sample was annealed at 500 K to make it suitable for Liquid crystal display and electro-chromic device applications. The spectroscopy analysis in UV-VIS region gave more than 87% transmittance. Scanning electron microscopy was used to get the surface morphology and particle size. EDAX was used to confirm the chemical composition of the sample. The surface roughness comes to about 9.03 nm as calculated through AFM.

References:

1. T. Dimopoulos a, G.Z. Radnoczi b, Z.E. Horvth b, H. Brckl a. Increased thermal stability of Al-doped ZnO-based transparent conducting electrodes employing ultra-thin Au and Cu layers. Thin Solid Films 520 (2012) 52225226.
2. Huiyong Liu, V. Avrutin, N. Izyumskaya, . zgr, H. Morko. Transparent conducting oxides for electrode applications in light emitting and absorbing devices. Superlattices and Microstructures 48 (2010) 458484.

- C. Guilln , J. Herrero. TCO/metal/TCO structures for energy and exible electronics. *Thin Solid Films* 520 (2011).

■ ID-210

Structural and Switching Properties in Polymer Dispersed Ferroelectric Liquid Crystal Composites

Divya Jayoti, Praveen Malik*

Department of Physics, Dr B R Ambedkar National Institute of Technology, Jalandhar Punjab, 144011, INDIA

*Email: pmalik100@yahoo.com

Polymer dispersed liquid crystals (PDLCs) composites consist of dispersions of micron-sized liquid crystals (LCs) droplets in polymer matrix[1-2]. These composite have been extensively studied owing to their excellent electro-optic (E-O) properties used in large area displays, switchable windows and flexible display applications[3-6]. In PDLC films, initially LC droplets are randomly distributed in polymer matrix in the absence of electric field (OFF-state) and sample appears opaque. However in presence of electric field (ON-state), LC director are aligned in the director of field and sample becomes transparent. In On State, the transparency of film is due to the matching of refractive index of polymer and LC droplets[2].

In this work, PDLC films comprising ferroelectric liquid crystal (FLC) and UV curable polymer in different compositions have been synthesized and studied in thin sample cell of thickness few micron meters. The behaviour of LC droplets, size and shape and phase transition temperature have been investigated. The effect of polymer concentrations on textural and electro-optical parameters (polarization, switching time, viscosity, rise time, fall time, contrast) have been measured and discussed in SmC* phase of FLC. The effect of nanomaterial doping in PDLC will also be discussed.

References:

- P. Drazic, *Liquid Crystal Dispersions*, World Scientific, Singapore, (1995).
- J W Doane, A. Golemme, J L West, J B Whitehead & B G Wu, *Polymer dispersed liquid crystals for display application*, *Mol Cryst Liq Cryst*, 165 (1988) 511.
- P. Malik, K.K. Raina, Droplet orientation and optical properties of polymer dispersed liquid crystal composite films, *Optical Materials*, 27 (2004) 613-617.
- P. Malik, K.K. Raina and A. K. Gathania, Effects of polymer viscosity on the polymerization switching and electro-optical properties of unaligned liquid crystal/UV curable polymer composites, *Thin Solid Films*, 519 (2010) 10471051.
- A. Shanks, Daniel Staszczuk. Thermal and optical characterization of polymer dispersed liquid crystals. *International Journal of Polymer Science* (2012), 767581.
- M. Elouali, F. Zohra Elouali, Christophe Beyens, O. Yaroshchuk, B. Abbar, Ulric Maschke. The effect of diamond nanoparticles on electro-optical properties of polymer dispersed liquid crystals. *Molecular Crystals and Liquid Crystals* 2012, 561:1, 136-144.

■ ID-211

Wide Temperature Range and Optical Studies of Polymer Stabilized Blue phases in a Binary Mixture

Arshdeep Singh, Praveen Malik*

Liquid Crystal Research Laboratory, Department of Physics,

Dr. B. R. Ambedkar National Institute of Technology Jalandhar, Punjab, INDIA

*Email: pmalik100@yahoo.com

Blue phase liquid crystals (BPLC) have become technologically important due to large number of applications in displays and photonics. BPLCs has several advantages like submillisecond response time, wide viewing angle and absence of alignment layer. Blue phases usually exist in a very narrow temperature range of the order of 1K at the boundary of chiral nematic and an isotropic phase of liquid crystal.[1,2] Three types of blue phases BPI having body centered cubic structure, BPII having simple cubic structure and BPIII which is nearly amorphous are known. 3 In the present study BPLC, mono functional monomer, bifunctional monomer and photo initiator were mixed in weight ratio 93.5:3:3:0.5. The mixture was cured at temperature 325.65K under UV light of intensity 3mW/cm² for 1hour. Polarizing optical microscopy and electro-optic studies of PS-BPLC were performed. Polymer Stabilized Blue Phases over a temperature range 14.8K have been realized having a Kerr constant $K = 1.23 \times 10^{-9} \text{ m}^2/\text{V}^2$ calculated from electric field induced birefringence studies. Hysteresis effect measured in the PS-BPLC is almost negligible.

References:

- H. Stegmeyer, T. H. Bluemel, K. Hiltrop, H. Onusseit and F. Porsh, *Liquid Crystals*, 1986, 1,3.
- P. P. Crooker, in *Chirality in Liquid Crystals*, ed. H. S. Kitzevrow and C. Bahr, Springer, New York, 2001, ch.7.
- S.Meiboom and M. Sammon, *Physical Review Letters*, 44 (13), 882-885 (1980).
- Ji-Liang Zhu, Jian-Gang Lu, Jing Qiang, *Journal of Applied Physics*,111, 033101(2012).
- Linghui Rao, Jin Yan, S.T.Wu, Shin-ichi Yamaoto, and Yasuhiro Haseba, *Applied Physics Letters* , 98, 081109 (2011).

■ ID-212

Study of Hydrogen Adsorption on Multiwall Carbon Nanotubes (MWNTs)

Balram Tripathi

Department of Physics, S S Jain Subodh P G College, Jaipur-302004, INDIA

*Email: ballu1181@gmail.com

Hydrogen storage is one of the key challenge in developing hydrogen economy. Hydrogen can be stored as (i) Pressurized gas (ii) Cryogenic liquid (iii) Solid fuel as chemical or physical combination with materials, such as metal hydrides, complex hydrides and carbon materials. Solid state hydrogen storage systems are expected to be simple for engineering design of vehicles and considerably safer than the storage of elemental hydrogen. Storage by adsorption on carbon materials have definite advantages from the safety perspectives such that some form of conversion or energy input is required to release the hydrogen for use. The storage values are dependent on many parameters of the carbon nanotubes, including their structure, structure defects, pre-treatment, purification, geometry (surface area, tube diameter and length), and arrangement of tubes in bundles/or ropes, storage pressure, temperature etc. In the present study an effort has been made for the hydrogen adsorption on MWNTs

and functionalized MWNTs at room temperature.

■ ID-213

Nano Ceramic (BaCO₃)/Polymer Composites for Dielectric Study

Balram Tripathi^{1*}, Vinod Chahar¹, G.Tripathi², K.B. Sharma¹, Y.K. Vijay³

¹Department of Physics, S S Jain Subodh P G College, Jaipur-302004, INDIA

²Department of Chemistry, S G N Khalsa P G College, Sriganganagar-335001, INDIA

³Departemnt of Physics, University of Rajasthan, Jaipur-302055, INDIA

*Email: ballu1181@gmail.com

Nanodielectric composites have been developed in recent years attempting to improve the dielectric properties such as dielectric constant, dielectric strength and voltage endurance. Conventional dielectric material development followed the paths of organic polymers, inorganic ceramics and thin films separately, due to type of capacitors, manufactured, polymeric film and multilayer ceramic capacitors. Polymer dielectrics show very high dielectric strength ($> 300\text{kv/mm}$), lower dielectric losses (< 0.01) and adequate mechanical flexibility in processing which is important in thin film capacitors. However they have low relative dielectric permittivity or constant (< 4) and low operating temperature ($< 200^\circ\text{C}$) compared to ceramic materials. Ceramic dielectrics tend to have very high dielectric permittivity (> 100) but relative low dielectric strength ($< 50\text{kv/mm}$) or may be piezoelectric associated with the structure of ceramic. Nanodielectric composites belong to a new type of materials, engineered for improved specific functionality such as better performance in electrical insulation. In the present study BaCO₃ as a filler has been dispersed in polycarbonate in various concentration, Dielectric constant and loss has been measured as a function of frequency. Figure shows variation in dielectric constant with frequency for BaCO₃/PC.

■ ID-218

Electro-Optic and Dielectric Studies in Magnetic Nanoparticle Doped Ferroelectric Liquid Crystal Mixtures for Soft Magneto-Electrics

Khushboo^{1*}, Praveen Malik², Puneet Sharma¹, K. K. Raina¹

¹ Material Research Laboratory, School of Physics and Material Science, Thapar University Patiala, Punjab, 147004, INDIA

²Liquid crystal Research Laboratory, Department of Physics, Dr B R Ambedkar National Institute of Technology, Jalandhar Punjab, 144011, INDIA

*Email: khushurpuk@gmail.com

In this work, the effect of magnetic nanoparticles (Ni) doping in ferroelectric liquid crystal (FLC) properties have been studied in thin sample cell of thickness 5 μm . The effect of Ni doping ($< 1\%$) into FLC structure and physical properties have been investigated. The

temperature and Ni concentration dependence on polarization, switching time, viscosity, permittivity, relaxation mode, dielectric strength and conductivity have been investigated and discussed. Obtained data exhibits that small amount of Ni doping has considerable impact on FLC switching, optical and dielectric parameters. The spontaneous polarization increasing the increasing the applied voltage and decreases with increasing the temperature. The results shall be discussed in conference.

References:

1. B. Rozic et al. Mol. Cryst. Liq. Cryst. 545 (2011)1323.
2. P. Goelet et al., J. App. Phys. 115 (2014)124905.
3. F. Brochard et al. J. Phys. (paris) 31 (1970)691.
4. P. Kopcansky et al. Phys. Rev. E, 78 (2008)011702.
5. N. Tomasovicova et al. J. Phys: Condens. Matter, 20 (2008)204123.
6. M.S. Zakerhamidi, et al. J. Mol. Liq. 191 16 (2014).
7. Yu. Garbovskiy, et al. Appl. Phys. Lett. 101 (2012)181109.

■ ID-219

Electronic Properties of Organic Schottky Diode based on Polycarbazole Nanocomposites

Arun Kumar Singh^{1,2*}, Rajiv Prakash²

¹ Department of Physics, Motilal Nehru National Institute of Technology, Allahabad-211004, INDIA

²School of Materials Science and Technology, Indian Institute of Technology (Banaras Hindu University), Varanasi-221005, INDIA

*Email: arunsingh.itbhu@gmail.com

In recent years, nanomaterials have been found to be an interesting filler for formation of polymer nanocomposites because it improves the thermal, mechanical, electrical, and optical properties of the pristine polymers[1]. Here we report the polycarbazole (PCz) nanocomposite with two different fillers (Multiwalled carbon nanotubes (MWCNTs) organic modified nano clay).The synthesized materials have been used for fabrication of Schottky diode. The current density-voltage (J-V) and capacitance-voltage (C-V) characteristics of the Schottky diode were studied and subsequently used for extracting the electronic parameters of the device such as the ideality factor, barrier height, reverse saturation current, built-in potential, depletion width and doping concentration etc. Excellent rectifying behavior is observed with an ideality factor of 1.4 and 1.8 for PCz-MWCNT and PCz-Clay Schottky diode, respectively.[2,3] We have also studied photovoltaic characteristics of the device under illumination of 650nm laser light. The morphology of the nanocomposite is studied using scanning electron microscopy and high resolution transmission electron microscopy images, before fabrication of the diode.

References:

1. M. T. Byrne and Y. K. Gunko, Advance Materials 2010, 22:1672.
2. A. K. Singh, P. Chakrabarti, R Prakash IEEE Electron Device Letters 2011, 32: 593.
3. A. K. Singh, R. Prakash RSC Advances 2012, 2:5277.

■ ID-223

Synthesis and Characterization of Liquid Crystal Elastomer

Rita A. Gharde^{1*}, Santosh A. Mani^{1,2}, Suman Lal^{3,4}, Samriti Khosla³, S. K. Tripathi⁴

¹ Department of Physics, University of Mumbai, Mumbai 400 098, INDIA

² K. J. Somaiya College of Engineering, Vidyavihar (E), Mumbai 400 077, INDIA

³ Department of Physics, J.C.D.A.V College, Dasuya, Punjab 144205, INDIA

⁴ Department of Advanced Study, Panjab University, Chandigarh 160014, INDIA

*Email: gharde.rita@gmail.com

The thermal and mechanical properties of Liquid Crystal Elastomers (LCEs) were characterized using various techniques for understanding of their physical behavior. The material used for investigation was synthesized by us using Finkleman procedure, with proper crosslinking density in nematic phase. The material is found to have unique coupling between anisotropic order of liquid crystal component and elasticity of polymer network. The chemical structures were confirmed by Fourier Transform Infrared (FTIR) Spectroscopy and Scanning Electron Microscopy (SEM). Fabry Perot Scattering Studies (FPSS), Thermo gravimetric Analysis (TGA) and Data Thermal Analysis (DTA) were used to study thermal properties. The mechanical properties were studied using force sensor. Our investigation shows that this synthesized Liquid Crystal Elastomer has ability of spontaneous change as a function of temperature and mechanical force, which shows it a unique class of soft material.

References:

1. H. Finkelmann, J. Kupfer, Makromol. Chem. Rapid Commun. 12, 717-726 (1991).
2. M. Warner and E. M. Terentjev, Liquid Crystal Elastomers, Clarendon Press Oxford, (2003).
3. Biggins, J.S.; Warner, M.; Bhattacharya, K. Elasticity of poly-domain liquid crystal elastomers. J. Mech. Phys. Solids 60, 573590 (2012).
4. Jayaraman, A. J. Polym. Sci., Part B: Polym. Phys. 51, 524 534 (2013).

■ ID-225

Influence of Substrate Stiffness and Cell-Substrate Adhesions on Cell-Matrix De-Adhesion Dynamics

Soumya S S^{1*}, Lakshmi Kavitha Sthanam², Ranjith Padinhateeri², Mandar M.Inamdar¹, Shamik Sen²

¹ Department of Civil Engineering, Indian Institute of Technology Bombay, Mumbai 400076, INDIA

² WRCBB, Department of Biosciences and Bioengineering, Indian Institute of Technology Bombay, Mumbai 400076, INDIA

*Email: soumyass@iitb.ac.in

Adhesion of cells to their extracellular matrix (ECM) plays important roles in various physiological processes including proliferation, motility, death and differentiation. The force balance between cells and their ECM, called as tensional homeostasis whereby forces exerted through the

actomyosin cytoskeleton are balanced by focal adhesions formed between the cell and the ECM, is thought to be the key for these activities. Trypsin de-adhesion assay serves as a simple biophysical tool for probing this force balance. Upon treatment with enzyme trypsin, adherent cells detach rapidly till they attain a rounded morphology. Using this assay, it is shown that the cell cortical stiffness increases in proportion to the increase in substrate stiffness in fibroblast and some other cell types. Combining experiments and computational modelling, we study the role of various substrate properties in regulating de-adhesion dynamics of adherent cells. The contribution of substrate stiffness and bond breakage rate in setting de-adhesion timescales is modelled by considering the cell as a viscoelastic solid connected to an elastic substrate through cell-matrix adhesions, and takes into account the active contractile pre-stress. We show that, consistent with experiments, a force-dependent breakage of adhesions predicts faster de-adhesion on stiffer substrates. In addition to illustrating the utility of employing trypsin de-adhesion as a biophysical tool for probing mechanoadaptation, our computational results highlight the collective interplay of substrate properties and bond breakage rate in setting de-adhesion timescales.

References:

1. Sen S, Kumar S (2009) Cell-matrix de-adhesion dynamics reflect contractile mechanics. Cell. Mol. Bioeng. 2: 218-230.
2. Edwards CM, Schwarz US (2011) Force localization in contracting cell layers. Phys. Rev. Lett. 107:128101.
3. Solon J, Levental I, Sengupta K, Georges PC, Janmey PA (2007) Fibroblast adaptation and stiffness matching to soft elastic substrates. Biophys. J. 93: 4453-4461.

■ ID-226

Dielectric behaviour of $Ni_{0.2}Cu_{0.2}Zn_{0.6}Fe_2O_4$ Spinel Ferrite

Jyoti Parashar^{1*}, V. K. Saxena¹, Jyoti¹, Deepak Bhatnagar¹, K.B.Sharma²

¹ Department of Physics, University of Rajasthan, Jaipur -302055, INDIA

² Department of Physics, S. S. Jain Subodh P. G. College, Jaipur-302004, INDIA

*Email: phyjyoti.2@gmail.com

Dielectric properties such as permittivity (Real part ϵ' and imaginary part ϵ'') and dielectric loss factor $\tan \delta$ are reported for Cu substituted Ni-Zn ferrite having formula $Ni_{0.2}Cu_{0.2}Zn_{0.6}Fe_2O_4$ prepared by sol-gel auto combustion method. The variation of real and imaginary parts of dielectric constant, dielectric loss $\tan \delta$ and A. C. conductivity with frequency are measured in the frequency range 1000 Hz to 120 MHz at room temperature. The real part of dielectric constant (ϵ') decreases with the increase in frequency where as the A. C. conductivity (σ_{ac}) increases with increase in frequency. The relation of $\tan \delta$ with frequency shows relaxation spectra. Dielectric constant and dielectric loss as a function of temperature are studied at different temperatures ranging from 303 K to 623 K.

References:

1. Zhenxing Yue, Ji Zhou, Longtu Li, Hongguo Zhang and Zhilun Gui. Synthesis of nano-crystalline NiCuZn ferrite powders by

sol-gel auto combustion method. Journal of magnetism and magnetic materials 208 2000 55-60.

2. A. Verma, T. C. Goyal, R. G. Mendiratta, M. I. Alam. Dielectric properties of NiZn ferrites prepared by the citrate precursor method. Material science and engineering B60 1999 156-162.
3. Preeti Mathur, Atul Thakur and M. Singh. Comparative Study of dielectric behaviour of $Mn_{0.4}Zn_{0.6}$ nanoferrite by citrate precursor method. International Journal of Modern Physics B 22, 2008 16:2537-2544.

■ ID-227

A Comparative Study of Fe- Doped ZnO Nanowire Bundle and their Spin Coated Thin Film for NO₂ and CH₄ Gas Sensing

Rishi Vyas^{1,2*}, Sarla Sharma³, Shabana Khan⁴, R. Divakar⁵, K. Sachdev², S. K. Sharma²

¹Department of Physics, School of Basic Sciences, Jaipur National University, Jaipur-302025, INDIA

²Department of Physics, Malaviya National Institute of Technology, Jaipur-302017, INDIA

³Department of Physics, JaganNath Gupta Institute of Engineering and Technology, Jaipur-302022, INDIA

⁴Mechanical Metallurgy Division, Bhabha Atomic Research Centre, Mumbai-400085, INDIA

⁵Physical Metallurgy Group (MMG), Indira Gandhi Centre for Atomic Research, Kalpakkam-603102, INDIA

*Email: mail2rishivyas@gmail.com

The free standing Fe-doped ZnO nanowire bundle is synthesized by employing a typical vapor phase transport method in single step from Fe+Zn powder in O₂+Ar flow. Transmission Electron Microscopy (TEM) and Energy Dispersive Spectroscopy (EDS) suggest the formation of hexagonal wurtzite phase of ZnO with 7 wt% Fe in ZnO with typical nanowire diameter in the range of 20 nm - 70 nm. These nanowire bundles are ultrasonicated and processed into thin film using spin coating technique. Both of the Fe- doped ZnO nanowire bundle and thin films are tested for their NO₂ and CH₄ sensing properties. The thin film specimen exhibited higher operating temperature (300⁰C) and response time (45 sec) as compared to nanowire bundle (150⁰C and 15 sec).

References:

1. Zhenxing Yue, Ji Zhou, Longtu Li, Hongguo Zhang and Zhilun Gui. Synthesis of nano-crystalline NiCuZn ferrite powders by sol-gel auto combustion method. Journal of magnetism and magnetic materials 208 2000 55-60.
2. A. Verma, T. C. Goyal, R. G. Mendiratta, M. I. Alam. Dielectric properties of NiZn ferrites prepared by the citrate precursor method. Material science and engineering B60 1999 156-162.
3. Preeti Mathur, Atul Thakur and M. Singh. Comparative Study of dielectric behaviour of $Mn_{0.4}Zn_{0.6}$ nanoferrite by citrate precursor method. International Journal of Modern Physics B 22, 2008 16:2537-2544.

■ ID-229

A Comparative Study on Effect of Conventional / Microwave Sintering in Tin Oxide, Antimony Oxide and Their Nanocomposite for NO₂ Gas Sensing

Neeraj Goyal^{1*}, Rishi Vyas¹, S. N. Dolia², S. K. Sharma¹

¹Department of Physics, Malaviya National Institute of Technology, Jaipur-302017, INDIA

²Department of Physics, University of Rajasthan, Jaipur - 302 004, INDIA

*Email: goyalneeraj5@gmail.com

The pure and nanocomposite (1:1) of Tin oxide and Antimony oxide were synthesized employing solid-state reaction method[1] using suitable salts in presence of NaOH and NaCl for their NO₂ sensing characteristics. The effect of microwave sintering (800⁰C for 10 min) on NO₂ gas sensing behaviour is also compared in contrast with conventional sintering (800⁰C for 4 hours). The surface morphology and structure of oxide-nanocomposites were investigated using scanning electron microscopy (SEM) and X-ray diffraction (XRD). The NO₂ gas sensing results revealed higher sensitivity in conventionally sintered specimens as compared to the microwave sintered specimens.

References:

1. Capone S, Forleo A, Francioso L, Rella R, Siciliano P, Spadavecchia J, Presicce DS, Taurino, Solid state gas sensors: state of the art and future activities, ChemInform, 2004, 35:29.

■ ID-230

Synthesis & Characterization of Co doped SnO₂ nanoparticles

Kirti Sankhala*, Rishi Vyas, S. K. Sharma

Department of Physics, Malaviya National Institute of Technology, Jaipur-302017, INDIA

*Email: 30sankhalakirti@gmail.com

This research, have done synthesis of Cobalt doped SnO₂ nanoparticles by solid state reaction method using SnCl₄.6H₂O, CoCl₂.6H₂O and NaOH. The samples have been studied after annealing in air at temperature 600⁰C for 4 hours and characterized by XRD, SEM, EDAX, TEM, EDS and UV-VIS spectroscopy. The average particle size of sample calculated from XRD data is 52.7nm. The grain size is observed to increase with Co doping. TEM images have shown that for the sample with 10% impurity, the grain size is obtained in 7 to 23 nm range with lattice parameter 0.13nm. Absorbance spectra show that bandgap energy decreases with the Co doping. The effect of Co doping on the optical, structural and morphological properties of the samples are studied and discussed comparative to pure SnO₂. These properties in Tin dioxide (SnO₂) material can be utilized as gas sensing materials.

References:

1. K. Ihokura and J. Watson, "The Stannic Oxide Gas Sensor Principles and Applications." CRC Press, Boca Raton, FL, 1994.
2. D. Lindackers, C. Janzen, B. Rellinghaus, E. F. Wassermann, and P. Roth, Nanostruct. Mater. 10, 1247 (1998).

3. A. Cabot, J. Arbiol, J. R. Morante, U. Weimar, N. Barsan, and W. Gopel, *Sens. Actuators B* 70, 87 (2000).

■ ID-231

Synthesis of Polyaniline-MgO Nanocomposite by In-situ Chemical Oxidative Polymerization

Ashutosh Shrivastava^{1*}, Kashyap Dave¹, Rajveer Singh Rajaura¹, S. Shrivastava², M. Singh², Y.K.Vijay²

¹Centre for Converging Technologies, University of Rajasthan, Jaipur (Raj.) 302004, INDIA

²Department of Physics, Thin film & Membrane Science Lab, University of Rajasthan, Jaipur (Raj.) 302004, INDIA

*Email: ashutosh.dlp@gmail.com

In this work, Polyaniline-MgO Nano composite was synthesized. In which first MgO was synthesized by wet chemical Reduction method and then by in situ chemical oxidative polymerization of aniline at ambient condition, Polyaniline-MgO Nano composite was synthesized. The characterization studies of the product was done by Scanning Electron Microscopy (SEM), Fourier Transform Infra red spectroscopy (FTIR) and UV-Vis spectroscopy. SEM image shows that the MgO nanoparticles were uniformly spread throughout the polymer matrix of polyaniline and confirm the formation of Polyaniline-MgO Nano composite. The optical behavior of Polyaniline-MgO Nano composite was investigated by UV-Vis Spectroscopy.

References:

1. S Sarmah and A kumar. *Indian J. Phys.*, Vol. 85, No. 5, pp. 713-726, May, 2011.
2. Ganesh R. Yerawar, *Der Pharma Chemica*, 2012, 4 (3):1288-1291.

■ ID-232

Structural and Thermal Characterization of Sol-Gel Derived Nanodimensional Zirconium Silicates

Surbhi, Saruchi, Sushil Kumar*

Materials Science Lab, Department of Physics, Chaudhary Devi Lal University, Sirsa 125055, INDIA

*Email: sushil_phys@rediffmail.com

Sol-gel derived nanodimensional powders of zirconium silicates were prepared at room temperature by hydrolysis followed by polycondensation using Zirconium propoxide and TEOS as starting precursors.

As-prepared samples were annealed at 650, 875 and 1100°C for 4 h. Structural parameters of annealed powdered samples were determined by X-ray diffraction. The crystallite size was calculated using Debye-Scherrer formula as well as Williamson-Hall relation and then compared. Other structural parameters such as lattice constants, micro-strain, dislocation density etc. were also estimated from W-H plot.

The FTIR spectra elucidate the bonding pattern of the constituent atoms and groups such as Zr, Si, O and OH which throw light on the expected structure. The thermal analysis suggested that the decomposition of intermediate compounds occurred in different stages; and hydroxyl groups as well as residual organic impurities

were removed successively and hence the prepared glasses became more and more dense.

References:

1. B. Jongsomjit, S. Kittiruangrayub and P. Praserttham, *Mat. Chem. Phys.*, 105, 14, (2007).
2. D. H. Aguilar, L. C. Torres-Gonzalez, L. M. Torres-Gonzalez, T. Lopez and P. Quintana, *J. Solid State Chem.*, 158, 349, (2000).

■ ID-233

An Innovative Approach for Synthesis of Zero Valent Iron Nanoparticles and Its Antimicrobial Activity Against *Serratia marcescens*

Ashutosh Shrivastava^{1*}, Arpita Sundaria¹, Kailash Agrawal^{1,2}

¹Centre for Converging Technologies, University of Rajasthan, Jaipur (Raj.) 302004, INDIA

²Department of Botany, University of Rajasthan, Jaipur (Raj.) 302004, INDIA

*Email: ashutosh.dlp@gmail.com

In the present work, synthesis of zero valent Iron nanoparticles was done using biopolymer agarose and was compared with ZVI nanoparticles synthesized by wet chemical reduction method. These resulting ZVI nanoparticles were characterized by Scanning Electron Microscopy, UV-Vis Spectroscopy and Photo Luminescence. The SEM images show evenly distributed almost spherical shaped Nps, the energy band gap of the nanoparticles synthesized by both methods were studied by UV-Vis spectra and the PL spectra provides the information about the population of energy states involved in transition. Antibacterial activity on *Serratia marcescens* (pathogenic bacteria) were also investigated for these NPs by disc diffusion method. The ZVI exhibited stronger antibacterial activity as the inhibition shown to the growth of bacteria by these nanoparticles.

References:

1. Yuan-Pang Sun, Xiao-Qin Li, Wei-Xian Zhang, H. Paul Wang, *Colloids and Surfaces A: sicochem. Eng. Aspects* 308 (2007) 6066.
2. C. Jiao, Y. Cheng, W. Fan, J. Li., *International Journal of Environmental Science and Technology*, DOI: 10.1007/s13762-014-0524-0.

■ ID-234

Development of Bioactive 3D Scaffold with Nano/Micro Hierarchy for Bone Tissue Engineering through Combinatorial Approach

Prabhash Dadhich^{1*}, Bodhisatwa Das¹, Pavan Kr. Srivas¹, Pallabi Pal¹, Joy Dutta¹, Sabyasachi Ray², Santanu Dhara¹

¹Biomaterial and Tissue Engineering Laboratory, School of Medical Science and Technology, Indian Institute of Technology Kharagpur, Kharagpur, INDIA

²Midnapore Medical College and Hospital, Midnapore, INDIA

*Email: prabhashd11@gmail.com

In spite of astounding fabrication techniques and bioreactor based expansion procedures, musculoskeletal scaffold

based bone regeneration strategy is limited due to inferior macro-structural properties and inadequate mass transport. Where cells failed to migrate inside the scaffolds due to poor oxygen and nutrient supply in the body during clinical transplantation. To address such challenges combination of natural origin biomaterials in combinatorial fabrication approach has been used to develop osteointegrative scaffolds. In this study, we propose to develop a bioactive anisotropic scaffold by designing aligned nanofiber sheet through electrospinning of functionalized biopolymers (FBP) and subsequent multi-scalar 3D scaffold formation via micro-fabrication strategy with help of calcium phosphate (CP).

Natural origin resorbable FBP fabricated into aligned nanofibers sheet via electrospinning. Towards mimicking the natural bone hierarchy, CP randomly infiltrated in between the FBP nanofibrous sheet through fused deposition technique. This infiltrated CP act as spacer provide mechanical strength and osteoinduction property. The spacer concentration and composition depends of type of bone implant. The gap between to nanofibrous sheet and thickness of layer associated to physico-mechanical strength of targeted tissue.

Natural sources were successfully used for synthesis of multiphasic highly interconnected multi-scalar porous, aligned nanofibrous FBP scaffold. Highly porous interconnected nano-micro architecture provide high mechanical support and interphase for bone tissue growth. Intermingled and integument CP enhance cell attachment and act as nucleation site during osteogenesis. Not only combination of two different phases, but also their organization can also be varied with analogues to the bone in terms of nano-micro organization and mechanical properties. Preliminary cytotoxicity assay, hemocompatibility assay shown promising results. Mesenchymal stem cells survival percentage, growth rates and differentiation has been found enhanced with scaffolds. During ectopic site implantation, hybrid composite scaffold displayed increased RNA expression of collagen I and osteocalcin.

References:

1. US Patent 8652215 B2, Nanofilament Scaffold for Tissue Regeneration. Feb. 2014.
2. US Patent 0154063 A1, Nanofiber Construct and Method of Preparing Thereof. Jul. 2006.
3. Place, E. S., Evans, N. D., & Stevens, M. M. (2009). Complexity in biomaterials for tissue engineering. *Nature Materials*, 8(6), 45770. doi:10.1038/nmat2441.
4. Bose, S., Roy, M., & Bandyopadhyay, A. (2012). Recent advances in bone tissue engineering scaffolds. *Trends in Biotechnology*, 30(10), 54654

■ ID-236

Synthesis of Star Shaped Cu doped CdS Nanoparticles and its Antibacterial Effect

Sundaria Arpita^{1*}, Shrivastav Ashutosh¹, Vijay Bhavisha¹, Goyal Sumvit¹, Soni Ritesh¹, Meshugga Ronin¹, Agarwal.K²

¹Centre For Converging Technologies, University of Rajasthan, Jaipur, INDIA

²Department of Botany, University of Rajasthan, Jaipur, INDIA

*Email:

Cadmium sulfide nanoparticles and its dopants were widely studied for their antibacterial property. Copper doped star shaped nanoparticles were synthesized by wet chemical method at low temperature. The shape and size were detected by the SEM characterization. The doping was confirmed by the band shift in graph of UV-Vis spectrophotometry. A comparative study of antibacterial effect among Cadmium sulfide, copper doped cadmium sulfide and star shaped copper doped cadmium sulfide was performed on *Serratia marcescens*. Star shaped copper doped showed higher antibacterial effect while Cadmium sulfide and Copper doped CdS had given almost same antibacterial effect. The antibacterial effect was also studied on ampicillin and streptomycin resistant strain of *Staphylococcus*. In this also star shaped nanoparticles had shown highest inhibition zone of 18 mm.

References:

1. N. Shashidhar Reddy, B. S. Shankara, Murali Krishna, C. Basavaraj, B. Mahesh. Synthesis, Characterization and Antibacterial Activities of Co(II), Ni(II), Cu(II), Zn(II), Cd(II) and Hg(II) complexes of Schiff's Base Type Ligands Containing Benzofuran Moiety. *International Journal of Inorganic Chemistry*, 2013, 10.1155/2013/61428.
2. Jing, Zhihong Tan, Lihua Li, Fen Wang, Jun Fu, Yucai Qian, Li. Photocatalytic and Antibacterial activities of Cadmium sulfide Nanoparticles prepared by solvothermal method. *Indian Journal of Chemistry*, 2013, Vol.52A(01).

■ ID-238

The Structure and Self-Assembly of Amyloid Fibrils

Cait E. MacPhee*

School of Physics and Astronomy, The University of Edinburgh, The Kings Buildings, Mayfield Road, EH9 3JZ, UK

*Email: cait.macphee@ed.ac.uk

Amyloid fibrils are ordered aggregates of misfolded protein. These fibrils are of great interest because of their role in degenerative diseases including Alzheimer's and Type-2 diabetes. Their physical properties also make them potentially useful in the development of novel materials.

I will describe a simple model that describes protein and peptide self-assembly. Fragmentation-dominated models for the self-assembly of amyloid fibrils have had important successes in explaining the kinetics of amyloid fibril formation but predict fibril length distributions that do not match experimental observations. We have resolved this inconsistency using a combination of experimental kinetic measurements and computer simulations. I will provide evidence for a structural transition which occurs at a critical fibril mass concentration, or CFC, above which fragmentation of the fibrils is suppressed. Our simulations predict the formation of distinct fibril length distributions for protein concentrations above and below a critical threshold, which we have confirmed by electron microscopy.

Our results point to a new picture of amyloid fibril growth in which structural transitions that occur during self-assembly have strong effects on the final population of aggregate species with small, and potentially cytotoxic, oligomers dominating for long periods of time at protein concentrations below the critical threshold, but not for protein concentrations above the threshold. We further

show that the CFC can be modulated by environmental conditions, pointing to possible strategies for controlling cytotoxicity in vivo or controlling length distributions in vitro.

References:

1. R Morris, K Eden, R Yarwood, L Jourdain, RJ Allen and CE MacPhee (2013) Mechanistic and environmental control of the prevalence and lifetime of amyloid oligomers. *Nature Comm* 4: art. 1891 doi:10.1038/ncomms2909.

■ ID-239

Interfacial Self-assembly of the Bacterial Hydrophobin BslA

Cait E. MacPhee^{1*}, Keith M. Bromley¹, Ryan J. Morris¹, Giovanni B. Brandani¹, Matthew McCluskey¹, Laura Hogley², Nicola R. Stanley-Wall²

¹*School of Physics and Astronomy, The University of Edinburgh, The Kings Buildings, Mayfield Road, EH9 3JZ, UK*

²*College of Life Sciences, University of Dundee, Dundee, DD1 5EH*

*Email: cait.macphee@ed.ac.uk

The Gram-positive soil bacterium, *Bacillus subtilis*, can assemble to form a biofilm, a community of bacteria supported and protected by a self-produced extracellular matrix. Biofilms created by *B. subtilis* are remarkably hydrophobic, a property that arises from the surface active protein biofilm-surface layer protein A or BslA. The high interfacial activity and hydrophobic properties of BslA are due to its unusual amphiphilic structure, which we have recently elucidated by X-ray crystallography. BslA in its purified form also forms stable, viscoelastic films at air- and oil-water interfaces, and has been likened to the fungal hydrophobins. I will describe the novel mechanism of self-assembly of BslA, present the physical properties of the interfacial films, and describe possible applications of the protein.

References:

1. L Hogley, A Ostrowski, FV Rao, Bromley KM, Porter M, Prescott AR, MacPhee CE, Van Aalten, DMF, Stanley-Wall, NR (2013) BslA is a self-assembling bacterial hydrophobin that coats the *Bacillus subtilis* biofilm. *Proc Natl Acad Sci USA* 110: 13600-13605.

■ ID-240

Study of Magneto-resistive Behaviour of Praseodymium Substituted Perovskites $\text{LaMn}_{0.8}\text{Co}_{0.2}\text{O}_3$

B.L.Choudhary^{1*}, Anjali Krishnamurthy², Bipin K. Srivastava²

¹*U.S.I.C, University of Rajasthan, Jaipur 302004, INDIA*

²*Retired from Department of Physics, University of Rajasthan Jaipur 302004, INDIA*

*Email: blcphysics@gmail.com

LaMnO_3 is orthorhombic structure but if we substitute the Mn by Co then the structure change into rhombohedral (hexagonal) and reported that Co 20% gives the maximum ferromagnetism in LaMnO_3 structure. So we

substitute the 20% Co and then after we substitute La site by Pr. Pr substituted samples exhibit electrically insulating character and show large magnetoresistance (MR). Variation of MR with H shows very interesting results including hysteresis in MR H, switchover from ive MR to +ive and vice-versa and sudden drop in the value. These observations are indicative of realignment of magnetic moments at different fields and the phenomena of pinning and unpinning of the moments.

■ ID-242

Multifunctional Bio-Composites for Lightweight Structure: High Performance Materials and Health Monitoring with Conductive Nanocomposites

Kumud Malika Tripathi*, Suvam Nag Chowdhury, Mickael Castro, Alain Bourmaud, Antoine Le Duigou, Jean-Francois Feller

Smart Plastics Group, European University of Brittany (UEB), LIMATB-UBS, Lorient, FRANCE

*Email: kumud20010@gmail.com

Polymer composites materials of carbon nanotubes have a wide variety of applications in diverse field of science and technology. Unidirectional flax fibres reinforced polymer composites are used as high performance materials due to their high mechanical properties and lower density compared to glass fibres. Mechanical properties of these bio-composites are primarily influenced by the interfacial properties and distribution of fibres inside the matrix. Damage mechanism of plant fibre composites are complex and include matrix crack, fibre/matrix interface debonding, fibre/fibre interface failure (inside bundle of fibres), fibres cell-wall peeling and fibre failure. Therefore, the motoring of the damage in such structures can be of immense interest to anticipate any failure of parts and eventually trigger maintenance operations if necessary. Recently quantum resistive sensors (QRS) made of conductive polymer nanocomposites (CPC) have proved to be very promising for the monitoring of composites mechanical properties such as deformation and damage. Actually, the great sensitivity of these smart materials to their environment is based on their percolated architecture that can transduce any tiny change of internanofiller gap into large resistance variation. There are different strategies to achieve composites health monitoring with CPC sensors. Among all processing techniques to fabricate QRS with reliable and reproducible properties, the spray LbL process was found to be the most versatile to tailor sensing properties. QRS are also expected to help understanding the complex failure mechanisms in composites.

Herein we explore the development of a novel smart bio-composite with piezo-resistive capabilities to detect deformations and damage, with the implementation of CPC sensors of $\sim 0.5 - 2\mu\text{m}$ thick, on the surface or in the core of flax fibre-PLA composites. Conductive biopolymer nanocomposites have been fabricated by dispersing multi-wall carbon nanotubes (MWCNT) in biopolymer, (poly lactic acid) PLA via solution mixing to develop strain sensors for real time damage detection in advanced polymer-based composites. Conductive polymer

nanocomposite sensors were prepared by spray layer by layer (sLbL) technique and composites were prepared by vacuum stacking. Both mechanical and electrical responses of the smart bio-composite are recorded and analysed simultaneously for the better understanding of failure mechanisms and to sense the interface between flax fibre and polymer matrix.

References:

1. A. Le-Duigou, P. Davies and C. Baley, *J. Biobased. Mater. Bioenerg.*, 2011, 5:1.
2. C. Baley, A. Le Duigou, A. Bourmaud and P. Davies *Compos. A*, 2012, 43:1226.
3. K. J. Loh, T. C. Hou, J. P. Lynch and N. A. Kotov, *J. Non Destr. Eval.* 2009, 28:9.
4. J. F. Feller, M. Castro and B. Kumar, Woodhead Publishing Ltd, Cambridge, UK, Chap. 2011, 25:848, ISBN 1845697618.
5. S. Chatterjee, M. Castro and J. F. Feller, *J. Mater. Chem. B Biol. Med.* 2013, 1:4563.

■ ID-244

Sonochemically prepared Lead Tungstate (PbWO_4) nanocrystals

S. Kannan¹, G. Sivakumar², S. Barathan², K. Mohanraj^{1*}

¹*Department of Physics, Manonmaniam Sundaranar University, Tirunelveli-12, Tamilnadu, INDIA*

²*Department of Physics, Annamalai University, Annamalai Nagar, Tamilnadu, INDIA*

*Email: kmohanraj.msu@gmail.com

Lead tungstate (PbWO_4) nanocrystals were synthesized by ultrasonication method with the assistance of polyvinyl alcohol (PVA). The formation of PbWO_4 was confirmed by X-ray diffraction (XRD) and Fourier transforms Infrared Spectroscopy (FTIR) studies. The influence of PVA on the shape, size and purity of PbWO_4 particles were analyzed by Field Emission Scanning Electron Microscope (FESEM) with Energy dispersive Spectroscopy (EDS) respectively. Thermal and luminescence properties were also studied using thermal analysis and Photoluminescence (PL) spectroscopy respectively. The experimental results are confirmed that the PVA assisted PbWO_4 particles behave better performance than without PVA.

■ ID-250

Carboxyl Group Functionalized CNT/ SPEEK Nanocomposite Membrane for Nanofiltration Application

Swati Gahlot¹, Prem P. Sharma¹, Vaibhav Kulshrestha^{1,2*}

¹*CSIR-Central Salt and Marine Chemicals Research Institute (CSIR-CSMCRI), Gijubhai Badheka Marg, Bhavnagar- 364 002, Gujarat, INDIA*

²*Academy of Scientific and Innovative Research, CSIR-CSMCRI, Gijubhai Badheka Marg, Bhavnagar- 364 002, Gujarat, INDIA*

*Email: vaibhavk@csmcri.org

The present study describes the synthesis, characterization and performance evaluation of carboxylic group

functionalized MWNT (c-MWNT)/ SPEEK (sulfonated poly ether ether ketone) composite membrane towards nanofiltration experiment. Carboxylation of MWNT was done to graft functional groups onto the walls and to purify MWNTs. Sulfonation of PEEK was achieved by the reaction with cons. H_2SO_4 at 60°C. The membranes were synthesized by dispersing various weight fraction of c-MWNT (0.1%, 0.2% and 0.5%) into SPEEK matrix. Surface morphology, roughness, thermal and mechanical strength of the prepared membranes was characterized by SEM, AFM, TGA, DSC and DMA analysis. SEM and AFM images showed the uniform dispersion c-MWNT in SPEEK matrix. DSC, TGA and DMA analysis showed the improvement in thermal and mechanical behavior of composite membrane with increasing c-MWNT content. The addition of c-MWNT enhanced the membrane flux and salt rejection in comparison to membranes without c-MWNT content which further increases with increasing c-MWNT concentration. This type of the membrane can be used for the removal of salt for industrial applications.

References:

1. H B Park, BD Freeman, ZB Zhang, M. Sankir, JE McGrath. *Angew. Chem., Int. Ed.* 2008, 47:6019.
2. AK Singh, S. Prakash, V. Kulshrestha, VK Shahi. Cross-linked Hybrid Nanofiltration membrane with Antibiofouling Properties and Self-Assembled Layered Morphology. *ACS Appl. Mater. Interfaces* 2012, 4:1683.

■ ID-251

Synthesis and Characterization of PVA/GO Nanocomposite Films

Swati Gahlot¹, Prem P. Sharma¹, Vaibhav Kulshrestha^{1,2*}

¹*CSIR-Central Salt and Marine Chemicals Research Institute (CSIR-CSMCRI), Bhavnagar- 364 002, Gujarat, INDIA*

²*Academy of Scientific and Innovative Research, CSIR-CSMCRI, Bhavnagar- 364 002, Gujarat, INDIA*

*Email: vaibhavk@csmcri.org

Nanocomposite films of PVA (polyvinyl alcohol) with GO (graphene oxide) as organic filler have been synthesized successfully. GO was prepared through modified Hummers method and confirmed by SEM and XRD. Nanocomposites were prepared containing various weight amount of GO (0.1, 0.2 and 0.5%) within PVA matrix. Membranes were casted on clean glass plate through solution casting method and dried followed by. Further the investigation of thermal and mechanical as well as physicochemical properties of nanocomposites are done using respective analysis techniques. Electronic conductivity of the prepared membranes was also measured. The value of electronic conductivity enhances as the GO content increases within polymer matrix. Thermal and mechanical analysis shows the enhanced values with increasing GO content.

References:

1. S Gahlot, PP Sharma, V. Kulshrestha, PK Jha. SGO/SPES-Based Highly Conducting Polymer Electrolyte Membranes for Fuel Cell Application. *ACS Appl. Mater. Interfaces* 2014, 6:5595.
2. BP Ladewig, RB Knott, AJ Hill, JD Riches, JW White, DJ Martin, JC Diniz da Costa, GQ Lu, Physical and Electrochemical Characterization of Nanocomposite Membranes of

Nafion and Functionalized Silicon Oxide. Chem. Mater. 2007, 19:2372.

■ ID-252

Synthesis and Characterization of $\text{Cu}_2\text{ZnSnS}_4$ (CZTS) Nanoparticle

Garima Agarwal^{1*}, Vaibhav Kulshrestha²

¹Department of Physics, MK Bhavnagar University, Bhavnagar- 364 002, (Gujarat), INDIA

²CSIR-Central Salt and Marine Chemicals Research Institute (CSIR-CSMCRI), Gijubhai Badheka Marg, Bhavnagar- 364 002, (Gujarat), INDIA

*Email: garima114@gmail.com

Copper rich CZTS nanocrystals were synthesised using the precursor $\text{CuCl}_2 \cdot 2(\text{H}_2\text{O})$, $\text{ZnCl}_2 \cdot 2(\text{H}_2\text{O})$, SnCl_4 and thioacetamide in oleylamine. The amount of copper in CZTS is varied from 1 to 4 times. The synthesised nano particles were characterized by the means of optical and structural properties. The TEM analysis shows the spherical nanoparticle of 10-30 nm in size. The nanoparticle can be used for the assembly of thin films for solar cell applications from nontoxic and earth-abundant materials forming hybrid pn-junctions.

References:

1. SK Saha, A. Guchhait, AJ Pal, $\text{Cu}_2\text{ZnSnS}_4$ (CZTS) nanoparticle based nontoxic and earth-abundant hybrid pn-junction solar cells, Phys. Chem. Chem. Phys., 2012, 14:8090
2. SC Riha, BA Parkinson, AL Prieto, Solution-Based Synthesis and Characterization of $\text{Cu}_2\text{ZnSnS}_4$ Nanocrystals, J. Am. Chem. Soc. 2009, 131:12054.

■ ID-253

Water Desalination Performance of Quaternized Polyethyleneimine and f-GO based Anion Exchange Membrane

Prem P. Sharma¹, Swati Gahlot¹, Hariom Gupta¹, Vaibhav Kulshrestha^{1,2*}

¹CSIR-Central Salt and Marine Chemicals Research Institute (CSIR-CSMCRI), Gijubhai Badheka Marg, Bhavnagar- 364 002, (Gujarat), INDIA

²Academy of Scientific and Innovative Research, CSIR-CSMCRI, Gijubhai Badheka Marg, Bhavnagar- 364 002, (Gujarat), INDIA

*Email: vaibhavk@csmcri.org

The preparation of anion exchange membrane for desalination Process by semi-interpenetrating polymer network method is very efficient now days. The overall study describes the performance and characterization of anion exchange membrane formed by Poly (vinyl alcohol) as polymer matrix and quaternized polyethyleneimine as a cationic polyelectrolyte, sulfonated graphene is used to improve the ionic conductivity and physic chemical stability. The quaternization of polyelectrolyte was done by using bromoethane. To attain a desirable property of polymer membrane APTS functionalized chemically converted GO (f-GO) sheets was added as a precursor to fabricate the organic and inorganic hybrid membranes with different composition as (1%,2% & 5%).The surface

morphology and roughness of polymer membrane was characterized by using Atomic Force Microscopy (AFM). Confirmation of silica within graphene sheets was confirmed by (Transmission Electron Microscopy) TEM & ^{29}Si NMR spectroscopy. Physicochemical characterization of the membranes was done by the means of ionic conductivity, IEC (ion exchange capacity), WU(water uptake) etc. The ionic conductivity of 5% f-GO membranes increases three times comparative to virgin membrane and reaches to $3.9 \times 10^{-3} \text{Scm}^{-1}$. 30 % of more water uptake is observed due to f-GO in to membrane it may be due to the hydrophilic nature of graphene as well as bound water uptake by quaternary ammonium groups present within the matrix. Thermal and mechanical properties were analyzed by TGA, DSC, DMA and UTM respectively. The endothermic peaks of DSC thermogram was found at 98°C , 107°C and 114°C as we increase the f-GO content respectively as (1%,2% and 5%). The composite membrane shows the better water desalination performance comparative to virgin one. Power consumption during water desalination decreases while current efficiency increases by incorporation of f-GO into polymer matrix.

References:

1. S Gahlot, PP Sharma, V. Kulshrestha, PK Jha. SGO/SPES-Based Highly Conducting Polymer Electrolyte Membranes for Fuel Cell Application. ACS Appl. Mater. Interfaces 2014, 6:5595.
2. S Gahlot, PP Sharma, V. Kulshrestha, PK Jha. Preparation of graphene oxide nano-composite ion exchange membranes for desalination application. RSC Advances. 2014, DOI: 10.1039/C4RA02216E.

■ ID-254

Synthesis, Characterization and Applications of Ion Exchange Membranes

Vaibhav Kulshrestha^{1,2*}

¹CSIR-Central Salt and Marine Chemicals Research Institute (CSIR-CSMCRI), Gijubhai Badheka Marg, Bhavnagar- 364 002, (Gujarat), INDIA

²Academy of Scientific and Innovative Research, CSIR-CSMCRI, Gijubhai Badheka Marg, Bhavnagar- 364 002, (Gujarat), INDIA

*Email: vaibhavk@csmcri.org

Membranes have become essential parts of the human life because of their growing industrial applications in hi-tech areas such as biotechnology, nano-technology and membrane based energy devices in addition to different membrane based separation and purification processes. Rapid growth of chemical technology in diversified areas fuels the demand for the need of reliable green technologies for the downstream processes, which include separation, purification and isolation of the molecules. Ion-exchange membrane technologies are non-hazardous in nature and being widely used not only for separation and purification but their application also extended towards recovery of value added products. Now there is a quite demand for the ion-exchange membrane with better selectivities, high chemical, mechanical and thermal stability as well as good durability. Here in we are preparing the polyethylene based interpolymer ion exchange membrane in lab scale

and their performance evaluation in water desalination by electrodialysis. Most of the commercial IEMs are prepared by solution casting method. Here in we are preparing the PE/PSt interpolymer cation exchange membrane (CEM) and PE/PMS based anion exchange membrane (AEM). PE is chosen as the based material due to its low cost and higher degree of inertness to chemicals. This type of membranes can be processed by melt extrusion process and therefore a large quantity can be prepared in short duration. The prepared membranes were not only be useful for water desalination as well as for industrial applications. Here we proposed to prepare environmental friendly method for the preparation of IEMs. The performances of the membranes for diluted sea water desalination have been demonstrated in ED unit of different stack size. The sea water desalination in multi stages will be evaluated in big ED unit (1800 cm² area). The application of prepared membranes in EDI for the production of ultrapure water and reverse electro-dialysis for the generation of energy will be tested.

References:

1. S. Gahlot, PP Sharma, V. Kulshrestha, PK Jha. Preparation of graphene oxide nano-composite ion exchange membranes for desalination application. RSC Advances. 2014, DOI: 10.1039/C4RA02216E.
2. T. Chakrabarty, AM Rajesh, A. Jasti, AK Thakur, AK Singh, S. Prakash, V. Kulshrestha, VK Shahi. Stable ion-exchange membranes for water desalination by electrodialysis, Desalination 2011 282: 2.

■ ID-255

Micro-Structural and Optical Characterization of Chemically Synthesized CdS Nanoparticles

Sushil Kumar^{1*}, M.A. Majeed Khan²

¹Materials Science Lab., Department of Physics, Chaudhary Devi Lal University, Sirsa-125055, INDIA

²King Abdullah Institute for Nanotechnology, King Saud University, Riyadh-11451, SAUDI ARABIA

*Email: sushil_phys@rediffmail.com

Cadmium sulphide (CdS) is a II–VI group semiconductor, and as such, its nanoparticles have generated great interests due to their unique size-dependent physical and chemical properties. CdS nanoparticles and their thin films with cubic phase were prepared using simple precursors by chemical route. The prepared nanoparticles were characterized for their structural, morphological and optical properties by X-ray diffraction, field emission transmission electron microscopy, UV-visible absorption spectroscopy and photoluminescence respectively. X-ray diffraction pattern reveals that the prepared CdS nanoparticles are highly pure and are crystalline in nature with cubic phase. Their sizes, estimated to be 3 nm, were in agreement with the values calculated by Bragg formula. Selected area electron diffraction also recognized the cubic structure of CdS nanoparticles. The UV-visible spectra exhibited a blue-shift with respect to that of bulk samples which is attributed to the quantum size effect. The band gap of CdS nanoparticles have been calculated from absorption data using Tauc plot and found to be 2.82 eV. Energy dispersive X-ray analysis reveals the presence of Cd and S in almost stoichiometric ratio in

the prepared CdS nanoparticles. The emission spectra of CdS nanocrystals shows peak centred at ~540 nm, which is attributed to the presence of cadmium vacancies in the lattice.

References:

1. T. R. Ravindran, A. K. Arora, B. Balamuruganm, B. R. Mehta. Inhomogeneous broadening in the photoluminescence spectrum of CdS nanoparticles, Nano-struct. Mater. 1999, 11:603.
2. X. Song, Y. S. Fu, Y. Xie, J. G. Song, H. L. Wang, J. Sun, X. W. Du. The effect of post annealing on the conversion efficiency of solar cells sensitized by CdS quantum dots, Semiconductor Science & Technology 2010, 25:045031.

■ ID-256

Multiferroic BiD_{0.7}Y_{0.3}FeO₃ thin films integrated with ZnO films: Characterization for potential applications

Deepak Bhatia¹, V.R. Palkar¹, R.S.Meena², Seeraj Nawa^{1*}

¹Centre for Nanoelectronics, Department of Electrical Engineering, Indian Institute of Technology Bombay, Mumbai 400076, INDIA

²Department of Electronics Engineering, Rajasthan Technical University, Kota 324010,INDIA

*Email: bhatia_deepak26@rediffmail.com

Multiferroics having coexistence of ferroelectric and ferromagnetic ordering in the same phase at certain temperature ranges have large potential for variety of device applications. Multiferroic Bi_{1-x}Dy_xFeO₃ (BDFO) shows the significant coupling and simultaneously ferroelectric and ferromagnetic ordering at room temperature.

Integration of BDFO films with ZnO piezoelectric can be used directly as electricity generator with increased output voltage.

ZnO thin films were deposited by dielectric sputtering using a ZnO target (99.9%) with a diameter of 2 inch and thickness 3mm. The Si substrate used was p-type conducting (.0001–0005Ωcm). The standard RCA (Radio Corporation of America) cleaning was performed on silicon wafers before loading them into dielectric sputter. In the deposition of ZnO thin films the RF power was 150W, the Base pressure was 5 × 10⁻⁵, Operating Pressure was 2.2 × 10⁻². The deposition rate was 15nm/min and gas used in the chamber was Ar.

BDFO thin films of 300 nm were deposited using PLD (Pulsed laser deposition) technique. Complex Pro 201, 248 KrF excimer laser from Coherent, was used for deposition of BDFO thin films: Laser density- 2J/cm², target to substrate distance 5 cm, substrate temperature- 650⁰C and O₂ Pressure- 4.5 × 10⁻⁴ mbar, Repetition Rate = 10 Hz, No. of Pulses - 22500. The deposition was performed for 35 minutes to obtain approximately a 300nm thickness film.

X-ray from Rigaku (Cu-K_α radiation, λ = 1.5405 Å) was used for structural phase identifications. The XRD pattern indicates that the BDFO film deposited on the ZnO films is a single phase and polycrystalline in nature. XRD pattern of ZnO thin film indicates that diffraction peak located around 34.4220 is very high and just the ZnO (002) diffraction peak. So the deposited ZnO thin film on the Si substrate has a high c-axis preferred

orientation, which is necessary to achieve a ZnO film with high piezoelectric quality. Scanning electron microscopy (SEM) was done using Raith150 to determine the grain morphology of BDFO and ZnO films. SEM is also used to find the uniformity and the thickness of BDFO films over ZnO films. SEM images reveal the BDFO coating with granular structure.

References:

1. TaO Xu, Guoying Wu, Guobing Zhang, Yilong HaO. The compatibility of ZnO film with micromachining process. *Sensor and Actuators A104* (2003) 61-67, Elsevier.
2. M.Mandal, Sriparna Chatterjee, V. palkar. Multifunctional behavior of ZnO supported $\text{Bi}_{1-x}\text{Dy}_x\text{FeO}_3$ nanorods. *Journal Applied Physics* 110 (2011).

■ ID-257

Rheological Signatures of Gelation and Effect of Shear Melting on Aging Colloidal Suspension

Shweta Jatav, Yogesh M Joshi*

Department of Chemical Engineering, Indian Institute of Technology, Kanpur 208016, INDIA

*Email: joshi@iitk.ac.in

Colloidal suspensions that are out of thermodynamic equilibrium undergo physical aging wherein their structure evolves to lower the free energy. In aqueous suspension of Laponite, physical aging accompanies increases of elastic and viscous moduli as a function of time. In this work we study temporal evolution of elastic and viscous moduli at different frequencies and observe that freshly prepared aqueous suspension of Laponite demonstrates identical rheological behavior reported for the crosslinking polymeric materials undergoing chemical gelation. Consequently at a certain time $\tan\delta$ is observed to be independent of frequency. However, for samples preserved under rest condition for longer duration before applying the shear melting, the liquid to solid transition subsequent to shear melting shows greater deviation from classical gelation. We also obtain continuous relaxation time spectra from the frequency dependence of elastic and viscous moduli. We observe that, with increase in the rest time, continuous relaxation time spectrum shows gradual variation from negative slope, describing dominance of fast relaxation modes to positive slope representing dominance of slow relaxation modes. We propose that the deviation from gelation behavior for the shear melted suspensions originates from inability of shear melting to completely break the percolated structure thereby creating unbroken aggregates. The volume fraction of such unbroken aggregates increases with the rest time. For small rest times presence of fewer number of unbroken aggregates cause deviation from the classical gelation. On the other hand, at high rest times presence of greater fraction of unbroken aggregates subsequent to shear melting demonstrate dynamic arrest leading to inversion of relaxation time spectra.

References:

1. Coussot, P., Rheophysics of pastes: A review of microscopic modelling approaches, *Soft Matter* 3, 528-540 (2007).
2. Joshi, Y. M., Dynamics of Colloidal Glasses and Gels, *Annual Review of Chemical and Biomolecular Engineering* 5, null (2014).

3. Ruzicka, B., and Zaccarelli, E., A fresh look at Laponite phase diagram, *Soft Matter* 7, 1268-1286 (2011).
4. Shahin, A., and Joshi, Y. M., Irreversible Aging Dynamics and Generic Phase Behavior of Aqueous Suspensions of Laponite, *Langmuir* 26, 42194225 (2010).
5. Tschoegl, N. W., *The Phenomenological Theory of Linear Viscoelastic Behavior* (Springer, Berlin, 1989).
6. Winter, H. H., Can the gel point of a cross-linking polymer be detected by the $G' = G''$ crossover, *Polymer Engineering & Science* 27, 1698-1702 (1987).
7. Winter, H. H., Glass Transition as the Rheological Inverse of Gelation, *Macromolecules* 46, 2425-2432 (2013).
8. Winter, H. H., and Chambon, F., Analysis of linear viscoelasticity of a crosslinking polymer at the gel point, *Journal of Rheology* 30, 367-382 (1986).

■ ID-258

Neutron Membrane Diffraction study of the solute profile of trehalose and sucrose between lamellar stacks of dioleoylphosphatidylcholine (DOPC)

Ben Kent¹, Tamim A. Darwish², Taavi E. Hunt³, Bruno Deme⁴, Thomas Haub¹, Christopher J. Garvey², G. Bryant^{3*}

¹*Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Berlin, GERMANY*

²*Australian Nuclear Science and Technology Organisation, Locked Bag 2001, Kirrawee DC, NSW 2232, AUSTRALIA.*

³*Australian Nuclear Science and Technology Organisation, Locked Bag 2001, Kirrawee DC, NSW 2232, AUSTRALIA.*

⁴*Institute Laue-Langevin, Grenoble, FRANCE.*

*Email: gary.bryant@rmit.edu.au

Sugars are widely known for their cryoprotective effects, and they accumulate naturally in species which can survive freezing and/or dehydration. Sugars are known to affect lipid membrane systems by raising lipid phase transition temperatures, thereby helping to avoid deleterious transitions to non-fluid bilayer phases. However, there is debate about the precise mechanism: one theory suggests that sugars hydrogen bond with the lipid headgroup, becoming partially incorporated into the bilayer and thereby preventing a reduction in area per lipid during the compressive stress experienced at low hydration; an alternative mechanism suggests that the osmotic and volumetric properties of the sugars prevent the close approach of bilayers, thus reducing the membrane stress.

The location of sugars in a stacked lipid bilayer system at reduced hydration resembling a biological system undergoing water stress is central to elucidating the mechanism of protection. Recently we demonstrated that neutron membrane diffraction on partially hydrated aligned stacks of dioleoylphosphatidylcholine provided information about the distribution of trehalose between bilayers[1]. In the present study we compare the location of sucrose and trehalose, two well-known cryoprotectant sugars, between bilayer stacks. Using partial deuteration of the sugars, we find that both sugar molecules follow distribution profiles centred in the middle of the water layer, regardless of the sugar concentration. This result demonstrates that the protective effects of the sugars must be due to mechanisms that do not rely on direct interactions between the sugars and lipid headgroups, and instead are due to the non-specific osmotic and volumetric effects of the sugars.

References:

1. B. Ken, T. Hunt, T. A. Darwish, T. Hau, C.J. Garvey, G. Bryant. Localisation of trehalose in partially hydrated DOPC bilayers - insight into cryoprotective mechanisms. *J. R. Soc. Interface* 2014, 20140069.

■ ID-259

Gelatin Organo-Nanocomposite Based Multianalyte Biosensor

Anshu Sharma^{1,2}, Kamla Rawat^{2*}, Pratima R. Solanki^{2*}, H. B. Bohidar^{1,2}

¹*Polymer and Biophysics Laboratory, School of Physical Sciences, Jawaharlal Nehru University, New Delhi 110067, INDIA*

²*Special Center for Nanosciences, Jawaharlal Nehru University, New Delhi 110067, INDIA*

*Email: pratimarsolanki@gmail.com,

We have systematically probed the gelation phenomenon of the well-dispersed porcine gelatin-based nanocomposites (GA-NC), which were prepared by adding laponite, nanoclay as fillers to glycerol solution. Structurally better and functionally advanced material, so produced, allowed us the possibility of formation of homogeneous thin gel films that had good thermo-mechanical property and transparency.

This gelatin organo nano composite (GA-NC) was deposited onto indium tin oxide (ITO) coated glass plates via drop casting method to produce sensor electrodes. The structural and morphological studies of these GA-NC/ITO electrodes were characterized by scanning electron microscopy (SEM), Fourier transform infrared (FTIR) spectroscopy and electrochemical techniques. The redox behaviour of GA-NC/ITO electrode towards ascorbic acid (AA), citric acid (CA), oxalic acid (OA), glucose (Glu), cholesterol (ChO) and Urea (U) have been investigated by cyclic voltammetry (CV). The electrochemical response of these electrodes was monitored with different metabolites in the concentration range of 1-20 mM. This electrode response shows a broad range of linearity and higher sensitivity. The excellent electrocatalytic behaviour of GA-NC/ITO electrode may find application towards the construction of strip based biosensors.

References:

1. A. Kaushik, R. Khan, P. Solanki et al. *Biosensor and Bioelectronics* 24 (2008)676-683.
2. K. Rawat, P. R. Solanki, K. Arora, H. B. Bohidar. *Appl. Biochem. Biotech.* 2014. doi.org/10.1007/s12010-014-0936-9.

■ ID-260

Dynamics in 1:1 Laponite-Montmorillonite Mixed Clay Dispersions

Nidhi Joshi¹, Kamla Rawat^{2*}, H. B. Bohidar^{1,2*}

¹*Polymer and Biophysics Laboratory, School of Physical Sciences, Jawaharlal Nehru University, New Delhi 110067, INDIA*

²*Special Center for Nanosciences, Jawaharlal Nehru University, New Delhi 110067, INDIA*

*Email: bohi0700@mail.jnu.ac.in

Soft nanomaterials have attracted significant attention because the combination of organic and inorganic components at nanoscale offer prospects of new and synergistic properties. We have investigated network rigidity, hydration and heterogeneity of 1:1 laponite montmorillonite (MMT) gels using dynamic light scattering, rheology and FT-Raman techniques. These soft gels were found to be homogeneous whereas those prepared with excess of MMT or laponite yielded non homogeneous gels. In order to describe universality to the observed kinetics, the relative viscosity η_r ($=\eta_s/\eta_0$, η_s and η_0 are viscosity of the dispersion and solvent respectively) and low frequency storage modulus G_0 were fitted to the following concentration dependent power-law growth function given as $\eta_r, G_0 \sim c\beta$. Frequency sweep measurement revealed that the dynamic mechanical behavior of the dispersion approximately obeyed liquid like behavior in the concentration range 0.8-1.0 % (w/v) and above these concentration all samples showed frequency independent G' behavior i.e. gel like behavior. The typical behavior of the intensity correlation function obtained from dynamic light scattering revealed slowing down of the relaxation times.

Dynamic structure factor exhibited two-mode relaxation where the stretching parameter decreased linearly with aging time whereas slow mode relaxation time increased exponentially and fast mode relaxation time remained invariant of ageing time. We have used this system for making electrochemical biosensors.

References:

1. B. Ruzicka, E. Zaccarelli. A fresh look at Laponite phase diagram. *Soft Matter* 2011, 7:1268.
2. R. K. Pujala, Nisha Pawar, H. B. Bohidar. *Universal Sol State Behavior and Gelation Kinetics in Mixed Clay Dispersions.* *Langmuir* 2011, 27:5193.

■ ID-261

Interplay of Gelation in Protein/polyampholyte Aqueous Solutions

Jyotsana Pathak¹, Kamla Rawat^{2*}, H. B. Bohidar^{1,2*}

¹*Polymer and Biophysics Laboratory, School of Physical Sciences, Jawaharlal Nehru University, New Delhi 110067, INDIA*

²*Special Center for Nanosciences, Jawaharlal Nehru University, New Delhi 110067, INDIA*

*Email: bohi0700@mail.jnu.ac.in

The interaction between protein bovine serum albumin (BSA) and gelatin B (GB) can result in the preparation of a 3 D-physical network having a wide range of industrial application, such as in food, personal care and biomedical fields. When a solution of interacting biomolecules (BSA/GB), is prepared below the gelation temperature, the degree of physical entanglement is found to be considerably dependent on the mixing ratio of the two constituents. This interaction between BSA and GB was studied at fixed BSA (1.0% w/v) and varying GB concentration (0.5-3.5% w/v) at near their common pI (5 ± 0.2) with no salt. The interaction profile revealed two distinct regimes (i) $0.25 < C_{GB} < 1.00\%$ which results in the formation of a dense condensate,

and (ii) $1.0\% < \text{CGB} < 3.5\%$ which produced a network gel. The zeta potential profile showed how the surface charge changed with different mixing ratio in these two regimes. Melting properties and homogeneity in the systems in regime (ii) was investigated by rheology. A heat-induced phase diagram of first order transitions was observed in these gel samples. The aim is to investigate the surface charges and thermal behaviour of different protein /polyampholyte ratios. The aim is to investigate the interaction between protein /polyampholyte near their common pI. It also deals with the modulation of surface charges and thermal behaviour by controlling the different protein /polyampholyte mixing ratio.

References:

1. M. Antonov, M. Mazzawi, and P. L. Dubin, *Biomacromolecule*, 2010, 11, 51-9.
2. D. R. Caffrey, S. Somaroo, and J. D. Hughes, *Protein Sci*, 2004, 13, 190-202.

■ ID-263

Bioionogels of Gelatin and Agar as Functional Soft Materials

Kamla Rawat^{1*}, P. R. Solanki¹, H. B. Bohidar^{1,2*}

¹*Special Center for Nanosciences, Jawaharlal Nehru University, New Delhi 110067, INDIA*

²*Polymer and Biophysics Laboratory, School of Physical Sciences, Jawaharlal Nehru University, New Delhi 110067, INDIA*

*Email: bohi0700@mail.jnu.ac.in

The interpenetration of continuous 3-D networks of a biopolymer and ionic liquid results into bioionogels. Ionogels are famous due to their easy and cheap preparation method, and their non-trivial thermo-mechanical character. We present a comparative and systematic investigation of the effect of solvent hydrophobicity (alkyl chain length) on the gelation kinetics and the phase states of a polypeptide (gelatin) and a carbohydrate (agar) in imidazolium based ionic liquid (IL) solutions. IL molecules created bilayers around the polymer chains, and free IL molecules assembled as micelles inside the gel core. At concentration close to gelation, power-law exponents were evaluated and gelation mechanism could be described through anomalous percolation model to a good accuracy. Rheology data revealed a gradual softening of these gels on increasing the IL concentration and/or its alkyl chain length both of which caused the hydrophobic volume fraction to rise. As the IL concentration was increased, the corresponding ionogels so formed were softer and showed yield stress behavior.

In summary, it was concluded that the physical properties of these ionogels can be tailored in IL solutions to suit application requirements. These exfoliated bio-compatible, biodegradable matrices offered cost effective electrode surface design possibility with easy renewal of the active area. These ionogels were fabricated into bioelectrodes to develop sensors for detection of analytes. These electrodes were used for selective sensing of specific analytes. A comprehensive and systematic study of the same leading to the aforesaid aim will be presented. These concepts could be applied in the near

future towards designing of array of functional soft materials with appropriate characteristics for customized use.

References:

1. K. Rawat, J. Pathak and H. B. Bohidar. Effect of Hydrophobicity on Gelation Kinetics and Phase Diagram of Gelatin Ionogels. *Soft Matter*, 2014, 10:862-872.
2. K. Rawat, P. R. Solanki, K. Arora and H. B. Bohidar. Response of Gelatin Modified Electrode towards Sensing of Different Metabolites. *Appl Biochem Biotechnol*. DOI 10.1007/s12010-014-0936-9.

■ ID-266

Synthesis, Structure and Antibacterial Activity of 7-Fluoro-2-oxo-2Hchromene- 3-carboxylic acid ethyl ester

Latha Rani N.^{1*}, Prashanth T.², Sridhar M.A.¹, Lakshmi Ranganatha V.², Lokanath N.K.²

¹*Department of Studies in Physics, University of Mysore, Mysore 570 006, INDIA*

²*UG and PG Department of Chemistry, Yuvaraja's College, University of Mysore, Mysore 570005, INDIA*

*Email: lathascxrd@gmail.com

The title compound was synthesized by reacting 2-hydroxy-4-methoxy-benzaldehyde with diethyl malonate in the presence of catalyst piperidine. The compound was characterized by elemental analysis, FT-IR, ¹H-NMR, ¹³C-NMR. The structure was confirmed by single crystal X-ray diffraction technique. The compound crystallizes in monoclinic crystal system, P₂₁/n space group, $a = 7.8824(7)\text{\AA}$, $b = 13.5854(10)\text{\AA}$, $c = 20.6072(16)\text{\AA}$, $\beta = 98.786(3)^\circ$ unit cell parameters, and $Z = 8$. The benzene and pyrone rings are sp² hybridized and are in planar conformations. The crystal structure of the compound was stabilized by the intra and intermolecular interactions of the type C–H...O. This newly synthesized compound was screened for its antibacterial activity against three Gram-negative bacteria namely *Pseudomonas aeruginosa*, *E. coli*, *Salmonella typhimurium*. Two Gram-positive bacteria namely *Bacillus subtilis* and *Staphylococcus aureus*.

■ ID-267

Nonequilibrium Fluctuations in a Sheared Model-fluid

Pritha Dolai*, Aditi Simha

Department of Physics, Indian Institute of Technology Madras, Chennai 600036, INDIA

*Email: pritha@physics.iitm.ac.in

The fluctuation theorem (FT) which places conditions on the entropy production of nonequilibrium systems applies to systems driven arbitrarily far from equilibrium. Fluctuation theorem derived by Evans et al.[1-2] was motivated by their simulation results on sheared hard disks in two dimensions. It was proved for thermostated Hamiltonian systems driven by external forces[3-4]. For finite systems undergoing Langevin dynamics, a fluctuation theorem (of the Gallavotti-Cohen type) was derived by Kurchan for average power flux of the system[5]. It was proved that the

average power flux W_τ (averaged over duration τ) obeys the fluctuation relation $\lim_{\tau \rightarrow \infty} \frac{1}{\tau} \ln \frac{P(+W_\tau)}{P(-W_\tau)} = \beta W_\tau$ in the steady state.

We study fluctuations in the driven steady state of a many particle stochastic system that mimicks a fluid under shear at constant strain rate. Our model system consists of a one dimensional lattice of rotors, which rotate in a plane perpendicular to the lattice and have no translational freedom in the direction of the lattice. Each rotor interacts with its nearest neighbours via torsional forces. The system is thermostated with a dissipative and random force (using Dissipative Particle Dynamics algorithm). The resulting steady state supports a velocity gradient in the system, similar to a fluid under shear. The model has a rich phase diagram exhibiting a variety of phases similar to those seen in complex fluids under shear. We validate the FT in these phases. The FT allows us to define an effective temperature. We find its dependence on the imposed strain rate and the noise strength, and its relation to the systems phase behaviour is analysed. We also analyse fluctuations in the local strain rate $\dot{\gamma}_\tau$ (averaged over duration τ) in particular large deviations from mean value (which is the imposed strain rate $\dot{\gamma}$). The large deviation function (LDF) is defined as $F(\dot{\gamma}_\tau) \equiv \lim_{\tau \rightarrow \infty} -\frac{1}{\tau} \ln P(\dot{\gamma}_\tau)$, where $P(\dot{\gamma}_\tau)$ is the probability distribution of local strain rate $\dot{\gamma}$. The antisymmetric part of the LDF of local strain rate obeys the fluctuation relation i.e. $F(\dot{\gamma}_\tau) - F(-\dot{\gamma}_\tau) \propto \dot{\gamma}_\tau$. The LDF shows a kink near zero strain rate for points at the boundary of two phases.

References:

1. D. J. Evans and D. J. Searles, Phys. Rev. E 50, 1645 (1994).
2. D. J. Evans and E. G. D. Cohen, and G. P. Morriss, Phys. Rev. Lett. 71, 2401 (1993).
3. G. Gallavotti and E. D. G. Cohen, Phys. Rev. Lett. 74, 2694 (1995).
4. G. Gallavotti and E. D. G. Cohen, J. Stat. Phys. 80, 931 (1995).
5. J. Kurchan et al, J. Phys. A: Math. Gen. 31(1998) 3719-3729.

■ ID-268

Structural and Thermal Study of TiO₂ Embedded PC/PS Polymer Blend Nanocomposites

Shalini Agarwal^{1*}, Y.K. Saraswat², Vibhav K. Saraswat¹

¹Department of Physics, Banasthali University, Banasthali, Tonk, 304022, INDIA

²Department of Chemistry, SV College, Aligarh, UP, INDIA

*Email: shaliniagarwal48@gmail.com

Nanocomposites derived from organic polymers and inorganic nanoparticles have been expected to display synergistically improved properties. Present study deals with the polycarbonate (PC)/poly styrene (PS)-TiO₂ blend nanocomposites filled with different concentration of chemically synthesized TiO₂ nanoparticles (1,2,3 wt%), using solution casting method. The XRD and TEM study of nano TiO₂ reveals that the average particles size is 19 nm. The effect of filler content on PC blends have been investigated by means of Fourier transform infrared (FT-IR), X-ray diffraction (XRD) and Differential Scanning Calorimetry (DSC). The XRD scan and

FTIR spectrum confirm the formation of PC/PS-TiO₂ nanocomposites. The DSC thermograms indicate that the thermal stability of nanocomposites enhanced with addition of filler content.

■ ID-269

Interaction of Graphene with Self Assembled Monolayers

Devanarayanan.V.P, V. Manjuladevi, R.K.Gupta*

Department of physics, Birla Institute of Technology and Science, Pilani Pilani-333031,Rajasthan, INDIA

*Email: raj@pilani.bits-pilani.ac.in

The adsorption of graphene onto solid surface is vital for numerous device applications. In the present work we aim to control the deposition of graphene onto surfaces by altering the nature of the surfaces. We have formed the self assembled monolayer (SAM) of octadecanethiol (ODT), mercapto undecanoic acid (MUA), and biphenyl dithiol (BPD) onto the gold deposited substrates. The nature of the surfaces obtained for ODT and MUA were hydrophobic and hydrophilic, respectively. The SAM of BPD yields the surface with phenyl rings having delocalized π -electrons. Such surfaces were employed to study the adsorption of graphene from solution. The morphology of the aggregates were studied using atomic force microscope. We found a significant effect of graphene-SAM interaction on the morphology of such depositions.

References:

1. Nan-Fu Chiu, Teng-Yi Huang. Sensitivity and kinetic analysis of graphene oxide -based surface plasmon resonance biosensors. Sensors and Actuators B:Chemical 2014, 197:35.
2. Jia Zhang, Xiaoqiang Cui. Surface Plasmon resonance technique for directly probing the interaction of DNA and graphene oxide and ultra-sensitive biosensing. Biosensors and Bioelectronics 2014,58:374.

■ ID-270

Structural, Optical and Magnetic behaviour of α -Cu₂V₂O₇

Hemant K. Arvind¹, Sangeeta Kalal², P. B. Punjabi², B. L. Choudhary³, S. N. Dolia³, Sudhish Kumar^{1*}

¹Department of Physics, M. L. Sukhadia University, Udaipur-313002, INDIA

²Department of Chemistry, M. L. Sukhadia University, Udaipur-313002, INDIA

³Department of Physics, University of Rajasthan, Jaipur 302 004, INDIA

*Email: sudhish_k@yahoo.com

In recent years, low-dimensional spin systems with a general formula of $M_2X_2O_7$ (M: Cu, Co, Ni, Fe, Mn; X: P, As, V) have attracted considerable attention due to their rich structural features, catalytic, optical and complex magnetic properties[1]. Among these compounds special attention have been focused on the copper and vanadium based oxides containing magnetic Cu^{2+} ($3d_9$, $S=1/2$) ions and nonmagnetic tetrahedral OV_4 ($3d_0$, $S=0$). The compound $Cu_2V_2O_7$ adopts two common phases. The high

temperature phase β - $\text{Cu}_2\text{V}_2\text{O}_7$ crystallizes in monoclinic structure and show antiferromagnetic behaviour. On the other hand the low temperature phase α - $\text{Cu}_2\text{V}_2\text{O}_7$ crystallizes in orthorhombic symmetry and display ferromagnetic or canted antiferromagnetic states[2].

Inspired by the interesting work on low-dimensional spin systems, we have synthesized polycrystalline samples of α - $\text{Cu}_2\text{V}_2\text{O}_7$ using wet chemical route and characterized by FTIR, SEM and powder X-ray diffraction. In the synthesis, initially powdered sample of $\text{Cu}_3(\text{OH})_2\text{V}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$ was prepared using Copper-nitrate and ammonium-metavanadate solutions at 75°C with continuous stirring. The $\text{Cu}_3(\text{OH})_2\text{V}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$ powder was heated at 700°C for 5 hours for obtaining the desired α - $\text{Cu}_2\text{V}_2\text{O}_7$ phase. The room temperature X-ray diffraction pattern and data analysis confirmed that the synthesized α - $\text{Cu}_2\text{V}_2\text{O}_7$ crystallizes in a single phase orthorhombic structure and belongs to the Fdd2 space group. The obtained structural parameters are in very good agreement with the reported one. SEM micrographs show that the synthesized product α - $\text{Cu}_2\text{V}_2\text{O}_7$ is mostly in sphere like particles. The UV-Vis optical absorption spectrum display broad and swift absorption in the range of 200-300 nm and the estimated band gap is about 2.8 eV. The room temperature field dependent magnetization curve display ferromagnetic hysteresis loop and the obtained value of the saturation magnetization is 0.233 emu/g. Details of the synthesis route, characterization, UV-Vis absorption and magnetic measurements will be presented in the conference.

References:

1. M. Touaiher, K. Rissouli, K. Benkhrouja, M. Taibi, J. Aride, A. Boukhari, B. Heulin. Crystal structures and magnetic properties of $\text{M}_2\text{V}_2\text{O}_7$ (M = Co, Ni and Cu) compounds. *Materials Chemistry and Physics* 2004, 85: 4146.
2. L. A. Ponomarenko, A. N. Vasil'ev, E. V. Antipov, Yu. A. Velikodny. Magnetic properties of $\text{Cu}_2\text{V}_2\text{O}_7$. *Physica B* 2000, 284-288:1459-1460.

■ ID-271

Synthesis, Structural and optical Characterization of Cadmium Sulphide Nanoparticles

Mahendra Singh Yadav¹, A. K. Sinha², M. N. Singh², Anuj Upadhyay², B.N. Rajasekar³, T. K Sharma², V. K. Dixit², Anil Pathak^{1*}

¹Centre of Nanotechnology, RTU, Kota (Rajasthan)-324010, INDIA

²Raja Ramanna Centre for Advanced Technology, Indore (M.P.)-452013, INDIA

³Atomic and Molecular Physic Division, BARC, Mumbai-400085, INDIA

*Email: rtu.nano@gmail.com

CdS nanoparticles (NPs) of size between 4 nm and 10 nm were synthesized at various conditions by co-precipitation technique, by varying reaction temperature and reactant ratios. Williamson-Hall analysis on synchrotron XRD data was used to estimate strain and size of NPs. The sizes were further confirmed by Transmission Electron Microscopy. Optical spectroscopy (UV-VIS region) showed quantum confinement effect. The band gap of NPs were estimated to be between 2.8 and 3.5 eV; much larger

than the bulk band gap of 2.42 eV. Photoluminescence (PL) spectra showed main emission bands at 535 ± 5 nm (B1), 560 ± 10 nm (B2) and 625 ± 15 nm (B3). Bands B1/B2 are attributed to transitions from extended band to localised acceptor/donor levels due to the presence of Sulphur/Cadmium interstitials. Red emission (B3) is attributed to transition on trap states due to Sulphur vacancy. FTIR results show the presence of stretching band of CdS at 670 ± 10 cm^{-1} .

References:

1. Vineet Singh et al. Synthesis of CdS nanoparticles with enhanced optical properties. *Materials characterization* 62 (2011) 43-5.

■ ID-272

Characterization of Ionic Conduction in Poly(vinyl alcohol)montmorillonite Clay Nanocomposite Aqueous Colloidal Suspensions

Sonu Sankhla

Department of Physics, Poornima University, Jaipur 303905, INDIA

*Email: sonu.sankhla@gmail.com

Polymer-clay nanocomposites (PCNs) have been a subject of intense industrial and academic research recently, due to their remarkable improved mechanical, thermal, optical, chemical and electrical properties over pure polymers. The biodegradable colloidal suspensions of these PCNs have applications in paper coating, textile sizing, packing, pharmaceutical and separation membranes. This paper investigates the dielectric behaviour and alternating current (ac) electrical conductivity of Poly(vinyl alcohol) (PVA)montmorillonite clay (MMT) nanocomposites aqueous colloidal suspensions with varying clay concentration prepared in deionized water.

The alternating current electrical conductivity and impedance spectra of the PVAMMT clay materials were measured in the frequency range 20 Hz to 1 MHz at 27°C . It is found that the direct current electrical conductivity of the materials have anomalous behaviour and it increases a little with increase of clay concentration. The intercalation of PVA chain in the MMT clay galleries and the interactions between PVA and MMT clay were explored from the MMT clay concentration dependent dielectric behaviour in relation to their structural conformations.

References:

1. R. J. Sengwa, S. Choudhary, S. Sankhla. Dielectric spectroscopy of hydrophilic polymers montmorillonite clay nanocomposite aqueous colloidal suspension. *Colloids and Surfaces A: Physicochemical and Engineering Aspects* 2009, 336:79.
2. S. Pavlidou, C. D. Papaspyrides. A review on Polymer Layered silicate nanocomposites. *Progress in Polymer Science* 2008, 33:1119.

■ ID-273

Electro-Optic and Dielectric Studies on Quantum Dot Doped Nematic Liquid Crystal

Jitendra Kumar¹, R K Gupta¹, Sandeep Kumar², V. Manjuladevi^{1*}

¹*Birla Institute of Technology & Science, Department of Physics, Pilani Campus, 333031, INDIA*

²*Raman Research Institute, Bangalore, INDIA*

*Email: manjula@pilani.bits-pilani.ac.in

Liquid crystals are shape anisotropic organic materials[1] which find many applications[2] in a wide variety of fields such as display technology, bioscience and surface science. On doping the liquid crystals with nanomaterials such as nanoparticles or carbon nanotubes the switching properties can be altered. In this report, the electro-optic and dielectric properties of cadmium selenide quantum dots (CdSe QDs) doped nematic liquid crystal(NLC) is presented. The nematic liquid crystal was doped with different concentrations of the semiconducting QDs. The nematic to isotropic (N-I)transition temperature for doped sample is comparable to that of pure NLC. The doped sample is found to have a lower threshold voltage than that of pure NLC. The value of threshold voltage decreases with increasing concentration of the QDs. The dielectric permittivity is estimated as a function of temperature in both planar and homeotropic geometry. Doping QDs led to increase in dielectric anisotropy in comparison with that of pure liquid crystal. The result showed that the incorporation of QDs into NLC provides a way to improve the performance of LC based devices.

References:

1. P.G. de Gennes, J. Prost *The Physics of Liquid Crystals* Clarendon Press, Oxford (1993).
2. J. W. Doane, *Liquid Crystals: Applications and Uses*; World Scientific: Singapore, 1990.
3. V. Manjuladevi, R. K. Gupta, and S. Kumar. Effect of functionalized carbon nanotube on electro-optic and dielectric properties of liquid crystal. *Mol. Liq.* 171, 60 (2012).

■ ID-274

Fabrication of Organic Schottky Diode using Langmuir-Blodgett Technique

Saloni Gupta, Rajiv K. Pandey, Apurv Saxena, C. Upadhyay, Rajiv Prakash*

School of Materials Science and Technology, Indian Institute of Technology (Banaras Hindu University), Varanasi-221005, INDIA

*Email: rprakash.mst@itbhu.ac.in

We report the fabrication and characterization of polyindole (PIn) Langmuir Blodgett (LB) films and their applications in electronic devices. Electrochemical method is used to obtain the PIn polymer and ordering of the polymer film is achieved by LB technique. Pressure (II) vs. area (A) isotherm in Langmuir trough is used to study the interaction between molecules over air-water interface. PIn LB films are obtained at 30mN/m controlled surface pressure by vertical lifting and dipping of substrates for UV-vis spectra, surface morphology and

electrical characterizations. The UV-vis spectra of PIn LB films show the 2.9 eV band gap of polymer. The morphology of the PIn LB films is studied using scanning electron microscopy and atomic force microscopy images. Further Schottky diodes are fabricated using the Pin LB films. A very smooth and uniform film is obtained using LB method onto the indium tin oxide (ITO) surface. Metalorganic junction largely depends on the surface morphology, which plays a crucial role in the fabrication of Schottky diodes. The current density-voltage characteristics of the Schottky diodes are subsequently used for extracting electronic parameters of the device such as the ideality factor, barrier height, reverse saturation current, etc. Further the dependency of IV characteristics with number of layers (thickness) s studied by forming various number of LB layers. Excellent rectifying behavior is observed with an ideality factor 4.7 in PIn LB films of 5 layers.

■ ID-275

Effect of Gamma Radiation on Chitin-Nanosilver Membranes

Rita Singh*, Durgeshwer Singh

Defence Laboratory, Defence Research and Development Organization, Jodhpur 342011,INDIA

*Email: singhritadr@yahoo.com

Antimicrobial wound dressings are indispensable for the effective healing of skin wounds such as burns and ulcers. Various synthetic and natural polymers with good biocompatibility have been used to develop wound dressings. Chitin possesses excellent properties that are advantageous for wound dressing namely biocompatibility, biodegradability and haemostatic activity. Chitin-nanosilver membranes were developed for use as an antimicrobial dressing for wound care. For clinical applications, the wound dressing should be assuredly free of microbial contamination. Gamma irradiation has well appreciated technological advantages and is the most suitable method for the sterilization of biomedical materials.

The present study was carried out to evaluate the effect of gamma radiation on the chemical and functional characteristics of the chitin-nanosilver membranes. The change in the chemical structure of chitin-nanosilver membrane on gamma irradiation at 25 kGy was evaluated by means of Raman Spectroscopy and UV-Vis Spectroscopy. The unirradiated and irradiated chitin-nanosilver membranes were examined by laser Raman spectroscopy using the 514.5 nm line of Ar⁺ laser as the exciting beam. Spectral scanning was carried out in the range of 500-3500 cm⁻¹. No change in the spectra of chitin-nanosilver membranes due to gamma radiation was observed. UV-Vis spectroscopy also showed no significant effect on the absorption peaks in the irradiated membrane as compared to the unirradiated chitin-nanosilver membranes. The in vitro degradation of chitin membranes was also evaluated. No significant difference was obtained in the biodegradability of the unirradiated and irradiated chitin-nanosilver membranes.

The effect of gamma radiation on microbicidal efficacy of the chitin-nanosilver membranes was tested using *Pseudomonas aeruginosa* and *Staphylococcus aureus*.

The results indicated antimicrobial efficacy of irradiated chitin-nanosilver membranes comparable to unirradiated membranes. Impermeability of the chitin-nanosilver membranes to different microorganisms was also not affected by gamma irradiation. The study has demonstrated that sterilization by gamma irradiation at doses of 25 kGy did not evoke undesirable changes in the structural and functional properties of the chitin-nanosilver membranes.

■ ID-276

Morphology and Hydrophobic Properties of Tantalum Nanocluster Films Grown by Plasma Gas-condensation Method

Vidyadhar Singh*, Cathal Cassidy, Panos Grammatikopoulos, Kengo Aranishi, Sushant Kumar, Murtaza Bohra, Jeong-Hwan Kim, Mukhles Sowwan

Nanoparticles Design by Unit, Okinawa Institute of Science and Technology (OIST) Graduate University, 1919-1 Tancha, Onna-son, 904-0495, Okinawa 302017, JAPAN

*Email: vidya.singh@oist.jp

Research into nanocluster film growth and characterization of their novel properties is a growing research field[1]. The properties of nanoclusters vary from the bulk material and are tunable by varying the nanocluster size[1]. The production of nanocluster films using the plasma gas-condensation technique is being considered nowadays as one of the most controlled methods for such films formation[1,2]. Control over deposition parameters like magnetron power, aggregation zone length and inert gas pressure, in combination with in-situ mass filtration, have allowed for the growth of size-selected nanoclusters with great accuracy[2]. Tantalum and tantalum oxide materials have been studied due to their prospective application in biomedical, optical, catalyst and electronic fields[2,3]. In this work, we have investigated the morphology and hydrophobic properties of tantalum nanocluster porous films grown by a plasma gas-condensation process. This study emphasizes the importance of characterization and understanding the surface morphology of nanoclusters film. Size-selected nanoclusters of tantalum were deposited on silicon/fused quartz substrates for surface analysis and TEM grids for TEM/STEM analysis. The obtained nanocluster films were characterized by AFM, SEM, XRD, TEM, XPS, and water contact-angle measurements. The nanocluster films grown using this method were compared to conventional magnetron sputtered tantalum films. The AFM images and XPS spectra were also studied of the tantalum deposited surface taken after different temperatures of post-deposition annealing under ultra-high vacuum conditions. Surface topography maps by AFM and SEM clearly demonstrated the porous structure of the nanocluster films. TEM imaging and XPS study confirmed this structure after air exposure and the resultant oxidation of nanoparticles to core/shell tantalum/tantalum oxide configuration. TEM and XRD results showed the nanoclusters as amorphous structure. The size-selected tantalum nanocluster-assembled films with nanoscale porosity provide an enhancement a contact angle value of 75.4° , but the magnetron sputtered tantalum film is hydrophilic with a contact angle value of 41.2° .

References:

1. P. Jensen. Growth of nanostructures by cluster deposition: Experiments and simple models. *Rev. Mod. Phys.* 2005, 71:1695.
2. V. Singh, P. Grammatikopoulos, C. Cassidy, M. Benelmekki, M. Bohra, Z. Hawash, K. W. Baughman, M. Sowwan. Assembly of tantalum porous films with graded oxidation profile from size-selected nanoparticles. *J. NANOPART. RES.* 2014, 16:2373.
3. M. J. Lee, C. B. Lee, D. Lee, S. R. Lee, M. Chang, J. H. Hur, Y.-B. Kim, C.-J. Kim, D. H. Seo, S. Seo, U. I. Chung, I.-K. Yoo, K. Kim. A fast, high-endurance and scalable non-volatile memory device made from asymmetric Ta₂O_{5-x}/TaO_{2-x} bilayer structures. *Nat. Mater.* 2011, 10:625.

■ ID-277

Revealing Mechanism of Membrane Poration by Antimicrobial Peptides

Ankita Arora, Abhijit Mishra*

Department of Materials Science & Engineering Indian Institute of Technology, Gandhinagar, INDIA

*Email: amishra@iitgn.ac.in

Bacterial resistance to conventional antibiotics is a major health concern. Antimicrobial peptides (AMPs), which are an important component of mammalian immune system, are thought to utilize non-specific interactions to target common features on the outer membranes of pathogens; hence development of resistance to such AMPs may be less pronounced. Most AMPs are amphiphilic and cationic in nature. The general consensus is that most AMPs form pores in the bacterial membranes causing them to lyse. However, the exact mechanism for pore formation is unknown. We selected the AMP CHR01 (KSSTRGRKSSRRKK), derived from human β defensin 3 (hBD3) with all Cysteine residues substituted with Serine, for study. This substitution removes all disulfide bond linkages within the sequence and makes the peptide unstructured in solution. The effectiveness of this peptide against different bacteria is tested by growing bacteria, characterizing bacterial strains so as to determine the effect of AMP on specific microbe, and inspecting Minimal inhibitory concentration of AMP against different species of bacteria. The effect of this AMP on bacterial and model membranes is characterized using Atomic Force Microscopy, Scanning Electron Microscopy, and Small Angle X-ray scattering (SAXS) to elucidate the mechanism behind antimicrobial activity.

■ ID-278

Applicability of Boltzmann Superposition Principle on Ageing Materials

Asheesh Shukla, Manish Kumar, Yogesh M. Joshi*

Department of Chemical Engineering, Indian Institute of Technology, Kanpur 208016 INDIA

*Email: joshi@iitk.ac.in

In this work, we study rheological behavior of thermodynamically out of equilibrium materials which show temporal evolution of elastic modulus, relaxation time and viscosity. We have used commercially available acrylic emulsion paint and aqueous synthetic clay

(Laponite) suspension prepared in lab. They show time dependent slowing down of the relaxation dynamics, due to which Time-Translational Invariance (TTI) and Boltzmann superposition principles are not applicable in their conventional form. We have shown that such materials follow Boltzmann superposition principle only in the effective time domain, wherein time dependent relaxation processes are scaled by a constant relaxation time. In this work we extend the effective time framework to successfully demonstrate a timeaging time-stress superposition of creep curves obtained for different stresses and at different waiting times. Such a superposition is possible when the average relaxation time of the material changes with time and stress without affecting the shape of the spectrum. We have also analyzed effect of step jumps performed on the materials for different stresses in a Boltzmann superposition framework. We carry out different kind of experiments including up and down step jumps and ramps at different waiting times. We observe that these permutations and combinations lead to further validation of Boltzmann superposition principle.

■ ID-279

Enhancement of Polymerase Chain Reaction Efficiency using Graphene oxide

Rajveer Singh Rajaura^{1*}, Ronin Messhugga¹, Shivdutt Purohit¹, Vinay Sharma¹, Kailash Agrawal^{1,2}

¹Centre for Converging Technologies, University of Rajasthan, Jaipur-302004, INDIA

²Departments of Botany, University of Rajasthan, Jaipur-302004, INDIA

*Email: rajveer.nano_cct@live .com

An emerging area of research is improving the efficiency of the polymerase chain reaction (PCR) by using nano-material. Graphene oxide showing promising results. In this paper we report the effect of Graphene oxide on Polymerase Chain reaction (PCR) efficiency. The reason behind the use of graphene oxide is lies in its electrical, mechanical and thermal properties. Graphene oxide was efficiently synthesized via modified hummers method. SEM and TEM images confirmed the formation of graphene oxide. The experimental results show that amplification during PCR indicates the high thermal conductivity of graphene oxide probably main cause of the PCR enhancement. Further research should be concentrated on estimating the maximum concentration of graphene oxide for which the efficiency of PCR be maximum.

References:

1. Weijie, W., J.T.W. Yeow, and M.I. Van Dyke. Effect of silver and titanium dioxide nanoparticles on PCR efficiency. in Nanotechnology, 2009. IEEE-NANO 2009. 9th IEEE Conference on. 2009.
2. Khaliq, R.A., et al., Enhancement in the efficiency of polymerase chain reaction by TiO₂ nanoparticles: crucial role of enhanced thermal conductivity. Nanotechnology, 2010. 21(25).
3. Cui, D. and et al., Effects of single-walled carbon nanotubes on the polymerase chain reaction. Nanotechnology, 2004. 15(1): p. 154.

■ ID-284

Structural Effects of ZnO Substitution on Crystallization Characteristics and Microstructure of SiO₂-MgO-Al₂O₃-B₂O₃-K₂O-MgF₂ Glasses and Glass-Ceramics

Mrinmoy Garai*, Nibedita Sasmal, Basudeb Karmakar
Glass Science & Technology Section, Glass Division, CSIR-Central Glass & Ceramic Research Institute, Kolkata 700032, INDIA

*Email: mrinmoygarai@yahoo.in

Amongst various types of materials, Glass, a special kind of polymeric system is considered with great attention due to having vitreous 3D-network lacking symmetry and periodicity, greater structural energies, same average packing and properties in all directions and infinite unit cell but no repeating large scale structures. SiO₂-MgO-Al₂O₃-K₂O-B₂O₃-F (BPAS) is such a kind of oxide system largely used for high temperature vacuum sealing application. Many technological applications require a substrate with large value of thermal expansion coefficient, as well as good shock absorbance. So, the increase of thermal expansion coefficient and shock absorbance power is of great interest now a day for potassium aluminium-borosilicate glasses and the corresponding glass-ceramics as they can also be useful for high temperature sealing application (SOFC).

Here, we studied the effect of Zn²⁺ substitution for Mg²⁺ on crystallization and microstructure of SiO₂-MgO-Al₂O₃-B₂O₃-K₂O-MgF₂ (BPAS) glass system designed in the glass forming region of fluorophlogopite [KMg₃(AlSi₃O₁₀)F₂]. Bivalent metal oxide ZnO was selected on the basis of ionic radius which is nearly equal for Mg²⁺ and Zn²⁺ in six coordination site (Mg²⁺ ~ 0.72Å, Zn²⁺ ~ 0.75Å⁰). The conventional melt-quenched (at 1550°C for 2 h) glasses with compositions (mol%), 41SiO₂ 10 Al₂O₃ 7 K₂O 10 B₂O₃ 12 F₂ (32-x)Mg²⁺-x ZnO where x = 0, 5, 10, 15, 20, 26 and 32; have been investigated to establish the effect of Zn²⁺/Mg²⁺ ratios. It is found that the density (measured using Archimedes method) of base glass without zinc content is 2.52 g-cm³ and increases linearly on replacement of Mg²⁺ by 5-32 mol% ZnO. Glass transition temperature (T_g) and dilatometric softening point (T_d) of BPAS glass first increases with adding 5 mol% ZnO and then decreases on further addition. From the DSC study, it is found that the crystallization exotherm changes significantly in the temperature range 750-1000°C where different crystalline phases are formed, and the activation energy varies in the range of 254-388 kJ/mol. The crystalline phases formed in opaque BPAS glass-ceramics derived by controlled heat treatment at 800 and 1050°C are identified as fluorophlogopite [KMg₃(AlSi₃O₁₀)F₂] and willemite (Zn₂SiO₄) by XRD technique and subsequently confirmed by FTIR spectroscopy. The change of crystallization phenomena on increasing Zn²⁺/Mg²⁺ ratios correspond to the significant microstructural change studied from FESEM photomicrographs. A wide range of dilatometric thermal expansion values were obtained for the investigated glasses and their corresponding glass-ceramics. Thermal expansion (50-500°C) of BPAS glass without zinc content is 7.76 10⁻⁶/K decreased sequentially with increase of Zn²⁺/Mg²⁺ ratios. The density of glass-

ceramic after heating at 800 and 1050⁰C increases linearly increase of Zn⁺²/Mg⁺² ratios. Microhardness of the BPAS glasses is in the range of 4.26-6.15 GPa and found to increase to 4.58-6.78 GPa on heat treatment at 1050⁰C.

References:

1. M. Garai, N. Sasmal, A. R. Molla, S. P. Singh, A. Tarafder and B. Karmakar, Effects of nucleating agents on crystallization and microstructure of fluorophlogopite mica-containing glass-ceramics, *J. Mater. Sci.*, 2014, 49, 1612.
2. E.M.A. Hamzawy, H. Darwish, Crystallization of sodium fluormica Na(Mg, Zn, Ca)_{2.5}Si₄O₁₀F₂ glasses, *Materials Chemistry and Physics* 71 (2001) 70.

■ ID-285

Z43 Ultrafiltration Membrane Over on Low-Cost Porous Clay-Alumina Ceramic Support Tubes and Application for Water Treatment

Surajit Dey*, Priyankari Bhattacharya, Ganesh .C. Sahoo
Ceramic Membrane Division, CSIR-Central Glass and Ceramic Research Institute.196, Raja S.C. Mullick Road,Kolkata-700 032, INDIA

*Email: deysurajit033@gmail.com

Ceramic membranes are finding wide applications in various fields including treatment of wastewater loaded with organic matter. Ceramic ultrafiltration membranes having pore size in the range of 10-100 nm are applied for separation of microorganisms and organic loading. In the present study, zirconia powder coated ceramic membrane was prepared on ceramic MF membrane supports of single-channel and multi-channel configurations. The ceramic support was indigenously developed by CSIR-Central Glass and Ceramic Research Institute from a cost effective composition of clay and alumina. Coating slurry was comprised of zirconia powder, a dispersant, a plasticizer and an organic binder. Well dispersed and stable slurry was obtained by add-mixing of the ingredients under gentle stirring and ultrasonication. Membrane was elaborated using dip coating technique. The membranes were sintered in air atmosphere at 700⁰C for 2 h in electric furnace at a heating and cooling rate of 1 and 2⁰C/min, respectively. Membrane characterization was done by XRD, FESEM and Mercury intrusion pore size distribution techniques. Analysis results show that the membrane is in the ultrafiltration range with average pore size of 50 nm. The prepared membrane was applied for treatment of surface water, tannery and domestic wastewater. Surface water was collected from a local lake and wastewater from the canteen of the Institute, and subjected to characterization in terms of chemical oxygen demand (COD), biochemical oxygen demand (BOD), turbidity, total suspended solids (TSS) and pathogen. Filtration experiments were carried out in cross flow membrane filtration (CMF) mode. Feed was passed tangentially to the membrane under pressure and permeate came out of the membrane pore in the cross-flow direction. Membrane permeates collected at regular intervals for analysis. The main aim of the study was to remove pathogenic bacteria represented in terms of most probable number (MPN) so that the water may be used for drinking purpose or reused for other purposes. The ultrafiltration membrane was effective

in removing pathogenic bacteria with 92% reduction in COD.Turbidity was reduced below 1 NTU. A steady state flux of about 22 LMH was obtained. Therefore, it might be concluded that indigenously developed ceramic ultrafiltration membranes can be effectively used for treatment and reuse of surface water and domestic wastewater.

■ ID-286

Optimization of polymeric membrane and microspheres morphology using ionic liquid as an additive

D.Shanthana Lakshmi*, Rene Ruby Figueroa, A.Figoli, L.Giorno

Institute on Membrane Technology, ITM-CNR, c/o University of Calabria via P. Bucci, cubo 17/C, I-87030 Rende (CS), ITALY

*Email: sl.shaluvar@itm.cnr.it

Hydrophilic porous Poly (ether) sulfone membranes and microspheres with a controlled morphology were prepared via Non-Solvent Induced Phase Separation (NIPS) with 1-butyl-3-methylimidazolium hexafluorophosphate ([BMIM][PF₆]) as structure control additive in addition to conventional PVPK17. Response surface methodology (RSM) was employed to optimize ionic liquid polymer microspheres (ILMC) and membranes (ILMs) preparation. The results showed that the concentration of polymer, additive and ionic liquid as well as the viscosity were the key factors. BoxBehnken design were introduced to optimize the level of the key factors and these are as follows: 5-10% (w/w) PES (polymer), 0-4% (w/w) PVPK17(additive), and 5-15% (w/w) [BMIM][PF₆](ionic liquid) for ILMCs and 10-15% (w/w) PES, 0-4% (w/w) PVPK17, and 10-15% (w/w) [BMIM][PF₆] for ILMs.Compared with conventional solvents (DMF, DMSO, NMP) and additives (PEG, PVP), presence of [BMIM][PF₆] alters the phase inversion mechanism in a particular way and different morphologies were observed. [BMIM][PF₆] concentration clearly affects the internal membrane morphology from channel structure to spongy (loosen) nature. Membranes prepared with higher [BMIM][PF₆] concentration showed a sponge-like morphology; whereas membrane prepared without or lower concentration of [BMIM][PF₆] presented a finger-like morphology. [BMIM][PF₆] concentration increases the polymer dope viscosity and reduces solvent exchange speed thereby alters the morphology to spongy nature. Hydrophilicity of PES membrane is influenced by the concentration of [BMIM][PF₆]. This investigation provide a vital information about the phase inversion exchange rate and polymer dope viscosity are interrelated.

References:

1. M.F. Anjum, I. Tasadduq, K. Al-Sultan, Response surface methodology: A neural network approach, *Eur. J. Oper. Res.* 1997, 101: 65-73.
2. M.C. Mart-Calatayud, M.C. Vincent-Vela, S. Ivarez-Blanco, J. Lora-Garca, E. Bergantinos-Rodrguez, Analysis and optimization of the influence of operating conditions in the ultrafiltration of macromolecules using a response surface methodological approach, *Chem. Eng. J.* 2010,156: 337-346.
3. D.Shanthana Lakshmi, A.Figoli, G.Fiorani, M.Carraro, L.Giorno, E.Drioli, Preparation and Characterization of Ionic Liquid Polymer Microspheres

[PEEKWC/DMF/CYPHOSIL101] using Phase-Inversion technique, Separation and Purification Technology, 2012, 97:179-185.

■ ID-287

Size Dependent Cytotoxicity of Silver Nanoparticles using Whole-Cell Based Biosensor Chip

Javed H. Niazi^{1*}, Ashish Pandey^{1,2}, Yasar Gurbuz¹, Anjum Qureshi^{1*}

¹*Sabancı University Nanotechnology Research and Application Center, Orta Mahalle 34956, Tuzla, Istanbul, TURKEY*

²*Faculty of Engineering and Natural Science, Sabancı University, Orhanlı 34956, Tuzla, Istanbul, TURKEY*

*Email: anjum@sabanciuniv.edu

Despite of intensive research efforts on the toxicity of engineered nanomaterials, current knowledge on their cytotoxic mechanisms remains limited. Relationships between the cell and nanomaterial properties such as size and concentration are not well understood. In this work, we developed a whole-cell biosensor chip for rapid testing of silver nanoparticles (NPs) toxicity and monitored the responses under AC electrical field by non-Faradaic electrochemical impedance spectroscopy (nFEIS). This biosensor was made of an array of capacitor chips immobilized with living *E. coli* cells capable of performing multiple toxicity assays to address the need for a consistent method to study size and concentration dependent toxicity of silver NPs. The cellular response obtained through the biosensor exhibited size and concentration dependent toxicity of silver NPs. The relative change in capacitive response with respect to controls enabled determination of the toxicity of NPs using whole-cell biosensor chip. *E. coli* cells were sensitive to, and severely affected by 10 nm sizes of NPs with loss of capacitance responses as a result of damage to living cells. However, *E. coli* cells were not severely affected by larger 100 nm size of silver NPs as the cells tend to resist and were not able undergo cellular stress. Our results demonstrated that whole-cell biosensor chip response at a particular frequency enabled determining the severity of the stress imposed by Ag NPs. The toxic effect of NPs was also studied using attenuated total reflection-fourier transform infrared (ATR-FTIR) spectra and scanning electron microscopy (SEM). The methodology developed has a great potential to be applied in nanomaterial industry for classifying toxic and non-toxic NMs.

■ ID-289

Study of Dielectric and Magnetic Properties of Polymer Ferrite Nanocomposite

S. P. Pareek¹, S. N. Dolia^{1*}, P. K. Sharma¹, Arun S. Prasad², Arvind Samariya¹, M. S. Dhawan¹, B. L. Prashant¹, K. B. Sharma³

¹*Department of Physics, University of Rajasthan, Jaipur - 302004, INDIA*

²*Department of Physics, Sree Narayana College Punalur, Kerala-691305, INDIA*

³*S. S. Jain Subodh P. G. College, Jaipur- 302004, INDIA*

*Email: sndolia64@gmail.com

The nanocrystalline ferrite of $\text{Cu}_{0.2}\text{Ni}_{0.8}\text{Fe}_2\text{O}_4$, synthesized through chemical co-precipitation method and subsequently, coated with intrinsically conducting polymer shell of polypyrrole and polyaniline have been studied. The XRD patterns confirm the formation of nano sized cubic spinel structure in single phase with average crystallite size of ~ 6 nm. The dc magnetization measurements performed on VSM show the magnetization enhancement in the M-H curves at 20K on polymerization. The value of blocking temperature, TB is found to be increased from 120K to 140 K on polymerization which confirms the increase in crystallite size due to the interaction of polymer chain with nanoparticle surface.

The frequency dependent dielectric measurements were performed in the range of 75 KHz to 10 MHz. Both the dielectric strength and the dielectric loss decrease with frequency for all the samples which could be explained on the basis of available ferrous, i.e. Fe^{2+} , ions on octahedral sites such that beyond a certain frequency of applied electric field the electronic exchange between the ferrous and ferric ions i.e. $\text{Fe}^{2+} \leftrightarrow \text{Fe}^{3+}$ cannot follow the applied alternating electric field. However, on polymerization, both the dielectric strength as well the dielectric loss increases at all frequencies.

■ ID-293

A Comparative Study of the Effects of Oxygen Ion upon the Free Volume and Physico-chemical Properties of Makrofol (KG & N) Polycarbonate

Sanjeev Kumar Gupta^{1,2}, Paramjit Singh¹, D. Das³, Rajesh Kumar^{1*}

¹*University School of Basic and Applied Sciences, Guru Gobind Singh Indraprastha University, New Delhi- 110078, INDIA*

²*University School of Basic and Applied Sciences, Guru Gobind Singh Indraprastha University, New Delhi- 110078, INDIA*

³*UGC-DAE Consortium for Scientific Research, III/LB-8, Bidhannagar, Kolkata-700098, INDIA*

*Email: rajeshkumaripu@gmail.com

Makrofol (KG & N) polymers are the important polymers used for SSNTDs. The Makrofol (KG & N) polymers samples were irradiated by 100 MeV O^{6+} ions at Inter University Accelerator Centre (IUAC), New Delhi, India. The fluences were taken in the range of $1 \times 10^{11} \text{ ions/cm}^2$ to $5 \times 10^{12} \text{ ions/cm}^2$. The pristine and irradiated samples were characterized by positron annihilation lifetime spectroscopy (PALS), X-ray diffraction, UV-visible and FTIR for the free volume, structural, optical and chemical studies respectively. PALS technique is an effective and non-destructive technique for the estimation of the amount of free volume present inside the polymers. The free volume and fractional free volume were calculated from the obtained value of hole radius using Tau-eldrup model[1]. A comparative study was carried out from the obtained values of free volume and its variation for both the polymers. The crystallite size and band gap energy values were calculated using Scherrer formula[2,3] and Taucs relation[4] respectively.

The absorption spectra of ultraviolet were found to be shifted towards longer wavelength region. The intensity of the various absorption bands of the infrared spectra were found to change in their wave numbers indicating the changes in the chemical properties of the exposed samples. The results will be discussed during presentation.

References:

1. M. Eldrup et al., Chem. Phys. 1981, 63: 5158.
2. P. Singh et al., Nucl. Instrum. Meth. Phys. Res. B 2014, 320: 6469.
3. Scherrer P. Nachr Ges Wiss Gttingen 1918, 26: 98-100.
4. R. Kumar, P. Singh, Results in Phys. 2013, 03: 122128.

■ ID-296

Luminescent Nanoparticle: Quantum-Sized Carbon Dots from Sugar Cane Straw

Nidhi Rani Gupta*

GSSDGS Khalsa college, Patiala - 147001 Punjab, INDIA

*Email: nidhigupta0508@gmail.com

Fluorescent semiconductor based nano-crystals with spherical morphology known as quantum dots (QDs[1]) have attracted significant interest especially in the field of optical bio imaging due as a fluorescent probe. Because of their very high quantum yield along with high resistivity against photo-bleaching effects makes these very applicative especially in vitro and in vivo optical imaging. However, for their known toxicity and potential environmental hazard associated with many of these materials may represent serious limitations. Therefore, the search for benign nanomaterials of similar optical properties continues. We report the finding of these quantum dots like carbon dots[2-4] just by burning waste material of sugar cane. These strongly emissive carbon dots may find applications similar to or beyond those semiconductors quantum dots via simple surface passivation. Carbon dots were synthesized by burning the waste material of sugar cane as "sugar cane straw" via simple carbonization method under insufficient amount of oxygen and collecting their soot. These carbon dots on spontaneous passivation exhibit strong fluorescence on excitation in varied wavelength of light and showing some unique properties. These are cheap to synthesize and these do not show any toxicity and environmental problems in relevance to green chemistry. The use of these as biological labels can be used as an efficient fluorescent labelling with E.coli cells.

References:

1. X. Michalet, F. F. Pinaud, L. A. Bentolila, J. M. Tsay, S. Doose, J. J. Li, G. Sundaresan, A. M. Wu, S. S. Gambhir and S. Weiss, Science 2005, 307, 538.
2. Y.-P. Sun, B. Zhou, Y. Lin, W. Wang, K. A. S. Fernando, P. Pathak, M. J. Meziani, B.A. Harruff, X. Wang, H. Wang, P.G. Luo, H. Yang, M.E. Kose, B. Chen, L.M. Veca and S.-Y. Xie, J. Am. Chem. Soc., 2006, 128, 7756.
3. K. M. Tripathi, A. K. Sonker, S. K. Sonkar and S. Sarkar, Rsc Advances, 2014, 4, 30100.
4. L. Tang, R. Ji, X. Cao, J. Lin, H. Jiang, X. Li, K. S. Teng, C. M. Luk, S. Zeng, J. Hao and S. P. Lau, ACS Nano, 2012, 6, 5102.

■ ID-297

Fabrication and Characterization of Thin Films of Aluminium Antimonide (AlSb)

Y. C. Sharma^{1*}, A. Purohit², A. K. Sharma³, A. Dixit³, U. Kumawat⁴, S. Ojha⁵, Y. K. Vijay⁴

¹Vivekananda Institute of Technology (East), Jagatpura, Jaipur, Rajasthan - 303 012, INDIA

²Vivekananda Institute of Technology, Jagatpura, Jaipur, Rajasthan - 303 012, INDIA

³Indian Institute of Technology Jodhpur, Jodhpur, Rajasthan - 342 011, INDIA

⁴Vivekananda Global University, Jagatpura, Jaipur, Rajasthan - 303 012, INDIA

⁵Inter-University Accelerator Centre, New Delhi- 110 067, INDIA

*Email: yogeshchandra.sharma@gmail.com

AlSb thin films were prepared by the vacuum evaporation technique. The influence of annealing temperature on compositional, structural, optical and electrical properties of the films was investigated using Rutherford backscattering spectrometry (RBS), X-ray diffraction (XRD), Scanning electron microscopy (SEM), resistivity and optical absorbance studies. The composition analysis shows the nearly stoichiometric nature of the deposited film. Optical absorbance measurements indicate the existence of direct allowed optical transition with a corresponding energy gap in the range of 1.51-1.52 eV. The results demonstrate the effect of the annealing temperature and elemental concentration on the structural, optical and electrical properties of AlSb thin films.

■ ID-298

Validation of Forcefield of Rubber by Investigating Glass Transition Temperature from Molecular Dynamics Simulations

Pragati Sharma, Sudip Roy*

Physical Chemistry Division, National Chemical Laboratory, Pune 411 008, INDIA

*Email: s.roy@ncl.res.in

Rubber is an extensively used amorphous polymer having variety of applications in automotive, rubber and electronics industries. Polyisoprene and Polybutadiene being the major constituents of Natural and Synthetic rubber have also gained considerable research interest. This study focuses on validating the existing forcefields by calculating various physical properties to reproduce the experimental values e.g. glass transition temperature[1] (T_g), density[2], viscosity.

To validate the forcefields already available, molecular dynamics simulations of cis and trans isomers of Polyisoprene and Polybutadiene using both all-atomistic and united-atom models are performed. Extensive micro-second simulations are conducted at various temperatures to assure complete equilibration of polymer melts. Physical properties like diffusion coefficient, radius of gyration and heat of vaporization, viscosity and density as a means of evaluating glass transition are calculated.

Obtained density and T_g values are validated with respect to experimental values. Novelty lies in the determination of T_g for all-atomistic models of these polymers, which is still not reported. In all the cases T_g obtained from all-atomistic models is found to be more accurate than united atom models. Effect of chain length on glass transition and density is also investigated.

References:

1. L. J. Fetters et al. *Macromolecules* Volume 27, Number 17 August 15, 1994.
2. Xinya Lu and Bingzheng Jiang *Changchun Institute of Applied Chemistry* 1990.

■ ID-299

Structure of Nanorod Assembly in the Gyroid Phase of Diblock Copolymer

Souvik Chakraborty, Sudip Roy*

Physical Chemistry Division, National Chemical Laboratory, Pune 411 008, INDIA

*Email: s.roy@ncl.res.in

Block Copolymer composites have gained significant attention due to the potential application in the field of nanoscience and nanotechnology. Block copolymers undergo microphase separation to form various microstructures e.g. lamellar, gyroid, cylindrical, cubic phases depending on composition and segregation strength[1]. Thus, it can act as template to organize doped nanomaterials into different 3-D self-assembled structures located within the block copolymer matrix. Gyroid phase is one of the microstructures formed by block copolymer. It has curved interfacial surface providing confinements throughout the matrix[2], and thus can regulate the shape and sizes of self-assembled nanorods doped in it.

Mesoscale simulations of composite of block copolymer and nanorods have been performed to explore the structure of bundles formed by aggregation of nanorods of different flexibilities in gyroid phase. Bundles of different shapes and sizes have been found to be formed depending upon the nanorod flexibility and copolymer-nanorod interactions. The shape anisotropy and radius of gyration of bundles situated at different interfacial confining locations of block-copolymer matrices have been investigated as function of nanorod flexibility, nanorod-copolymer miscibility.

References:

1. A. C. Balazs et al. *Science* 2006, 314:1107.
2. Zihui Li et al. *Nature Communications* 2014, 5:3247.

■ ID-300

Synthesis, Magnetic and Dielectric properties of Nanocrystalline $\text{CoDy}_x\text{Fe}_{2-x}\text{O}_4$ Ferrite

B. L. Prashant*, Arvind Kumar, M. K. Gora, Priya Jadoun, S. N. Dolia

Department of Physics, University of Rajasthan, Jaipur 302004, INDIA

*Email: bajranglal.prashant@gmail.com

Stoichiometric compositions of ferrites with the chemical formula $\text{CoDy}_x\text{Fe}_{2-x}\text{O}_4$ with $x=0, 0.1, 0.15$ and 0.2 were prepared by the standard chemical co-precipitation method. X-ray diffraction analysis confirmed the cubic spinel structure of the prepared samples. The structural, morphological, magnetic and dielectric properties were studied by X-ray diffraction, infra-red spectroscopy (IR), Transmission electron microscopy (TEM), vibrating sample magnetometry (VSM) and Impedance Analyser. Lattice constant, crystallite size and density were estimated using Reitveld analysis. IR measurements show the characteristic ferrite bands. The cation distribution estimated by the X-ray diffraction are supported by magnetization. The force constants for tetrahedral and octahedral sites were calculated and found to vary with Dy^{3+} ions content. The saturation magnetization increases with Dy^{3+} content. Spin orbital coupling is much stronger in rare earth ions than in 3d transition metal ions and would contribute to increase in TB and saturation magnetization when Dy^{3+} ion partially replace Fe^{3+} in CoFe_2O_4 nanoparticles. The frequency dependent dielectric measurements were performed in the range of 75 KHz to 10 MHz. The mechanisms involved will be presented.

■ ID-301

Intracellular Transport on Multifilament Tracks

Subhadip Ghosh^{1*}, Sudipto Muhuri², Ignacio Pagonabarraga³

¹*Institute of Physics, Sachivalaya Marg, Bhubaneswar 751005, INDIA*

²*Savitribhai Phule Pune University, INDIA*

³*Departament de Física Fonamental, Universitat de Barcelona, C.Marti i Franques 1, 08028 Barcelona, SPAIN*

*Email: subhadip@iopb.res.in

We study a multispecies two lane driven lattice gas model with open boundaries in which lane switching mechanism occurs in a correlated manner. The lane switching mechanism of the species is such that it favours lane switching when oppositely directed species meet on the lane.

We focus our attention on regime where the lanes are weakly coupled. We find that the interplay of the boundary loading/offloading processes the lane switching mechanism can lead to phase segregation between the lanes and localized density shocks. We find the Mean Field (MF) steady state profiles and find that they match well with the Monte Carlo (MC) profiles obtained by numerical simulation. Further we obtain the phase diagram corresponding to the same. This model might be useful in context of modelling vesicular cargo transport on multifilament lanes, with (off)loading of cargoes at the filament ends.

References:

1. M. R. Evans, D. P. Foster, C. Godrche and D. Mukamel, *Journal of Statistical Physics*, 1995, Volume 80, Numbers 1-2, Pages 69-102.
2. Robert Juhasz *Phys. Rev. E* 76, 021117 (2007).

■ ID-302

Synthesis of Noble Metal Quantum Clusters @Titania Core Shell Materials

Gupta Kalpna

Dept. of Chemistry, R.R.College, Alwar, INDIA

*Email: 27guptakalpna@gmail.com

Noble metal quantum cluster belongs to new category of nanomaterial[1-2] with defined optical absorption properties and intense luminescence. The metal core with shell nanocomposites is very interesting as they have wide applications in solar energy conversion, microelectronics, optical and photocatalyst. So combination of two nanomaterials may be suitably designed to yield enhanced optical and catalytic properties utilizing the possibility of photo excitation of electron from TiO₂ shell. Core shell has been intensively studied for their potential to have specific optical electronic magnetic and catalytic properties. Use of dielectric material such as metal oxide for shell coating can allow further tuning the properties of metal core. Most economic way to synthesize small metal core is through wet chemical method. Capping the metal cluster with by organic moiety is prone to chemical oxidation especially under light. So, to overcome from this the encapsulation of each cluster with a shell of inert material like metal oxide was proposed. The preparation of uniform oxide protected metal colloids can be facilitated by slow and steady growth of oxide layer on metal core and stability of metal colloid. As Ti alkoxides undergoes very fast hydrolyzed with water so we need to control the rate of hydrolysis. Here we used Titanium isopropoxide as Ti precursor and acetylacetone was used as complexing agent to make a shell around AgAu@MSA cluster. Characterization is done by UV-Visible, fluorescence spectroscopy, XRD and SEM, TEM etc.

References:

1. Habeeb Muhammed, M.A.; Pradeep, T. In *Advances in Fluorescence Spectroscopy*; Dushchenkov, A. Ed, Springer; Heidelberg 2010.
2. Synthesis of Au/TiO₂ Core-Shell Nanoparticles from Titanium Isopropoxide and Thermal Resistance Effect of TiO₂ Shell Kwon, Hyun-Woo; Lim, Young-Min, Tripathy, Suraj Kumar, Kim, Byoung-Gyu, Lee, Min-Sang, Yu, Yeon-Tae *Japanese Journal of Applied Physics*, Volume 46, Issue 4B, (2007) pp. 2567-70.

■ ID-303

Nano-herbal Drugs for Diabetes Research and Management: A ReviewHemant Pareek^{1*}, Sameer Sharma², G. C. Jain³¹*S. K. Govt P.G. College, Sikar, Rajasthan, INDIA*²*Govt P.G. College, Sawai Madhopur, Rajasthan, INDIA*³*Centre for Advanced Studies, Department of Zoology, University of Rajasthan, Jaipur, INDIA*

*Email: hemantjpr@yahoo.com

Diabetes, especially type 2 diabetes (which is strongly associated with the modern diet and life-style), has developed worldwide into an epidemic disease with an high impact over the developing countries like India. Diabetes imposes a heavy burden on public health as it is

one of the leading causes of mortality. Although several drugs (including Insulin) are used for the treatment of the diseases, none of these drugs offers complete remission of the disease; moreover, these drugs have limited efficacy. Herbal medicines have been widely used around the world against diabetes since ancient times. The advancement of phyto-chemical and phyto-pharmacological sciences has enabled elucidation of the composition and biological activities of several medicinal plant products. The effectiveness of many species of medicinal plants depends on the supply of active compounds. Most of the biologically active constituents of extracts, such as flavonoids, tannins, and terpenoids, are highly soluble in water, but have low absorption, because they are unable to cross the lipid membranes of the cells, have excessively high molecular size, or are poorly absorbed, resulting in loss of bioavailability and efficacy. Some extracts are not used clinically because of these obstacles. It has been widely proposed to combine herbal medicine with nanotechnology, because nano-structured systems might be able to potentiate the action of plant extracts, reducing the required dose and side effects, and improving activity. Nano-sized drug delivery systems of herbal drugs have a potential future for enhancing the activity and overcoming problems associated with plant medicines Nano-systems can deliver the active constituent at a sufficient concentration during the entire treatment period, directing it to the desired site of action. Conventional treatments do not meet these requirements. The purpose of this study is to review nanotechnology-based drug delivery systems and herbal medicines for diabetes research and management.

References:

1. B. V. Bonifacio, P. B. Silva, M. A. Ramos, K. M. Negri, T. M. Bauab, M. Chorilli. Nanotechnology-based drug delivery systems and herbal medicines: a review. *International Journal of Nanomedicine* 2014, 9:1-15. doi: 10.2147/IJN.S52634.
2. S. S. Ajazuddin. Applications of novel drug delivery system for herbal formulations. *Fitoterapia*. 2010, 81(7):680689.
3. A. Yadav, M. Ghune, D. K. Jain. Nano-medicine based drug delivery system. *J Adv Pharm Educ Res*. 2011, 1(4):201213.
4. R. Singh, S. Tiwari, J. Tawaniya. Review on nanotechnology with several aspects. *Int J Res Comput Eng Electron*. 2013, 2(3):18.

Author Index

- A. Dixit 297
A. Figoli 286
A. K. Sharma 297
A. K. Sinha 271
A. Purohit 297
A. S. Meena 127
A. Sarkar 133
A. Sarkar 133
A. Verma 108
Aashish Kumar 180
Abhijit Mishra 277
Achutha Prabu 190
Aditi Simha 267
Aditya Samant 128
Ajay Soni 145
Alain Bourmaud 242
Alexander Boker IT10
Amar Singh 131
Amena Salim 183, 209
Amit Kumar 115
Amrita Rath 179
Anchit Modi 174
Anil Kumar 115, 165, 173, 184
Anil Pathak 271
Anjali Awasthi 155, 168
Anjali Krishnamurthy 240
Anjum Qureshi IT06, 287
Ankita Arora 277
Ankita Dube 168
Ankita Pandey 191
Ankush Sengupta 203
Anna Klymenko PT02
Annika Hohendahl 202
Anshu Sharma 259
Antoine Le Duigou 242
Anuj Upadhyay 271
Apuv Saxena 274
Archana Srivastava 171
Arghya Majee 117
Armi Wulanawati 206
Arnim Schuchardt IT12
Arpita Sundaria 233, 236
Arshdeep Singh 211
Arun Kumar Singh 219
Arun S. Prasad 289
Arvind Kumar 300
Arvind Samariya 289
Asha Liza James 187
Asheesh Shukla 278
Ashish Pandey 287
Ashna Rajeev 176
Ashutosh Sharma PT01
Ashutosh Shrivastava 231, 233, 236
Aurelien Roux 202
B. L. Choudhary 240, 270
B. L. Prashant 289, 300
B. N. Rajasekar 271
Balram Tripathi 212, 213
Barbara Ruzicka 169, 170
Basavaraj M. Gurappa 163
Basavaraj Madivala 126
Basudeb Karmakar 284
Ben Kent 258
Bhavisha Vijay 236
Bipin K. Srivastava 240
Bishnupada Roy 101, 118
Bodhisatwa Das 205
Bodhisatwa Das 234
Bruno Deme 258
C. S. Biju 125
C. Upadhyay 274
Cait E. MacPhee 238, 239
Cathal Cassidy IT20, 276
Christophe Chassenieu PT02
Christopher J. Garvey 258
D. Bhatnagar 198
D. Das 293
D. Henry Raja 125
D. K. Avasthi IT05
D. Mareduzzo IT04
D. Michieletto IT04
D. Pathinettam Padiyan 125
D. Revannasiddaiah 172, 166
D. Shanthana Lakshmi 286
Dawit Gedamu IT12
Debarati Sarkar 144
Deepak Bhatia 256
Deepak Bhatnagar 226
Deepika 158
Devanarayanan.V.P 269
Dinesh Saini 162
Divya Jayoti 210
Durgeshwer Singh 275
E. Orlandini IT04
Ekta Rewar113
Emanuela Zaccarelli 169, 170
Emilie Roger IT22
Erwan Nicol PT02
Ethayaraja Mani 126, 163, 178, 194
F. A. M. Marques 170
Felix Hfling 150
Francesc Sagues IT15
Franz Faupel PT07
G. Bryant 258
G. C. Jain 303
G. P. Alexander IT04
G. S. Okram 167
G. Sivakumar 244
G. Tripathi 213
Ganesh C. Sahoo 285
Garima Agarwal 252
Ghanshyam Das Agrawal 175
Giancarlo Ruocco 169, 170
Giovanni B. Brandani 239
Giridhar U. Kulkarni IT03
H. B. Bohidar 259, 260, 161, 263
Hariom Gupta 253
Harshita Agrawal 122
Hemant K. Arvind 270
Hemant Kumar Gupta 175
Hemant Pareek 303
Holger Stark PT08
Ignacio Pagonabarraga IT13, 134, 140, 301
Ingo Paulowicz IT12
J. C. Gimel 190
J. Igenes-Mullol IT15
J. Miguel Rubi 134
J. P. Singh 138
J. S. Dolado 190
Javed H. Niazi IT06, 287
Jean-Francois Feller 242
Jeong-Hwan Kim 276
Jitendra Kumar 197, 207, 273
John H. Ipsen 196
John Manzi 202
Jorit Grottrup IT12
Joy Dutta 234
Jyoti 198, 226
Jyoti Parashar 198, 226
Jyotirmay Mathur 175
Jyotsana Pathak 261
K. A. Suresh 133
K. Agarwal 236, 233, 279
K. B. Sharma 198, 213, 226, 289
K. C. Bhamu 197, 207
K. C. Swami 149, 160, 173, 180, 184
K. K. Raina 218
K. Mohanraj 244
K. R. Prathyusha 140, 141
K. Raetzke IT07
K. S. Meena 127
K. S. Rathore 158
K. Sachdev 162, 183, 209, 227
K. V. Ramana Reddy 103
Kabeer Jasuja 187
Kailash 207
Kalpna Gupta 302
Kamla Rawat 259, 260, 261, 263
Kamlendra Awasthi 115, 122, 149, 160, 155, 165, 168, 173, 184
Kashyap Dave 231
Katja Loos IT01
Keith M. Bromley 239
Kengo Aranishi 276
Khalid Sultan 123
Khushboo 218
Kiagus Dahlan 206
Kirti Sankhala 230
Kumud Kant Awasthi 155, 168
Kumud Malika Tripathi 242
L. M. Aeshala 108
L. Raja Mohan Reddy 103
L. Ravelli IT07
L.Giorno 286
Lakshmi Kavitha Sthanam 225
Lakshmi Ranganatha V. 266

Latha Rani N. 266
 Laura Hobley 239
 Lazhar Benyahia PT02
 Lokanath N.K. 266
 Lokesh Kumar 149, 160, 165, 173, 184
 Lothar Schimmele 135
 M. Ikram 123
 M. K. Gora 300
 M. K. Usha 166
 M. M. Khan IT07
 M. N. Singh 271
 M. Obula Reddy 103
 M. S. Dhawan 289
 M. S. Turner IT04
 M. Singh 231
 M.A. Majeed Khan 255
 Madan Rao IT19
 Madivala G Basavaraj 176, 193, 194
 Mahendra Singh Yadav 271
 Mahesh M. Bandi 151
 Mahesh Soni 145
 Mandar M.Inamdar 225
 Manfred Stamm PT05
 Manish Kumar 278
 Manoj Kumar 149, 160, 173, 184
 Marco Schriings IT10
 Markus Biero 117
 Marshal Dhayal IT21
 Martin Lenz 202
 Matthew McCluskey 239
 Matthieu Piel 203
 Mayur Kumar Chhipa 113
 Meneka Banik 192, 204
 Mickael Castro 242
 Mir Zubida Habib 123
 Mohammed Saleem 202
 Mrinmoy Garai 284
 Mukhles Sowwan 276
 Murtaza Bohra 276
 N. K. Acharya 121
 N. K. Gaur 161, 167, 171, 174
 N. Kaurav 167
 N. Kumar 127
 N. Vinutha 166
 N. Vinutha 172
 N.Gurappa 189
 N.S. Saxena 158
 Nandini Bhandaru 185, 192
 Narendra Kumar Agrawal 180
 Naveen Kumar 104
 Navin Singh 131
 Neeraj Goyal 229
 Neethu Thomas 178
 Nibedita Sasmal 284
 Nicola R. Stanley-Wall 239
 Nidhi Joshi 260
 Nidhi Mishra 129
 Nidhi Rani Gupta 296
 Niladri Mukherjee 118
 Nir S. Gov 203
 Nitinipun Sharma 136, 137
 Oleg Lupan IT12
 Oliver G Schmidt PT06
 Olivier Colombani PT02
 Ornav Maulik 115
 P. B. Punjabi 270
 P. B. Sunil Kumar IT11, 140, 141, 191, 196
 P. Bayapu Reddy 103
 P. J. John 155
 P. K. Sharma 289
 P. L. Meena 127
 P. R. Solanki 263
 Palash Dhara 204
 Pallabi Pal 205, 234
 Panos Grammatikopoulos 276
 Paolo Maiuri 203
 Paolo Magaretti 134
 Paramjit Singh 293
 Patrick van Rijn IT10
 Patrick Wnnemann IT10
 Pau Guillamat IT15
 Pavan Kumar Srivas 205, 234
 Pierre Sens IT18
 Pietro Tierno IT15
 Pijush Ghosh 179
 Pooja Meena 183, 209
 Prabhash Dadheech 205
 Prabhash Dadhich 234
 Prachi Thareja 128, 129
 Pragati Sharma 298
 Pranesh Chowdhury 101, 118
 Prashanth T. 266
 Pratibha Goel 138
 Pratima R. Solanki 259
 Praveen Malik 210, 211, 218
 Prem P. Sharma 250, 251, 253
 Pritha Dolai 267
 Priya Jadoun 300
 Priyanka Choudhary 177
 Priyankari Bhattacharya 285
 Puneet Sharma 218
 Purushottam Soni 130
 R. Adhikari IT16, 191
 R. Divakar 227
 R. K. Duchaniya 162
 R. K. Gupta 273
 R. K.Gupta 269
 R. S. Meena 256
 R. Somashekar 166, 172
 Rabibrata Mukherjee 185, 192, 204
 Rainer Adelung IT12
 Rajbala Verma 155
 Rajesh K. Thakur 161, 167, 171, 174
 Rajesh Kumar 293
 Rajiv K. Pandey 274
 Rajiv Prakash 219
 Rajiv Prakash 274
 Rajveer Singh Rajaura 231, 279
 Raman Kapoor 138
 Ramesh Sharma 195
 Ranjith Padinhateeri 225
 Raphael Voituriez 203
 Rasna Thakur
 Rasna Thakur 161, 167, 171, 174
 Ravi Agarwal Gautam 180
 Rene Ruby Figueroa 286
 Rishi Vyas 162, 227, 229, 230
 Rita A. Gharde 223
 Rita Singh 275
 Ritesh Soni 236
 Roberta Angelini 169, 170
 Roland G. Winkler IT08
 Ronin Meshugga 236, 279
 Rukhsar Zafar 159
 Rumiana Dimova 105
 Ryan J. Morris 239
 S. Barathan 244
 S. Devashankar 189
 S. Dietrich PT04, 117, 135, 150
 S. Harms IT07
 S. K. Sharma 227, 229, 230
 S. K. Srivastava 207
 S. K. Tripathi 223
 S. Kannan 244
 S. Manigandan 194
 S. N. Dolia 198, 229, 270, 289, 300
 S. Ojha 297
 S. P. Pareek 289
 S. R. Vadera 10
 S. Raman 194
 S. Shrivastava 231
 Sabyasachi Ray 234
 Sahana Bhattacharyya 204
 Sajad Ahmad Mir 123
 Saloni Gupta 274
 Sam David Christdoss Pushpam 163
 Sameer Sharma 303
 Samir Kumar 138
 Samriti Khosla 223
 Sanat Karmakar 105
 Sandeep Kumar 273
 Sandrine Morlot 202
 Sangeeta Kalal 270
 Sanjay Mathur IT02
 Sanjeev Kumar Gupta 293
 Santanu Dhara 205, 234
 Santi P. Sinha Babu 101, 118
 Santosh A. Mani 223
 Sarla Sharma 227
 Satinder K. Sharma IT24, 145
 Seeraj Nawaj 256
 Sergi Hernandez IT15
 Shabana Khan 227
 Shalini Agarwal 268
 Shalini Dwivedi 195
 Shamik Sen 225
 Shaurya Seth 128
 Shikha Gaur 159
 Shivdutt Purohit 279
 Shubhayan Mandal 177
 Shweta Jatav 257
 Siddharth Kulkarni 128, 129
 Snigdha Thakur 144
 Sonu Sankhla 272
 Soren Kaps IT12
 Soumya S S 225
 Souvik Chakraborty IT09, 299

Sreeja K. K. 196
Sri Mulijani 206
Sridhar M.A. 266
Srikanth Sastry 141
Stephanie Hiltl IT10
Subhadip Ghosh 301
Sudhish Kumar 270
Sudip Roy IT09, 298, 299
Sudipto Muhuri 301
Sujin B Babu 177, 190
Suman Lal 223
Sumvit Goyal 236
Suprabhat Mukherjee 101
Surajit Dey 285
Surbhi,Saruchi 232
Sushant Kumar 276
Sushil Kumar 232, 255
Sutapa Roy 150
Suvam Nag Chowdhury 242
Swarn Lata Sing 135
Swati Gahlot 250, 251, 253
T. Emmler IT07
T. K Sharma 271
T. Koschine IT07
T.G.Anjali 193
Taavi E. Hunt 258
Taco Nicolai PT02
Tamim A. Darwish 258
Tamoghna Das 151
Thomas Haub 258
Tim Reimer IT12
Trivikram Nallamilli 126
U. Kumawat 297
V. Abetz PT03, IT07
V. Filiz IT07
V. K. Dixit 271
V. K. Saxena 198, 226
V. Manjuladevi 269, 273
V. R. Palkar 256
Vaibhav Kulshrestha 250, 251, 252,
253, 254
Vibhav K. Saraswat 122, 268
Vidyadhar Singh 276
Vijay Kumar 136, 137
Vijay M. Naik 130
Vikas Sharma 183
Vikas Sharma 209
Vinay A. Juvekar 130
Vinay Sharma 279
Vinod Chahar 213
Vinod Kumar 115, 165
W. C. Lo IT04
W. Egger IT07
Xin Jin IT12
Y. C. Sharma 297
Y. K. Saraswat 268
Y. K. Vijay PT10, 180, 213, 231, 297
Y. W Tong PT09
Yamini Sharma 195
Yasar Gurbuz 287
Yasar Gurbuz IT06
Yogendra K. Mishra IT12
Yogesh M Joshi 257, 278
Yogita Kumari 149, 160, 165, 173,
184

Soft Matter



Where physics meets chemistry meets biology for fundamental soft matter research



www.rsc.org/softmatter

ICON
Analytical

BRUKER

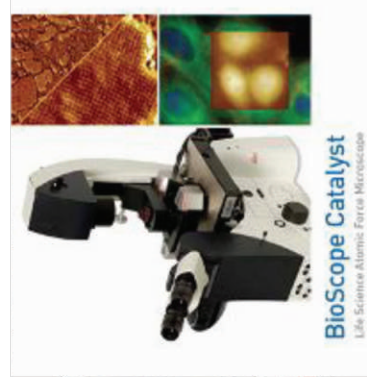
think forward



CONTOUR GT



DIMENSION EDGE



BIOSCOPE CATALYST



DEKTAk XT



NP FLEX



MULTIMODE 8



Helios NanoLab™ DualBeam™

Meet your most stringent 2D and 3D nanoscale characterization, prototyping, and sample preparation needs.

- Ultra to extreme high-resolution monochromated FE-SEM technology
- Best-in-class FIB performance
- Especially well-suited for soft or delicate materials, like nanotubes, polymers, particles, ceramics and metals



Quanta™ SEM

Image any sample; collect all data with this highly versatile SEM

- High and low vacuum modes, plus Environmental SEM (ESEM) operation
- Imaging and analysis of samples in their natural states
- Supports *in situ* dynamic experiments, including heating, humidity cycling and tensile testing



Scios™ DualBeam

Take your lab to the next level of achievement.

- Fast, high resolution 2D and 3D characterization—even for magnetic and non-conductive samples
- Clear distinction between materials and topographic contrast
- Rapid creation of site-specific samples for S/TEM, EBSD, or atom probe



Inspect™ SEM

Obtain fast answers for materials characterization and inspection

- High quality imaging and analysis for process control and failure analysis
- Easy to use for all experience levels
- Robust platform for multi-sample or multi-user laboratories



Versa 3D™ DualBeam

Explore new dimensions with FEI's most versatile DualBeam.

- Accepts a wide range of samples, from the conventional to the non-traditional
- Highly configurable platform with flexible detector and analytical options
- Optional Environmental SEM (ESEM) extends applications to include *in situ* dynamic studies



Vion™ Plasma FIB

Get outstanding milling and imaging performance in one instrument.

- Combines Xe plasma source with FIB
- Up to 20x speed increase for site-specific cross sectioning or bulk material removal
- High-contrast, high-resolution imaging
- Excellent low current or low kV polishing for sample preparation



Verios™ XHR SEM

Get unprecedented precision and surface-specific information.

- Second-generation XHR SEM technology
- Sub-nanometer resolution over the full 1 keV to 30 keV energy range
- Excellent materials contrast
- Extraordinary low-voltage performance



Titan Themis™ S/TEM

Get fast, easy access to atomic-scale information.

- Proven aberration-corrected optics
- Outstanding XEDS performance
- Powerful new software
- 16 megapixel CMOS camera
- Enhanced Piezo stage



Nova NanoSEM™

Experience uncompromised ultra-high resolution imaging and analysis.

- Excellent low kV imaging and high current for analytical applications
- Unique low vacuum mode
- Accommodates challenging uncoated, heavily charging, or contaminating samples



Talos™ S/TEM

Experience the fastest chemical analysis in multiple dimensions.

- New-generation technology for accelerated nanoscale analysis
- Fast acquisition of high quality, 2D and 3D S/TEM and EDS data
- Automated, simplified operation



Tecnai™ G2 Series

Gain fast analysis of a wide variety of materials with no compromises.

- Automated for repeatability
- High-throughput S/TEM imaging and characterization
- Ultra-high-resolution, high contrast imaging
- Superb analytical performance
- Easy to use platform



Tecnai Femto™ UEM

Study kinetics and phase transitions at atomic and molecular spatial scale.

- New 4D dynamic ultra-fast TEM for imaging and spectroscopy with femtosecond time resolution
- Multi-mode operation: stroboscopic, single pulse and continuous modes
- Easy to customize and optimize performance for a desired experiment



Titan™ ETEM

Gain detailed understanding of material structure-performance relationships.

- Characterize functional nanomaterials at nano- and atomic scales
- Study the geometric and electronic structures as well as chemical composition
- Dedicated environmental TEM enables *in situ* studies of gas-solid interactions

ICON Analytical Equipment Pvt. Ltd.

301, Landmark, 554, G M Bhosale Marg, Worli, Mumbai - 400018
Tel - 022- 43451600, Fax - 022- 66633914, Website: www.iconanalytical.com

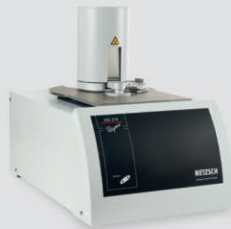
Advanced Material Testing



Order one of our Thermal Analysis posters free of charge
www.netzsch.com/n55065



Thermogravimetric Analysis (TGA)



Differential Scanning Calorimetry (DSC)

NETZSCH has the tools for the standard and the extreme, for the lowest and highest temperatures, for special atmospheres and for complex materials.

Avail our testing services at Chennai Lab. Just mail to india.at@netzsch.com



Thermal Conductivity (LFA)



Simultaneous Thermal Analysis (STA)

NETZSCH



Multiple Mode Calorimetry (MMC)



Dilatometry (DIL)

NETZSCH Technologies
 India Pvt. Ltd.
 No: 39, 2nd Street
 Spartan Nagar, Mogappair
 Chennai – 600037
 India
 Tel.: +91 44 42965111
 Fax: +91 44 42965115
india.at@netzsch.com
www.netzsch.com



With best compliments from:

UMESH CHANDRA SHARMA (PROPRIETOR)

SAVITA SCIENTIFIC & PLASTIC PRODUCTS

445, MISHRA RAJA JI 'S STREET, JAIPUR 302001

(O) 0141-2323365 (R) 2390651 • EMAIL:savita.chem@gmail.com

Contact Person: MANMOHAN SHARMA 9784369751,
ABHISHEK SHARMA 8432558881

STOCKIST:-

INDIAN(MERCK, LOBA, RANKEM, FISHER, CDH) & RARE IMPORTED CHEMICALS (SIGMA ALDRICH & ALFA-AESAR), INSTRUMENTS & EQUIPMENTS (TOSHCON, LABTRONICS &TANCO), GLASSWARES (BOROSIL R, DURAN RIVIERA), PLASTIC WARES (Tarsons, Polylab) Microscope (Olympus).

DEALS IN :-

COPPER GRID FOR TEM, SPUTTERING TARGET, QUARTZ (BOAT, CRUCIBLE& PLATE), ITO COATED GLASS PLATE, SILICON WAFER & SAPPHIRE SUBTRACT, SILVER PASTE, MAGNETIC BEADS AND TEFLON BEAKER



With best compliments from:

Ram Goyal (CEO)

M.Sc. (Physics)

S. G. Computers

G 59A, Ground Floor, Raiser Plaza, Jaipur

E-mail: sgcomputers.jpr@gmail.com

DEALS IN:

**Desktop, Laptop, Computer sale, service & accessories,
CCTV Camera, Security Systems**

ICSM 2014

International Advisory Committee

Benny Freeman

Univ. of Texas, USA

D. Weitz

Harvard Univ., USA

H. Stark

TU Berlin, Germany

R. Capral

Univ. of Toronto, Canada

V. Abetz

Univ. of Hamburg, Germany

D. Fink

U. A. Metropolitana, Mexico

F. Sciortino

La Sapienza, Italy

J. C. Gimel

Univ. of Angres, France

T. Nicolai

Univ. Du Maine, France

W. J. Koros

Georgia Inst. Tech., USA

D. Frenkel

Cambridge Univ., UK

F. Faupel

Univ. of Kiel, Germany

K. Dawson

UCD, Ireland

T. S. N. Chung

Nat. Univ. Singapore

Y. W. Tong

NUS, Singapore

National Advisory Committee

A. K. Bhowmick

Director, IIT Patna

I. K. Bhat

Director, MNIT, Jaipur

N. Sathyamurthy

Director, IISER Mohali

Sudhir K. Jain

Director, IIT Gandhinagar

Ashok Kumar

VC, CSJM Univ., Kanpur

Indranil Manna

Director, IIT Kanpur

R. C. Budhani

Director, NPL, New Delhi

Vinod K. Singh

Director, IISER Bhopal

D. Kanjilal

Director, IUAC, New Delhi

M. M. Salunkhe

VC, Cent. Univ. Raj.

R. K. Shevgaonkar

Director, IIT Delhi

R. K. Shevgaonkar

Director, IIT Delhi

National Program Committee

Ashutosh Sharma

IIT Kanpur

K. Sachdev

MNIT Jaipur

Suresh Chand

NPL New Delhi

Suresh Bhat

NCL Pune

T. Pradeep

IIT Madras

B. R. Mehta

IIT Delhi

S. K. Sharma

MNIT Jaipur

S. K. Kulkarni

Univ. of Poona, Pune

Suresh Chandra

BHU Varanasi

D. K. Avasthi

IUAC, New Delhi

Madan Rao

TIFR Mumbai

P. B. Sunil Kumar

IIT Madras

Y. K. Vijay

UOR, Jaipur



Conference Secretariat
Soft Materials Lab, Department of Physics
Malaviya National Institute of Technology Jaipur (INDIA)