Kaushal Kishore Memorial Award Lectures

AWARD LECTURE 1

Molecular Interaction Driven Self-Assembly of Amphiphilic Macromolecules

by

Professor Suhrit Ghosh
Polymer Science Unit
Indian Association for
Cultivation of ScienceKolkata

Date: January 8, 2017 | Time: 6.20 pm

AWARD LECTURE 2

Instability mediated Meso Patterning of Thin Polymer Films

by

Professor Rabibrata Mukherjee
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Date: January 10, 2017 | Time: 6.10 pm

Venue: MACRO-2017 at Hotel Uday Samudra
Kovalam, Thiruvananthapuram, India

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The Society for Polymer Science, India

AWARD LECTURE 1

Abstract

Immiscibility driven aggregation of amphiphilic block copolymers produce wide-ranging mesoscopic structures depending on their packing parameter which does not endow molecular scale precision in structural control of macromolecular assembly. We have recently introduced supramolecularly engineered amphiphilic macromolecules (SEAM) which consist of a supramolecular structure directing unit (SSDU) at the junction of the hydrophobic and hydrophilic segment of the amphiphilic polymer. The SSDU is made of a H-bonding functional group (hydrazide or amide) and a naphthalene-diimide (NDI) chromophore. By synergistic H-bonding and aromatic interaction, the SSDU pre-assembles and thus the subsequent step, involving hydrophobic association of the wedge, becomes a function of the first step (dictated by molecular interaction). Therefore the ultimate morphology of the self-assembled structure is determined by the distinct nature of the molecular interaction involved in the first step by fully ignoring the packing parameters. Consequently, two amphiphilic block copolymers having identical chemical structure and same hydrophobic/ hydrophilic balance organize to form distinctly different polymersome or cylindrical micelle depending on the nature of the single H-bonding functional group (hydrazide or amide) of the SSDU. So prominent is the motivation for self-selection, that in a mixture of two such polymers, self-sorted assembly was noticed although these two polymers differ merely by a SINGLE H-bonding functional group. The presentation will highlight our recent results in this area.

About the speaker

Dr. Suhrit Ghosh was born in 1976 in India. After completion of the undergraduate education in the Presidency College, Kolkata, he was admitted in the integrated PhD programme (Chemical Science) at the Indian Institute of Science, Bangalore in 1997. He received the M. S. (Chemistry) degree in 2000 and continued for PhD till 2005 under the supervision of Professor S. Ramakrishnan. Then he moved to the group of Professor S. Thayumanavan at the University of Massachusetts, Amherst, USA, for postdoctoral studies (2005-2007). Subsequently he worked as an Alexander von Humboldt postdoctoral fellow (2007-2008) with Professor Frank Würthner at the University of Würzburg, Germany. In 2008 he joined the Polymer Science Unit of the Indian Association for the Cultivation of Science (IACS), Kolkata, India, as an Assistant Professor where he currently holds the position of a Professor and head of the unit. Dr. Ghosh is an Associate of the Indian Academy of Sciences and recently has been admitted as a Fellow of the Royal Society of Chemistry (FRSC). He is the recipients of the SwarnaJayanti Fellowship (2015) from the Department of Science and Technology, Government of India and the B. M. Birla Science Prize in Chemistry (2014). He has been serving as an Associate Editor for RSC Advances since 2015. Research interest of his group includes supramolecular assembly of donor-acceptor π-systems, directional molecular interaction driven assembly of macromolecules and stimuli-responsive amphiphilic polymers for biological applications.

AWARD LECTURE 2

Abstract

Ultra thin films tend to become unstable due to amplification of disjoining forces on a non wettable substrate, leading to its spontaneous rupture and dewetting. While such instability is undesirable in coatings, it offers a novel nano fabrication strategy. However such instability patterns are random and isotropic, and thus have limited applicability. We have been exploring possibilities of aligning these structures by laterally confining the evolution pathway on topographically patterned substrates. That needs addressing issues related to coating of a thin film over a topographically patterned substrate (ACS AMI 2012). In this talk I will discuss how the precise morphology depends on the relative wettability of the substrate by the solvent. Further, I will introduce the novel concept of spin dewetting, where ordered morphologies form over a topographically patterned substrate during coating itself (Nano Letters, 2014). I will subsequently also highlight some of our recent work on the dewetting of a thin polymer bilayer on a topographically patterned substrate, that leads to extremely complex well ordered structures (Macromolecules 2013; Nanoscale 2016).

We will also discuss how utilizing the essential concepts of Soft Lithography and Stress Relaxation, we could come up with a novel nano patterning technique that allows fabrication of patterns with different feature height from a single stamp (ACS Macro Lett., 2013). We extended this approach for fabricating a topography gradient surface (ACS AMI 2014), that allowed us to perform various combinatorial dewetting studies (ACS AMI, 2012).

About the speaker

Dr Rabibrata Mukherjee obtained his B Tech, M Tech and PhD from Jadavpur University (1994), IIT Kharagpur (2003) and IIT Kanpur (2007, supervisor: Prof Ashutosh Sharma). He is presently an Associate Professor of Chemical Engineering at IIT Kharagpur, where he joined as in 2009 as an Assistant Professor. Prior to this, he was a Scientist at CSIR – Central Glass & Ceramic Research Institute (CGCRI), Kolkata between 1997 and 2009. His research area includes thin film instability and dewetting, novel soft lithography, colloidal self-assembly, super hydrophobicity, self organized wrinkling, polymer blends, droplet dynamics over slippery surfaces etc. He has published 40 research papers in Top class international journals like Nano Letters, ACS Nano, Advanced Materials, Advanced functional Materials Macromolecules, Langmuir, Soft Matter, ACS Applied Materials & Interfaces, Applied Physics Letters, etc. For his Ph. D thesis he won the best thesis awards from IIChE (Shah Schulman Award), INAE and MRSI (G C Jain Prize) in 2008. He received the CSIR Young Scientist award in 2007 and the MRSI medal in 2014. He is presently an Associate Editor of Bulletin of Material Science (Springer) and Advanced Powder Technology (Elsevier). He obtained the highest teaching feedback in IIT Kharagpur in 2015 and 2016 for his course "Instability and Patterning of thin Polymer Films". He is also an outstanding mentor as his students have won prestigious awards such as Best Graduate Student by European Materials Research Society, Shah Schulman Award from IIChE, along with innumerous best presentation awards in conferences.

About Professor Kaushal Kishore

Kaushal Kishore was one of the outstanding Polymer Scientists of our country. He was a professor at the department of Inorganic and Physical Chemistry at the Indian Institute of Science, Bangalore, till his untimely demise in 1999 at the age of 56. Kishore received his early education in chemistry from Lucknow University and his Ph.D. from the Gorakhpur University under the guidance of the distinguished physical chemist, Professor R. P. Rastogi. After a brief stint at Gorakhpur University as a lecturer, he moved to the Department of Inorganic and Physical Chemistry, at the Indian Institute of Science, as an Assistant Professor in 1974; he rose through the academic ladder to become a full professor in 1984 and served as the head of the department during the years 1994-1998.

Kishore's formal training was in thermodynamics and combustion chemistry. His early work in collaboration with scientists at ISRO and DRDO led to several novel discoveries that shed light on the role of different components in solid propellants; one of the very significant findings was that the polymeric binders generated polyperoxides during aging and combustion, which in turn accelerated the combustion process. With this insight, he soon discovered a unique phenomenon that he termed "autopyrolysis", which catapulted him into fame. He contributed immensely to the field of polyperoxides, both in terms of understanding its formation and exploiting their potential for a variety of applications. Thus, in his early work, he brought to bear upon the phenomenon of combustion his deep understanding of chemical thermodynamics to formulate, quantify and provide a detailed mechanistic insight into this incredibly complex process. His early work on combustion steered him to several other important problems, namely flame retardancy, which lead him to define a new dimensionless quantity he termed "Flammability Index", design of new additives that would retard/inhibit the flammability of polymeric materials, probing the molecular underpinnings of "plasticization", with a primary focus on the effect of molecular architecture on plasticizing efficacy. During his last years he studied a broad class of polymers he termed "weak-link" polymers; these were analogous to polyperoxides, such as polydisulfides and polyselenides; his main interest was to understand the degradation mechanism of these weak link polymers.

Kishore's work was always characterized by its ingenuity, depth and simplicity of analysis. He saw science in everything and had a strong conviction and motivation to understand all phenomena he observed at the microscopic and, if possible, at a molecular level. His solid foundation in chemical thermodynamics brought to polymer chemistry a much-needed "thermodynamic bias" – a term he often used to characterize his work. Using numerous tools, starting from thermal analytical methods, rheological measurements, NMR and computational methods, he attacked problems with passion and a characteristic zeal – which often culminated in nailing the issue on the head. His students and coworkers remember him with great fondness – for he was not only their research guide but also their friend and a confidant.

Recognition for his achievements came in many forms. Professor Kishore was awarded the Bhatnagar prize in 1988, was elected to the Fellowship of the Indian Academy of Sciences in 1991 and later to that of the Indian National Science Academy in 1999. Kishore served on several important decision-making bodies in the country – various assessment committees, research councils of national laboratories and in many others.

About Kaushal Kishore Memorial Award

The Kaushal Kishore Memorial Award was instituted in 2014 to recognize young outstanding polymer scientists of our country who have made outstanding research contributions and have demonstrated the potential to become global leaders in their chosen fields of research. The corpse fund for this award was donated to the Society for Polymer Science (India) after the successful conduct of the FAPS-MACRO 2013 conference in Bangalore. The award is open to researchers, under 45 years of age, who are working in India and will be awarded biannually during the MACRO conference held under the auspices of SPSI. The award will carry a cash prize of Rs 100,000, along with a citation.