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**Publication and Science Communication Unit**

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## Dr. Lele selected for S. S. Bhatnagar Prize in Engineering Sciences

Dr. Ashish K. Lele, Scientist, National Chemical Laboratory (NCL), Pune has been selected for the prestigious S.S. Bhatnagar (SSB) Prize in Engineering Sciences for the year 2006. Dr. Lele's work involves probing microstructure (at a molecular scale or meso-scale) of polymeric materials and relating it to the macroscopic dynamical and equilibrium properties using a combination of theory and experiments. He particularly works on smart gels, Influence of molecular topology on the dynamics, and polymer-nanoclay composites.

While smart gels were shown in the past to demonstrate sensitivity, selectivity, mobility, shape memory and enzyme catalysis, the research from Dr. Lele's group demonstrated for the first time two additional life-mimicking features namely, macroscopic self-organization and healing in hydrogels. The discovery of these two novel phenomena was hinged on understanding metal ion complexation with specific functional groups attached to the polymer chains. The theoretical basis of this work was provided by Dr. Lele's work on developing a mean field equilibrium model that specifically accounted for hydrogen bonding and dispersive interactions in hydrogels. Dr. Lele's work highlighted the link between the macroscopic swelling-collapse transition phenomenon and molecular events.

The understanding of how topology governs the dynamics of macromolecules is extremely important for polymers of different architectures such as linear, branched, ring, star and combs. Such polymers are expected to have novel applications in adhesives, gels, processing aids, bio-medical devices, etc. Dr. Lele has been exploring the roles of intrinsic and extrinsic constraints on the dynamics of polymer molecules. His group has investigated the role of constrained dynamics of grafted macromolecular brush in wall-slip, a phenomenon which is of substantial fundamental as well as applied interests. On the one hand it questions the basic assumption of the 'no-slip' boundary condition in fluid mechanics of macromolecular

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fluids and on the other hand it is highly relevant to the polymer processing industry. Dr. Lele's group has developed a coarse grained but rigorous molecular model describing the coupling between the dynamics of tethered chains and the bulk chains. The model unearthed for the first time the crucial role of the convective constrained release process as being the root cause of the stick-slip instability. Recently, he has investigated the dynamics of endless flexible ring polymers. The key questions to answer is whether such polymers, when constrained, can reptate at all; knowing well the critical role played chain ends in the reptation mechanism. Recently, theoretical research from his group resulted in the formulation of the first coarse grained mean model that rigorously predicts the dynamical parameters of thermal motions for ideal flexible ring polymers in fixed as well as moving obstacles.

Recently, organo-nanoclays have attracted attention in industry and academia alike due to the substantial improvement they impart to thermo-mechanical and barrier properties of polymeric resins for a relatively small incorporation into the matrix. Dr. Lele's group was an early entrant in this technologically relevant research area and illustrated crucial structure-property relations in these nanocomposites. They were the first to show that polymer nanoclay composite melts exhibit an apparent yield phenomenon in which the viscosity of the melt precipitously drops from a very high value (due to hydrodynamically percolating network of the highly asymmetric nanoclay tactoids) to a much smaller polymer melt-like value (due to flow induced orientation and breakage of the network) on application of a shear yield stress. Dr. Lele demonstrated the usefulness of rheology as a tool that should be used together with other techniques such as x-ray scattering and electron microscopy to elucidate the dispersion of nanoclays in polymers. Further, he quantitatively established through the use of a novel in situ rheo-xray technique the effect of shear on the orientation of the clay and the kinetics of partial disorientation on cessation of shear.

The SSB Prize, instituted in the honour of founder Director of CSIR, is the highest Indian award in Science and is known as "Shanti Swarup Bhatnagar (SSB) Prize for Science and Technology". The award carries a citation, a plaque and a cash prize of Rs 2 lacs.

Dr Lele leads "Complex Fluids & Polymer Engineering" group at NCL. He has been earlier awarded with CSIR Young Scientist Award (1996), Indian National Science Academy Young Scientist Award (1998), and UICT Alumni Young Scientist Award (2003). He is a fellow of the Indian National Academy of Engineering (2004). He has to his credit thirty-eight papers published in international peer reviewed journals, eleven conference papers and one US patent.

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National Chemical Laboratory (www.ncl-india.org), Pune, India is a research, development and consulting organisation with a focus on chemistry and chemical engineering. It has a successful record of research partnership with industry. National Chemical Laboratory (NCL) is a flag ship laboratory of the Council of Scientific & Industrial Research (CSIR) which is the largest network of publicly funded research institutes in India.


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