

Soft matter: Recent developments*

'Soft condensed matter' or in short 'soft matter' comprising colloids, micelles, emulsions, macromolecules, liquid crystals, membranes, nanomaterials, supramolecular aggregates, drug encapsulation, etc. has emerged as a major thrust area of interdisciplinary research. This field finds application in everyday life, promising industrial growth and helps in understanding the intricacies of the life processes. In view of great potential and all round importance of the subject, its status and trend require occasional assessment and reviewing on a common platform by scientists, researchers and technologists. This led the Indian Society for Surface Science and Technology and the Centre for Surface Science, Jadavpur University, Kolkata to organize an International Conference on Soft Matter.

More than 250 delegates attended the conference from different parts of India and abroad (Russia, Germany, Australia, Japan, Korea, Taiwan, Portugal, Pakistan, Malaysia, etc.). There were 40 invited lectures on topics like colloids and emulsions, surfactants and micelles, polymers and nanoparticles, membranes, monolayers, etc.

S. Aditya (Indian Society for Surface Science and Technology), in his address briefly summarized the developments in various areas of soft matter and its present state-of-the-art. According to him, although colloidal systems were known, the famous scientist Ostwald described them in 1915 as a 'world of neglected dimension'. In India, research schools developed under the guidance of J. N. Mukherjee, B. N. Ghosh, S. R. Palit in Kolkata, S. S. Bhatnagar in Lahore and Mata Prasad in Bombay.

In the first session on colloids and emulsions, Dinesh O. Shah (Centre for Surface Science and Engineering, University of Florida, USA) discussed in detail the results of investigations of several biomedical and engineering systems in relation to

interfacial phenomena. This included the formulation of a tear substitute that could stabilize a thick layer of water on the cornea and thus eliminate the discomfort of 'dry eye syndrome', promising blood compatible and injectable nanoemulsions for reversal of drug toxicity specially designed to tackle global problems of drug overdose, attempted suicides and pesticidal poisoning and so on. He also described preparation of a variety of nanoparticles in micro emulsion droplet form as nonreactors. These nano powders are useful as starting materials for preparing superconductors, as the prepared samples were more dense and showed seven times greater Meisner signals compared to conventionally prepared samples.

The second session was on surfactants and micelles. Li-Jen Chen (Department of Chemical Engineering, National Taiwan University) spoke on the hydrophobic effect and heat capacity change of micelle formation for non-ionic surfactants. He stated that thermodynamic relationship could be applied to experimental critical micelle concentration (cmc) data to evaluate enthalpy change of micellization and heat capacity of micellization. The striking resemblance between protein folding and micellization of surfactants, especially the hydrophobic effect was also discussed in detail.

In the third session on 'surfactants and micelles' (B), Kyang-Hee-Lim (Department of Chemical Engineering, Chung-Ang University, Seoul, Korea) exhibited models on temperature dependence of cmc in aqueous surfactant solutions. The linear behaviour of the enthalpy of micellization with temperature and compensation phenomena in which the enthalpy and entropy of micellization were related linearly, were also shown through mathematical equations. Radha Ranganathan (Department of Physics and Astronomy, California State University, USA) spoke on the scaling properties of ionic micelles with aqueous counterion concentration. She showed that properties like aggregation number, micelle hydration and Kraft temperature scale were found to depend solely on the aqueous counterion concentration. Thus

a series of surfactant/salt combinations could be prepared whose members, in spite of having different surfactant and salt concentrations, would yield the same aqueous counter-ion concentration. Measurement of hydration by the electron spin resonance method was also discussed in detail.

The first session on 19 November 2004 was on soft matter study. Yoshiaki Moroi (Kyushu University, Japan) discussed in detail the thermodynamics and kinetics of solubilization into micelles. According to him, the solubilization phenomenon was important industrially as well as biologically. Determination of the first step-wise solubilization constant, introduction of a theoretical expression for rate constant determination based upon the photochemistry in a micellar system and determination of constants for wider application to material transport across the membrane were discussed.

Yurii A. Shchipunov (Russian Academy of Sciences) discussed hybrid polysaccharide-silica nanocomposite materials fabricated by sol-gel technique with a novel biocompatible precursor. He described examination of nanocomposite formation, properties and structure by dynamic rheology, differential scanning calorimetry, scanning electron microscopy and atomic force microscopy.

In the poster session, 120 posters were displayed. Works on topics such as stabilizing effect of low concentration of urea on reverse micelles, role of microstructural parameters in micellar enzymology, fluorimetric probing of albumin-surfactant interaction, reactions of some lanthanides with adenosine diphosphate in aqueous and micellar media, synthesis of silver nanoparticles embedded in bio-artificial matrix and preparation of nanocrystalline tin oxide powder for gas sensor applications were explained through these posters.

*A report on the International Conference on Soft Matter organized at The Park (Hotel), Kolkata, during 18-20 November 2004 by the Indian Society of Surface Science and Technology and the Centre for Surface Science, Jadavpur University, Kolkata.

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