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Structures, interactions and optical responses from polymer and polymer nanocomposites

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Biological functions of biopolymers like proteins strongly depend upon their structures which can be modified by the interactions with surrounding environments. Understanding protein-protein interactions in solutions are very important as it helps in obtaining protein crystals, biochemical roles of proteins, ideas about some diseases like Alzheimer, Parkinson, etc. Biochemical functions of proteins are regulated in the presence of ions around them and hence the effect of ionic strength, nature of ions, temperature, pH, concentration, nanoparticles, etc. strongly affect the protein-protein interactions. Among different proteins, globular proteins like BSA, HSA, lysozyme can be considered as charged, colloidal particles and both short-range attraction and long-range electrostatic repulsion exists among the protein molecules in solution and hence Derjaguin-Landau-Verway-Overbeek (DLVO) potential can be applied to obtain the interaction nature and to explain the phase behaviors. However, DLVO model cannot fully explain the rich behavior of proteins due to the presence of inhomogeneous surface charges and irregular shape of proteins. One, two or three attractive or repulsive Yukawa form potentials were also used to explain the nature of interactions. Small angle neutron scattering (SANS) study shows that in combination with the short-range attraction and intermediate-range electrostatic repulsion, a possible weak long-range attractive interaction between protein molecules may exist. SANS study also shows that for different counterions and for the equal ionic strength, the interactions are largely modified by the tri-valent (Fe^{3+}) and di-valent (Ni^{2+}) ions and comparatively less by the mono-valent (Na^{+}) ions. Below the isoelectric point, protein has a net positive surface charge although local charge inhomogeneity presents and as a result interaction nature modifies. In presence of different ions, cold gelation behaviors of proteins have also been studied which indicates the fractal structure formation after gelation. In presence of charged polymers, conformational changes of globular proteins may occur depending upon the charge states of the polyelectrolytes. Protein-polyelectrolyte complexes (PPC) show modified behaviors than that of pure protein/polymer. It has been observed that the thin films of PPC show a larger red-shift in the fluorescence emissions in comparison with that of pure protein. Protein and protein films are also used as templates to form metallic nanostructures of different shapes and sizes which are also used for modifying both optical and electrical properties.

Biography

Dr. Sarathi Kundu did his M.Sc. from Visva-Bharati University, West Bengal. He completed his Ph.D. work from Saha Institute of Nuclear Physics, Kolkata in 2006 and the degree is conferred by Jadavpur University. He did is Post-Doctoral research work from University of Paris Sud, France. He was Visiting Faculty Fellow in S.N. Bose National Centre for Basic Sciences, Kolkata and Visiting Scientist in KEK, Japan. At present he is Associate Professor in IASST, Guwahati. Dr. Kundu has been working on soft matter physics with emphasis on organic thin films and nanomaterials. He is interested to explore structures and properties using scattering, spectroscopic and microscopic methods. Dr. Kundu has published nearly 50 journal papers so far.

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