TIFR Centre for Interdisciplinary Sciences
21 Brundavan Colony, Narsingi, Hyderabad 500075

Seminar

Novel Hybrid Complexes from Proteins and Polymer Surfactants

Kamendra P. Sharma

University of Bristol, UK

Proteins represent an extensive class of soft biological colloids with a multitude of advantages that can be exploited for fabricating functional smart materials and bio-based devices. Protein-based biomaterials with distinct structural and physical characteristics, such as elastic fibronectin-elastin films, ultrathin nano-filtration ferritin membranes, micro-porous bovine serum albumin membranes, silk fibroin patterned films and food-protein films, have been recently described. However, incorporation and retention of protein functions such as catalytic activity remain a considerable challenge due to problems associated with surface-induced denaturation, molecular aggregation, steric hindrance at the active site, and incompatibility with non-biological components. Clearly, there is a pressing requirement to retain both structure and function if high performance biomaterials in the form of films, hydrogels, nanoparticles, and fibers are to be successfully exploited for use in bio-sensing, tissue regeneration, molecular recognition, drug delivery, and opto-electronic devices.

In my talk, I will show my present work related to the development of a new class of protein-based nano-conjugated systems based on the molecular integration of structurally and functionally compatible polymer surfactants. I will show how the accessibility of reactive amino acid side chains present on the surface of globular proteins provides a spatially organized chemical platform for integrating hybrid components that can then be used to tune various biomaterial properties via site-specific surface functionalization. Specifically, I will talk about my recent work on the synthesis and characterization of single-component stoichiometric protein-polymer surfactant conjugates that melt at ambient temperatures to form solvent-free liquids with protein concentrations as high as 20-25 wt.%. These novel protein biofluids offer remarkable benefits over aqueous protein dispersions, including exceptionally high concentrations of protein molecules, remarkable levels of thermal stability (half denaturation temperatures of around 160°C), persistent protein dynamics and sustained biological functions. For example, equilibrium dioxygen binding and reversible redox transitions have been demonstrated in solvent-free myoglobin melts, and enzyme activity reported in solvent-free liquid lipases. Working on solvent-free liquid myoglobin and lipase, I also developed an experimental methodology that resulted in the first known examples of enzymatically active self-standing films obtained from the hierarchical assembly of protein-polymer surfactant bio-conjugates. This represented a novel and generic template-free hierarchical self-assembly methodology to fabricate self-supporting functional biomaterials comprising protein concentrations of ca. 35-40 wt.%.

Tuesday, Oct 14th 2014

11:30 AM (Tea/Coffee at 11:15 AM)

Seminar Hall, TCIS