



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : SUMIT CHOWDHURI
Roll Number : 176122040
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Name of Thesis Supervisor(s) : Prof. Debapratim Das
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SHORT ABSTRACT

My Ph.D. thesis focuses on the creation of short self-assembling peptide amphiphiles and polymer-based hydrogels, and coacervates to create several smart self-assembling systems. Cysteine have been purposefully included in the peptide backbone to provide redox responsiveness to the self-assembled systems. All peptides have a 'Lys-Cys' structural backbone, and Cysteine demonization plays an important role in self-assembly. Pyrene moiety was employed in two cases to add π - π staking and hydrophobicity into the self-assembly process. Two new Peptide and Peptide-Polymer-based composite hydrogels have been synthesized and have been used in various potential biological applications.

Initially, the hydrogelation process of short peptides containing C-terminal "Lys-Cys" (KC) residues was thoroughly investigated. When we add two hydrophobic amino acids in the N-terminal of the 'KC' peptide, they failed to form any self-supporting hydrogel but with the incorporation of the acyl unit, only peptides containing phenylalanine and Valine can form hydrogels via Cys residue dimerisation, and the Ac-FFKC-NH₂ hydrogel was found to be the strongest and most effective for proliferation within the hydrogel's 3D matrix in both differentiated RAW macrophages and undifferentiated THP-1 monocytes. In another study, the presence of a very small amount of PyKC increases the strength of the hydrogel with 4 different biopolymers and confers thixotropic behavior. The Hyaluronic acid-PyKC composite hydrogel was the strongest among the four composite hydrogels. It is biocompatible, stable under proteolytic degradation and assists matrix calcification and can support osteogenesis because MC3 T3-E1 osteoblast progenitor cells grown on the materials of the composite hydrogel. Finally, in my last two works, coacervation was achieved by employing dynamic covalent chemistry with an aldehyde-containing polymer (Poly-CHO) and the dimer of PyKC having the disulphide linkage. Coacervates are responsive to pH as well as with the redox agents. They have the capability to sequester a wide variety of small molecules, proteins and enzymes. Coacervate is also capable to entrap and protect enzymes (HRP) from degradation in the presence of excess amount of hydrogen peroxide. Finally, the dual transient property of the coacervates was achieved by utilizing dynamic imine chemistry and redox chemistry.