



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.
Thesis Title: De novo Design of Bioinspired Peptide based Molecular Constructs
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Thesis Submitted to the Department/ Center : BSBE
Date of completion of Thesis Viva-Voce Exam : 23.04.2022
Key words for description of Thesis : Functional Bio-nano assemblies Work

SHORT ABSTRACT

Molecular self-assembly is a powerful tool for the generation of functional nanostructures in a bottom-up fabrication. Peptides have drawn significant attention to be used as basic building blocks for such hierarchical assemblies. Diversification of chain stereochemistry offers tremendous increase in the peptide and protein design space. The use of D-amino acids in the peptide sequence can possibly help in accessing the otherwise “forbidden” region of the Ramachandran map for the generation of novel functional peptide sequences composed of L and D amino acids. In this thesis, we have de novo designed different sets of peptide molecules for four different application fronts. In the first project, we have designed a 30 amino acid long artificial blue fluorescent protein by impregnating an unnatural amino acid in the hydrophobic core of an altogether novel fold, which gives blue fluorescence. In the second project, we have designed syndiotactic hexamer peptide (Ff)₃-OH, which folds into a gramicidin helical architecture, facilitating an extended phenylalanine network forming quantum confinement. In the third project, we have synthesized Fmoc conjugated ultra-short peptide hydrogels, with interesting self-healing property, which make them potential candidates for tissue engineering and drug delivery. The antimicrobial property of the synthesized peptide hydrogel has been verified against Gram-positive and Gram-negative bacteria.

The aromatic π - π stacking involves interactions of aromatic rings, resulting in the formation of stable nanostructures. Triphenyl group (trityl radical), possessing three-phenyl rings, forms an

interesting crystalline organic nano-flower through aromatic π - π stacking interactions. In the last project, we have explored the possibility of using 1,2 bis(tritylthio) ethane crystal, for removing heavy metals in water. As an extension of this objective, we fabricated a cost-effective, water purification system using an isoform of human hair (pulverized human hair) for heavy metal removal.



