



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title: **Development of Novel Recyclable Coupling Reagents and Investigation on Chirality Controlled Self-Assembly of Dipeptides**

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Key words for description of Thesis Work : Recyclable coupling reagents, sustainable organic transformations, peptide synthesis, peptide self-assembly, secondary structure, morphology (ribbon, nanorod, nanotube, fibril, vesicle), drug/dye binding, metal ion sensing.

SHORT ABSTRACT

This thesis contributes to the development of novel coupling reagents for sustainable organic transformations. We demonstrated straightforward, efficient methods for synthesizing these coupling reagents. These reagents demonstrate excellent stability and are easily scalable. They are efficient for synthesizing racemization-free amides, hydroxamates, esters, thioesters, and peptides sustainably. Additionally, they are effective in modifying natural products and drug molecules under optimized conditions and synthesizing bioactive long-chain linear and cyclic peptides in solid-phase using green solvent mixtures. Some of our coupling reagents are also effective in synthesizing nitriles and assist in the metal-catalyzed synthesis of ketones from carboxylic acids with excellent yields. We synthesized a diverse library of amides, hydroxamates, esters, thioesters, peptides, nitriles, and ketones with excellent yields.

Additionally, we provided extensive structural information, including supramolecular self-assembly, conformation, and the morphology of various synthesized peptides containing natural and unnatural amino acids. We investigated the influence of side chains and chirality of amino acids on the self-assembly of Boc-protected dipeptides and the chirality's impact on Fmoc-diastereomeric and Fmoc-enantiomeric dipeptides. Peptides containing alternating L/L, L/D amino acids, and only one chiral (L or D) amino acid formed various nanostructures (ribbons, nanorods, nanotubes, fibrils, vesicles). Some of these self-assembled structures exhibited significant thermal stability upon dry heating. Additionally, some peptides also demonstrated the capability to bind bioactive drugs and dyes, and serve as fluorescent probes for various metal ions (Fe^{3+} , Cr^{6+}).