INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Stimulus Responsive Functional Nano-assemblies of Short-peptides

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SHORT ABSTRACT

The ability to direct peptide self-assembly opens up important avenues to construct a rich variety of molecular assemblies with novel functions. Besides, directing the folding and inhibiting aggregation may be an effective strategy in reducing amyloid elicited toxicity. In this thesis, we have explored and unveiled various physical and chemical modulators during peptide self-assembly for producing functional materials and developing non-invasive therapy against Alzheimer's disease. Central to our strategy is to rationally design peptide sequences with residues that respond to the applied stimulus and direct the self-assembly. We have designed, synthesized, and characterized a minimalistic peptide model that structurally mimics the active site of lytic polysaccharide monooxygenase at physiological pH. We have employed various spectroscopic techniques such as UV-Vis, CD, EPR, and NMR to characterize the structure of the complex. Using the knowledge of the Ramachandran plot, we have designed a series of 12 tri-peptides and tested their ability to form catalytic hydrogels for the C-C bond-forming Aldol reaction. We have examined the effect of external electric field on the structure-property relationship of the hydrogels in terms of their catalytic stereoselectivity. Further, we have extended our study to examine the effect of electric and magnetic field on the aggregation propensity of Aβ1-42 peptide during the primary and secondary nucleation process. The efficacy of the applied fields was characterized using various biophysical techniques and cell viability assay on human neuroblastoma (SH-SY5Y and IMR-32) and human embryonic kidney cells (HEK-293). Overall, this thesis put forth the possibility of employing a physical perturbant like the electric field, in modulating chemical as well as biological effects, in fine-tuning their designed functions.