A MINIMALISTIC APPROACH FOR FUNCTIONAL SELF-ASSEMBLING PEPTIDE AND PSEUDOPEPTIDE SYSTEMS

ABSTRACT

The thesis entitled **"A Minimalistic Approach for Functional Self-Assembling Peptide and Pseudopeptide Systems"** presents the modest designs of peptide and pseudopeptide molecules for the multifaceted applications in the diverse fields of nanotechnology and biotechnology. In addition, we have explored a hitherto unknown class of vesicles altogether different from the conventional bilayer vesicles. The work presented in the thesis has been divided into five chapters.

Chapter 1

Chapter 1 gives a panoramic view of designer peptide and pseudopeptide systems in a systematic manner encompassing all the preliminary designs as well as the recent advancements. A variety of self-assembling peptidic systems ranging from short peptides, amphiphilic peptides, cyclic peptides, linear peptides to polymeric peptides have been reviewed thoroughly. The mechanistic insight into the formation of nanotubes and vesicles using different strategies proposed in the literature, is also given. In addition, the diverse applications of designer peptides in the field of drug delivery, anion sensing and organic electronics is highlighted.

Chapter 2

Chapter 2 deals with the design, synthesis and self-assembling properties of a series of cystine-cored minimalistic dipeptides that exhibited the prominent redox-responsive behavior. Various experimental as well as the computational investigations were performed to reveal the self-assembling mechanism of dipeptides in water. Further, the encapsulation of drug molecules by the vesicle-forming dipeptide and their subsequent redox-triggered sustained release in an intracellular milieu is demonstrated.

Chapter 3

Chapter 3 presents the minimalistic design strategy for the development of amino acid appended supersensitive anion sensors that can detect anions in both aqueous as well as organic media. Various spectroscopic and electrochemical measurements were performed to demonstrate the ultratrace sensing of anions in water with the lowest limit of detection values reported so far. Further, the self-assembled morphologies of the host molecules were also investigated using different ultramicroscopic techniques.

Chapter 4

Chapter 4 outlines the fabrication of organic field effect transistors (OFETs) in a bottom-gate/bottom-contact configuration using the self-assembling peptidic polydiacetylenes. The peptide-based OFETs were found to exhibit a p-type FET behavior with an exceptionally high hole mobility of up to 9.29 $cm^2\ V^{-1}\ s^{-1}$ at room temperature. The key role of aromatic amino acids in providing high mobility values to the OFET is highlighted.

Chapter 5

Chapter 5 describes the new class of vesicles named as “reverse micellar vesicles”, possessing dual features of classical micelles and conventional vesicles. The novel model of vesicles was established by using a series of self-assembling pseudopeptidic polymers that were synthesized by the ring opening metathesis polymerization (ROMP) of lipidated amino acids appended norbornene monomers. The comprehensive ultramicroscopic and spectroscopic analyses were performed to delineate the hierarchical mechanism of formation of reverse micellar vesicles.