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Title:	Functional Polymers towards Photo-healable Coating, Orthogonal Nanocompartments and Chiroptical Properties
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Abstract:	<p>Proteins are among the most sophisticated natural polymers prevalent in nature that can respond to variations in the environment and can then alter their three-dimensional structures in order to perform highly specific functions, such as enzymatic catalysis. This inspires chemists to understand the fundamental principles behind the design of nature's architectures by designing biomolecular mimick. In that regard, functional polymeric systems offer excellent options for imparting structural and size control to furnish to a variety of compartmental applications, such as controlled self-healing, nanocompartment for drug delivery, biosensing and catalysis, that have been enlisted in chapter 1. In chapter 2, we discussed design of a series of smart photoresponsive polymers with stimuli- responsive thymine moiety using controlled free radical polymerization. The random functional copolymer systems with hydrophobic low-viscosity polybutylacrylate side chain grafted with photodimerizable thymine moiety result in the formation of uniform nanoparticles with a controlled size upon the polymer chain collapse. The rigidification of the crosslinked segments provide us with the strategy of photo-modulating the glass transition temperatures (T_g) for self- healing application. In chapter 3, we exploited RAFT polymerization to design a series of amphiphilic diblock copolymers systems with hydrophilic PEO and hydrophobic block tethered with stimuli- responsive moieties e.g. ferrocene and coumarin. The diblock copolymers show interesting chain collapse behavior of the hydrophobic block with respect to the stimuli such as light, redox and chemical cue thereby, furnishing reversible transformation of the vesicle to micelle. Further, co- assembled vesicles of the polymers with orthogonal stimuli-response to light or redox cue transform into self-sorted vesicles and micelles as demonstrated for the first time. Next, inspired from the complex hierarchical structure of the proteins, we designed triblock polymers that consist of PEO as a hydrophobic block and a hydrophobic block tethered with ferrocene and coumarin (Chapter 4). Using RAFT polymerization we designed segmented sequence specific triblock polymers and random triblock polymers containing ferrocene and coumarin moieties in the hydrophobic blocks. The sequence of the segmented blocks with respect to the stimuli-responsive moieties affects the chain collapse efficacy of the hydrophobic blocks. Such controlled polymer chain collapse leads to the interesting transformation of the vesicles to micelle nanostructures using the external stimuli e.g. light, redox, and chemical cues. Finally, we also demonstrated a unique design of topochemical polymerization satisfying the pre- requisites of monomers arrangement to give rise to peptide anchored polydiacetylenes (PDAs) with high crystallinity, tactility and chiral purity (Chapter 5). Such PDAs possessing ene-yne alternated polymer chains, which exhibit unique optical properties, as well as chiral amplification, due to their interaction with metal nanoparticles. Moreover, we demonstrate selective chiral amplification in polymer-plasmonic hybrid by designing chiral amino acid appended AuNPs in order to achieve stereo-structural matching of the pairs of polymer-plasmonic hybrids. This may pave way for the interesting design of biosensors and chiroptical materials in the future .</p>
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