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Tuning self-assembled peptide nanostructure via non-covalent interaction

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Nanomaterials, including quantum dots, fullerenes, nanoparticles (zero dimension), nanotubes, nanowires, nanofibrils (one dimension), and graphene (two dimension) possess intriguing physical, chemical and biological properties. As a consequence, these materials form the basis of many interdisciplinary studies, where scientists have been inspired by self-assembly processes occurring in nature to construct advanced nanomaterials with applications in many fields. Self-assembly involves the organization of molecules into highly ordered structures through specific, local interactions among the components, without any external direction. Weak interactions, such as Van der Waals, electrostatic, and π - π interactions, as well as hydrogen bonding, and halogen bonding can lead to all kinds of challenging self-assembled nanostructures. The hierarchical structures of many peptides are attributed to self-assembly, therefore, could potentially act as building blocks for new materials with significant functionalities and a range of biological functions. In our recent work, non-covalent interactions including hydrogen bonding, hydrophobic interaction and electrostatic interaction were employed to modulate the peptide assembled nanostructures. We could successfully realize the peptide assembly transition from nanospheres to nanofiber by tuning hydrogen bond and hydrophobic interaction; furthermore, two dimension peptide nanopatch could be constructed instead of nanofiber by introducing the terminus intermolecular hydrogen bonding between the peptide and small molecules. The electrostatic interaction was proved to play an important role in peptide self-assembly and disassembly. Furthermore, it is significant to be addressed that the mechanical properties of peptide assemblies do changing after the nanostructure transition of peptide occurred. These peptide-based nanostructures could potentially be applied to be a candidate of biomaterials with potential importance in a wide range of technological applications.

Biography

Lei Liu has completed his PhD in 2010 from National Center for Nanoscience and Technology, China, after that he went to iNANO Center of Aarhus University, Denmark for postdoctoral studies about 3 years. He is the Young Distinguish Professor of Jiang Su University China now. He has published more than 20 papers in reputed journals and 3 patents. He also completed the book chapter of Nucleic Acids Nanotechnology, and involved in the translation of "Springer Handbook of Nanotechnology". Now he is also the reviewer of different journals such as PCCP, Nanoscale, and Chemical Communication, etc.

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Steric repulsion-stabilized magnetically responsive photonic crystals and their individual retractable photonic crystal nanochains

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Magnetically responsive photonic crystals (MRPCs) have the merits of high refractive index, fast and fully reversible photonic response across the visible spectrum under external magnetic field when comparing to the traditional photonic crystals composed of monodispersed SiO_2 or polymer particles. They are promising for the fabrication of chemical or biomolecule sensors. In this presentation, we demonstrate the construction of steric repulsion-stabilized MRPCs in diverse organic solvents based on monodispersed superparamagnetic Fe_3O_4 @PVP CNC particles, which have been synthesized by a modified polyol process in the presence of glucose and polyvinylpyrrolidone (PVP), and have shown a long-range steric repulsion sufficiently strong to counteract the magnetic attractive force. The as-built MRPCs in solvents good compatible with PVP show the color tunability nearly within the entire visible spectrum and almost independent of the solvent polarity, ionic strength or pH value, highlighting the advantages over the so far reported electrostatic-stabilized MRPCs for the preparation of polymer-matrix PC composites. Furthermore, we have for the first time fabricated individual photonic crystal nanochains with retractable lengths under external fields by dispersing the steric-stabilized Fe_3O_4 @PVP CNC particles in solutions of monomers, which are subsequently polymerized under external magnetic field and UV irradiation. The as-obtained responsive photonic nanochains may response quickly and reversibly in the optical properties when the external environment such as temperature, pH, or solvent etc. changes due to the significantly shortened diffusion length of analytes, accelerating the response rate of photonic crystal sensors for chemical sensing or biosensing devices. Our results greatly facilitates the solidification and the practical applications of the magnetically responsive ordered photonic crystal structures in organic polymers, such as in sensors, reflective displays and optical systems, etc.

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