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Hydrophobic, hydrophilic and amphiphilic silica/copolymer nanoparticles by surface-initiated atom transfer radical polymerization

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Silica/Diblock Copolymer Nanoparticles (SDCNs) are synthesized by surface-initiated atom transfer radical polymerization (SI-ATRP) for hydrophobic, hydrophilic and amphiphilic materials, their properties as protein-resistance coatings are investigated. The hydrophobic SDCNs of SiO_2-g-PMMA-b-P12FMA is synthesized by Methyl Methacrylate (MMA) and dodecafluoroheptyl methacrylate (12FMA) using silica surface initiator (SiO_2-initiator with a density of 0.573 mmol·g-1). The three mass rations of hydrophobic SDCNs are proved as 25–30 nm core–shell particles in $CHCl_3$ solution composed of P12FMA core and PMMA shell, but densely twined together as agglomerated particles. The increasing P12FMA content could obviously increase the surface roughness of the film (50-500 nm) and thereby contributes to the hydrophobic (112-118^0) and oleophobic (45-78^0) properties with lower water absorption and viscoelasticity, but a high thermo stability at 420-450c. The amphiphilic SDCNs of SiO_2-g-P(PEGMA)-b-P(12FMA) is prepared by poly (ethylene glycol) methyl ether methacrylate (PEGMA) and P12FMA. Their amphiphilic behavior, lower critical solution temperature (LCST), and surface properties as protein-resistance coatings are characterized. The individual spherical nanoparticles (150 nm -170 nm) as P(PEGMA)-b-P(12FMA) shell grafted on SiO_2 core (130 nm) to gain obvious low LCST at 36-52^{0}C and high thermo stability at 290-320^{0}C. The water-casted SiO_2-g-P(PEGMA)-b-P(12FMA) films obtained much rougher surface (125.3–178.4 nm) than THF-casted films (11.5–16.9 nm). Therefore, the water-casted surfaces exhibit obvious high water adsorption amount and hard adsorbed layer, but present loser adsorbed layer than THF-casted films. While, the introduction of P (12FMA) segments does not show obviously reduce in the protein-repelling adsorption of SiO_2-g-P(PEGMA)-b-P(12FMA) films. The hydrophilic SDCNs of SiO_2-g-P(PEGMA)-b-P(PEG) is prepared by PEGMA and poly(ethylene glycol) methacrylate (PEG). Their temperature sensitive behavior, pH response and surface properties as protein-resistance coatings are characterized. 220 nm core-shell nanoparticles are formed in water solution, which gained LCST at 60-77˚C and good dispersion in water when pH>5.0. The introduction of P(PEG) segments could increase the protein-repelling adsorption of SiO2-g-P(PEGMA)-b-P(PEG) films. Therefore, these SDCNs are suggested to be used as protein resistance coatings.

Biography

Ling He is a Professor and Director of Chemistry Department, Xian Jiaotong University. She got her PhD in Material Chemistry and MSc in Analytical Chemistry in China. She has worked as Visiting Scholar in University of Munich University (Germany) and University of Bologna (Italy). The main research fields are focused on copolymers and their self-assembly micro/nano hierarchical properties for coating materials, and the characterization of polychromy and analysis of natural polymeric compounds by nondestructive and *in-situ* detecting techniques. The main research activities includes hosting the National Key Basic Research and Development Program (973 program), Natural Science Foundation of China (NSFC) program; Key Project in the National Science and Technology Pillar Program of China. During the last five years, she has published about 80 articles in peer reviewed journals, published 5 books and made many presentations as well as invited plenary lectures in international meetings and conferences.

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