

Using Synchrotron Light Source Performed on SAXS to Study Phase Transformation of Self-Assembled Nanostructure of PS-P2VP/HAuCl₄ Hybrid System

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Abstract: Self-assembly is ubiquitous in nature and has now become as a new approach in science and technology. The organization of inorganic materials into periodic nanostructures by using block copolymers as templates for self-assembling are expected to produce hybrid materials with synergistic improvements in properties. In this thesis, we studied the effect of incorporating inorganic material, chloroauric acid (HAuCl₄) in block copolymer template of polystyrene-*b*-poly 2-vinyl pyridine (PS-P2VP) on the morphology, phase behavior, thermal and optical properties of the hybrid material. PS-P2VPs are prepared by living anionic polymerization. Because of covalent bonding of mutually immiscible polymer blocks, block copolymers form a variety of nanostructures of ordered array of spheres, cylinders or lamellae depending on the volume fraction of their respective block. The nitrogen atom in pyridine ring having an extra lone-pair electrons forms complex with chloroauric acid which in turn changes the superstructure of the PS-P2VP/HAuCl₄ hybrid. Nanostructures of ordered array of spheres, cylinders, gyroids, lamellae as well as different shapes of micellar phases can be tailored by choosing appropriate block copolymer, by changing molar ratio of the gold salt to the copolymer added as well as the solvent chosen. The phase diagram of the hybrid system are determined and related to intermolecular interactions on nano- and mesoscopic scales. Self-assembled superstructure are characterized by transmission electron microscopy, wide angle and small-angle x-ray scattering. The superstructures are also used to reduce chloroauric acid into a variety of gold chloride and gold nanoparticles by heating the hybrid materials at 140°C under vacuum for 2 hours. The thermal property of the hybrid material before and after heat treatment was examined by DSC and the interaction between pyridine and gold salt are determined by FTIR technique.