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Editorial corner – a personal view

Block copolymer – a versatile template tool for nanomaterials

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Block copolymer as a special kind of copolymers is made up of blocks of different monomers. For example, polystyrene-*b*-poly(methyl methacrylate) is usually made by first polymerizing styrene, and then subsequently polymerizing methyl methacrylate from the reactive end of the polystyrene chains. Because the different blocks are covalently bonded to each other, block copolymer can only microphase separate (or self-assemble) to form various types of ordered nanostructures ranging from 5 to 50 nm either in the bulk or solution depending on the ratio of different blocks, like hexagonal cylinder array, lamellae, and micelle nanostructures. Block copolymer provides a perfect platform for fabricating novel nanostructural materials for potential applications in advanced technologies such as nanocomposites, information storage, and bio-related nanomaterials.

Due to the microphase separation of block copolymer, the morphology of block copolymer can be tuned from particles in the matrix, hexagonal cylinder to the lamellae and then inverse phases by continuously changing the length of blocks. These nanostructures are extensively used as templates for fabrication of mesoporous nanomaterials for example mesoporous SiO_2, TiO_2 and carbon. The mesoporous materials with high surface area have many important applications in catalyst carrier and membrane separation fields. Block copolymers are also used as template to organize the functional molecules, precursors, or nanoparticles due to the chemical difference of blocks. For example, metal ions can be loaded in one phase region; nanoparticles or nanowires can form within this phase region after reduction. On the other hand, the ordered nanostructures, especial for the vertical alignment array structure, can be directly or indirectly used as a mask for nanolithography such as Si, Ge and other semiconductor quantum dots or nanowires array. Nanostructure semiconductor and magnetic array structures are potentially possible for high efficiency information process and storage. Finally, block copolymer forms all kinds of micelles in the solution due to the solubility difference of different blocks, like spherical micelles, rodlike micelles, and vesicles. The functional units like drug molecules, fluorescent agent or magnetic agents can be co-assembled into the micelles in the solution and transferred to the target area for cure or diagnosis. Recently, block copolymer micelles have been extensively used for carrier of the drug delivery, image contrast agents, and fluorescence agents.

In brief summary, block copolymer as a robust tool can be extensively using for the synthesis and fabrication of nanomaterials and biomaterials.

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