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Microstructures of Polymer-Inorganic Hybrids

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The study of polymer based self-assembly (bottom-up) approaches to multifunctional polymer-inorganic hybrid materials is an exciting emerging research area interfacing solid state and soft materials and offering enormous scientific and technological promise. By choice of the appropriate synthetic polymers as well as ceramic precursors unprecedented morphology control down to the nanoscale is obtained. Tailoring of the polymer–inorganic interface is of key importance. The structures generated on the nanoscale are a result of a fine balance of competing interactions, a typical feature of complex biological systems. The potential for new multifunctional materials lies in the versatility of the polymer chemistry as well as that of the inorganic chemistry that can be exploited in the materials synthesis. In the present contribution physical insights into the way how to direct microstructures of polymer-inorganic hybrid materials will be presented. In all cases cooperative self-assembly of organic and inorganic species is induced by amphiphilic macromolecules, either block copolymers or extended amphiphilic dendrons, which are blocked species with one block being highly branched. Resulting microstructures are discussed based on the phase behavior of the parent polymer systems that act as structure directing agents. Morphology diagrams of the resulting polymer-inorganic hybrid materials are presented illustrating differences in self-assembly of parent polymer and resulting hybrid systems. Finally, mechanistic structure formation studies are highlighted that elucidate necessary requirements for successful hybrid nanostructure control.