NANOSTRUCTURED AND NANOPARTICLE BASED HYBRIDS

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Nanostructured and nanoparticle based hybrids self-assembled from blocked macromolecular architectures hold tremendous scientific as well as technological promise in areas ranging from microelectronics to energy generation and storage. By choice of the appropriate synthetic macromolecules as well as inorganic precursors unprecedented morphology control down to the nanoscale is achieved that may translate into improved property profiles including low dielectric constant, high strength, toughness or conductivity. For example, we recently demonstrated the first nanoporous bulk Pt metal structure directed by a block copolymer (Fig.1).[1] In another example for the first time we showed lithium ion transport in nanoscopic (10nm) domains of a bicontinous cubic block copolymer morphology.[2] In polymer–nanoparticle hybrids properties of polymers can be uniquely married with those of inorganic materials. Once the formation mechanisms and thermodynamics involving co-assembly of polymeric and nanoparticle species are better understood, morphologies across the entire phase space of blocked amphiphilic macromolecules can be produced.[3,4] A particularly fascinating bicontinuous cubic structure we discovered for silica-type hybrids is referred to as the 'Plumber's Nightmare'.[5] Completely novel property profiles are accessible through nanostructured self-assembled hybrids. For example, mesoporous materials with crystalline, superparamagnetic iron oxide nanoparticles in the walls open a way towards separation media exhibiting a combination of size exclusion and separation based on magnetic interactions. The approach can be extended from linear to dendritic, and from AB to ABC-type architectures. On the inorganic side besides amorphous/crystalline oxide materials[6] and metals novel systems toward nanostructured high temperature SiCN and SiC can be introduced.[7]

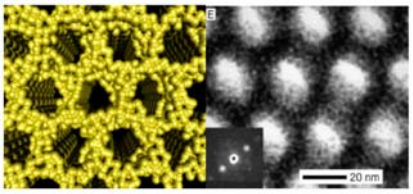


Figure 1. Illustration (left) and TEM image (right) of nano-porous Pt metal structure directed by block copolymers (BCs).

References

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