Mesoporous Inorganic Particles with Controllable Morphologies from Multicomponent Polymer Blends

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Mesoporous inorganic particles such as solid and hollow spheres have attracted great interests for a variety of applications, but synthesis approaches are typically material specific, complicated or lack of control over particle morphologies. Here it is reported how well-studied polymer physics can be applied to inorganic materials chemistry. We developed a new strategy combining mesoscale block copolymer (BCP) self-assembly and macroscale spinodal decomposition in multicomponent blends to prepare mesoporous inorganic particles. Microphase-separated (BCP/inorganic precursor)-domains are confined within the macrophase-separated majority homopolymer matrix, being self-organized toward particle shapes that minimize the total interfacial area/energy. The pore orientation and particle shape (solid spheres, oblate ellipsoids, hollow spheres) are tailored by changing the kind of homopolymer matrix. Furthermore, ordered mesostructure formation (lamellae, hexagonal cylinders, body centered cubic) and pore size could be independently controlled. Notably, this strategy is applicable to various materials including aluminosilicate, carbon, and transition metal oxides (TiO_2, Nb_2O_5, WO_3)