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A block copolymer approach to the pre-programmed organization of inorganic nanostructures

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Organized arrays of inorganic nanoparticles show electronic, optical, and magnetic properties that originate from the coupling of size- and shape-dependent properties of individual nanoparticles (NPs). Controllable and predictable organization of NPs in complex, hierarchical structures provides a route to the fabrication of new materials and functional devices. Significant progress has been achieved in the bottom-top organization of NPs arrays, which is based on their self-assembly, yet, currently, this approach remains largely empirical. We propose a block copolymer paradigm for the self-assembly of asymmetric inorganic nanorods. By using a striking analogy between amphiphilic ABA triblock copolymers and inorganic nanorods carrying distinct ligands at the edges and ling sides, we assembled the nanorods in structures with varying geometries. The self-assembly was tunable and reversible, and it was achieved solely by changing the solvent quality for the constituent "blocks". We mapped the self-assembly process by using phase-like diagrams and demonstrated control over the optical properties of the self-assembled structures. The proposed strategy provides a new route to the organization of nanoparticles by using the strategies that are established for the self-assembly of block copolymers.