Co-Continuous Gyroidal Hybrid Nanomaterials from Block Copolymer Self-Assembly

Uli Wiesner
Materials Science and Engineering Department, Cornell University, Ithaca, NY 14850, US
** E-mail: ubw1@cornell.edu*

ABSTRACT

Since the discovery of the Gyroid morphology in block copolymer self-assembly, this structure has fascinated polymer scientists around the world. This talk will discuss block copolymer self-assembly directed hybrid materials with double and single gyroid morphologies with a focus on the preparation of functional materials. To that end, diblock copolymers and triblock terpolymers will be used to structure direct inorganic components typically in the form of nanoparticles. Fundamental design criteria for successful periodic cubic gyroidal lattice formation of the resulting block copolymer-nanoparticle hybrids will be discussed. In addition to characterization of the as-made bulk hybrids, the talk will present the formation of mesoporous inorganic materials with gyroidal morphology from further thermal processing. It will be demonstrated how fundamental understanding of block copolymer co-assembly with inorganic nanoparticles allows these approaches to be generalized from meoporous amorphous oxides and high-temperature non-oxides to mesoporous highly crystalline transition metal oxides, metals, and seminconductors all the way to mesoporous superconductors. Associated applications range from separation technologies to energy conversion and storage all the way to catalysis. Special focus will be on the formation of block copolymer self-assembly directed mesoporous quantum metamaterials, where block copolymer mesostructure controls quantum materials properties beyond those of the intrinsic atomic lattice bulk structures.