Polymer Chemistry as Applied to the Emerging Field of Nanotechnology:
With an emphasis on devices for nanomedicine

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The covalent stabilization of supramolecular assemblies of block copolymers in solution allows for the establishment of robust nanoscale objects, which are showing significant promise as well-defined probes to investigate general issues related to nanomedicine, for example biodistribution and tissue targeting. The supramolecular assembly process provides access to nanoscale structures having interesting sizes, shapes and morphologies, and the covalent stabilization procedure "fixes" such initial structures to then allow for further physical and chemical manipulation.

This presentation will provide an update on our work to control the micelle morphologies and will describe recent di- and tri-block copolymer designs that allow for pH-triggered self assembly into amphiphilic core-shell micelles in water, without the use of organic solvents. To gain greater control over the shape and size, we have investigated the preparation and study of nanostructures having controlled composition, size and shape, provided by the conformational control over brush block copolymer topologies. In the work that will be described, various combinations of living polymerization processes (ring opening metathesis, reversible addition-fragmentation chain transfer, atom transfer radical and nitroxide-mediated radical polymerizations) are used to construct the linear block copolymers and brush block copolymer frameworks, with accurate control over the lengths and compositions of each block and brush segment. This work emphasizes the development of synthetic methodologies for the preparation of the brush block copolymers, their further chemical and physical manipulation (including their shell crosslinking and core excavation to afford nanocages), in addition to extensive characterization of their compositions, structures and properties.

In addition, this presentation will highlight the latest advances toward the application of such complex materials (having 10-100 nm dimensions and spherical, cylindrical, cage-like, toroidal or discoidal shapes), together with various bioconjugation strategies, in the detection and treatment of acute pulmonary and vascular injury and also cancer, with emphases upon the fundamental chemical designs and biological assays.