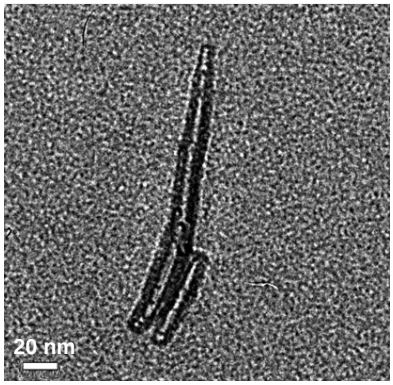
Nanostructured Materials from Multicomponent Bottlebrush Copolymers

Javid Rzayev
Department of Chemistry
University at Buffalo
The State University of New York



Bottlebrush copolymers, or molecular brushes, are comb-like macromolecules with densely grafted polymeric branches. When the backbone is longer than the branches, these molecules take on a cylindrical shape in solution. This unique macromolecular architecture allows for the unprecedented control of molecular shape and dimensions. We targeted the preparation of two types of materials from bottlebrush copolymers: organic nanotubes and periodic polymer nanostructures. In the first part, advanced bottlebrush copolymers with a tailored chemical framework were synthesized by a combination of living radical and ring-opening polymerization techniques. These multicomponent bottlebrush copolymers were then converted to standalone organic nanotubes with well-defined structural parameters (length, diameter and pore size) and functional composition (interior and exterior surface). Water soluble nanotubes prepared by this technique were efficiently internalized by living cells and thus can serve as versatile scaffolds for drug delivery applications. In the second part, we studied the self-assembly of bottlebrush block copolymers into periodic nanostructures with domain spacings larger than 100 nm, not easily achievable by linear block copolymers. A unique length scale of these nanomaterials render them useful for photonic applications and as templates for nanofiltration membranes.