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University Seminar Series

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Nanostructure and Material Construction through Peptide or Block Copolymer Solution Assembly

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ABSTRACT: Self-assembly of molecules into materials is an attractive materials construction strategy primarily due to its simplicity. By considering properly designed peptidic or synthetic polymer molecules, one can take advantage of inherently biomolecular attributes such as intramolecular folding events, secondary structure, electrostatic interactions, and traditional self-assembling molecular attributes such as amphiphilicty to define hierarchical material structure. Two classes of molecules will be discussed: peptides and synthetic block copolymers. First, local nanostructure control of 1D fibril growth with designed beta-hairpin peptides will be discussed. Changes in the assembling peptide molecules are manifested in the supramolecular fibril structure. If properly designed, hydrogel networks can be formed from the peptide assembly. Examples of nanostructure control as well as control of overall hydrogel network structure, and resultant viscoelastic and cell-level biological properties, will be presented. Peptide fibrils can be used to template the growth of inorganic materials as well as the assembly of inorganic nanoparticles. Next, kinetic pathways and temporal stabilities of synthetic block copolymers in solution have been used to construct exotic nanoparticles. Due to low molecular chain exchange dynamics between block copolymeric aggregates and solvent, global thermodynamic equilibrium is extremely difficult, if not impossible, to achieve in block copolymer assembly. However, by taking advantage of this slow kinetic behavior of polymeric nanostructures in solution, one can purposely produce multicompartment nanoparticles and mulitgeometry nanoparticles by forcing different block copolymers to reside in the same nanoscale structure through kinetic processing. Compartmentalization can be used within common micelle geometries to make complex spheres and cylinders or can be used to make new nanostructures such as multigeometry aggregates (e.g. hybrid cylinder-sphere aggregates, disk-cylinder nanoparticles). Various nanocharacterization techniques, in vitro cell culturing, and preliminary in vivo animal experiments have all been used to characterize the nano-through-microstructure and material properties of the above self-assembled systems.

BIOGRAPHY: Darrin Pochan is a Professor of Materials Science and Engineering Department and a member of the Delaware Biotechnology Institute at the University of Delaware. Since joining the department in 1999 after a Ph.D. in Polymer Science and Engineering at UMass-Amherst and a National Research Council Post-doctoral fellowship at NIST, he has developed a research program around the construction of new materials and nanostructures via molecular solution assembly mechanisms. Areas of focus are biomaterials and materials for nanotechnology and energy applications through organic/inorganic hybrids. Recent honors include an NSF Career Award, the DuPont Young Faculty Award, the Dillon Medal from APS, and fellowship in the APS and the ACS.

EVENT DETAILS

DATE:
October 16, 2013

TIME:
11:00 AM

LOCATION:
Morton 103
Stevens Institute of Technology

ATTENDANCE:
Public

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