UC MERCED | CHEMISTRY & BIOCHEMISTRY

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CHEMISTRY & BIOCHEMISTRY SEMINAR SERIES:

Biomolecules for Non-biological Things: Materials Construction through Peptide 'Bundlemer' Design and Solution Assembly

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Abstract:

Self-assembly of molecules is an attractive materials construction strategy due to its simplicity in application. By considering peptidic molecules in the bottom-up materials self-assembly design process, one can take advantage of inherently biomolecular attributes; intramolecular folding events, secondary structure, and electrostatic interactions; in addition to more traditional self-assembling molecular attributes such as amphiphilicty, to define hierarchical material structure and consequent properties. A new solution assembled system comprised of theoretically designed coiled coil bundle motifs, also known as 'bundlemers', will be introduced. The molecules and nanostructures are not natural sequences and provide opportunity for arbitrary nanostructure creation with peptides. With control of the display of all amino acid side chains (both natural and non-natural) throughout the peptide bundles, desired physical and covalent (through appropriate 'click' chemistry) interactions have been designed to produce polymer nanostructures as well as 2-D assembled lattices. One-dimensional nanostructures span exotically rigid rod molecules that produce a wide variety of liquid crystal phases to semi-flexible chains, the flexibility of which are controlled by the interbundle linking chemistry. The assemblies can be responsive to temperature since the individual bundle building blocks are physically stabilized coiled coil bundles that can be melted and reformed with temperature. Rigid rod polymer chains can be processed into liquid crystals and fiber materials with a completely peptidic molecular foundation. Computational design is used to design bundlemers with different net charged character to manipulate their interactions in solution with mixtures of oppositely charged bundlemer particles producing 2-D lattice assemblies. Included in the discussion will be molecule design, hierarchical assembly pathway design and control, click chemistry reactions, and the characterization of nanostructure via electron microscopy, neutron and x-ray scattering, and rheological measurements.

About the Speaker:

Darrin Pochan is currently Distinguished Professor in the Materials Science and Engineering Department as well as having appointments in the Delaware Biotechnology Institute, Department of Chemistry & Biochemistry, and the Department of Biomedical Engineering at the University of Delaware. Since joining the MSE department in 1999 after a Ph.D. in Polymer Science and Engineering at the University of Massachusetts-Amherst and a National Research Council Post-doctoral fellowship at the National Institute of Standards and Technology in Gaithersburg, MD, he has developed a research program around the construction of new materials and nanostructures via molecular solution assembly mechanisms. Areas of focus are polymer and biomolecular self-assembly, biomaterials, and materials for nanotechnology and sustainable materials. His honors include an NSF Career Award, the DuPont Young Faculty Award, the Dillon medal from the American Physical Society and Fellowship in the American Physical Society, American Chemical Society, Royal Society of Chemistry, and American Institute of Medical and Biological Engineering. Darrin recently served as Chair of MSE at UD from 2014-2022 and as Editor in Chief of Soft Matter from 2017-2022 published by the Royal Society of Chemistry in the United Kingdom.

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