CHEMISTRY

SPRING 2019 CHEMISTRY COLLOQUIA, CO-SPONSORED BY NCMN

NC3 AWARD LECTURE

April 19, 2019

3:00 Reception
548 Hamilton Hall

3:30 Seminar
112 Hamilton Hall

Open to the public

Nebraska Cluster for Computational Chemistry Award Lecture

Professor Juan de Pablo, University of Chicago
Vice President for National Laboratories (DOE Argonne & Fermilab)
Senior Scientist at Argonne National Laboratory

Directed Macromolecular Assembly in Synthetic and Biological Systems

There is considerable interest in controlling the assembly of polymeric systems in order to create highly ordered materials for applications. Polymers are easily trapped in metastable, non-equilibrium states, and the processes through which they assemble become an important aspect of any materials design strategy. An example is provided by di-block copolymer directed self-assembly, where a decade of work has shown that, through careful choice of process variables, it is possible to create ordered structures whose degree of perfection meets the constraints of commercial semiconductor manufacturing. As impactful as that work has been, it has focused on relatively simple materials – neutral polymers, consisting of two or at most three blocks. Furthermore, the samples that have been produced have been limited to relatively thin films, and their assembly has been perfected on ideal, two-dimensional substrates. The question that arises now is whether one can translate those achievements to polymeric materials having a richer sequence, to monomers that include charges, to three-dimensional substrates, or to active systems that are in a permanent non-equilibrium state.

This presentation will review recent work from our group and others that explains how directed assembly of polymeric materials and liquid crystals can be used to create functional thin films for applications in separations, nanofabrication, sensors and photonic materials. Building on discoveries from the biophysics literature, I will then discuss how nature has evolved to direct the assembly of nucleic acids into intricate, fully three-dimensional macroscopic functional materials that are not only active, but also responsive to external cues.
We will discuss how principles from polymer physics serve to explain those assemblies, and how one might design a new generation of synthetic systems that incorporate bio-inspired designs by relying on concepts from evolutionary optimization and machine learning.

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