Chemical Engineering Colloquium

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Goddard Hall, Room 227

12:00 PM – 1:00 PM

Entropic Bonding in Colloidal Crystals

Sharon Glotzer

Stuart W. Churchill Collegiate Professor of Chemical Engineering and John W. Cahn Distinguished University Professor

University of Michigan

Chemical bonds are among the most fundamental concepts in science. They describe the way in which atoms associate to form everything from molecules to materials and more, and they have been a central paradigm of science for a century. Today, powerful software packages that solve quantum mechanical theories of chemical bonding are in routine use to predict crystal structures. Are analogous capabilities possible for predicting colloidal crystals, where nanoparticles play the role of atoms? In this lecture, we discuss a remarkable finding that has emerged from 25 years of nanoscience research: Aside from differences in length, time and energy scales, atoms and nanoparticles can self-assemble into identical crystal structures, including crystals with large, complex unit cells. These colloidal crystal structures are possible even in the absence of explicit nanoparticle interactions, when entropy is the only driving force for assembly. What sort of "bonding" describes these structures, which emerge as the particles become crowded? We discuss these questions and a new theory of entropic bonding that has important analogies with chemical bonding theory.

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