DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Department of Materials Science and Engineering,

PhD Candidacy Exam

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Defects in Spherical Crystallography

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Abstract

Crystallization is a ubiquitous self-assembly process in Nature. By definition, crystallization implies that a unit cell self-repeats following translational symmetry. For example, when sphere particles pack on a flat surface, long-range ordered, hexagonally packed 2D crystals will form to reach the global energy minimum. A curved space, on the other hand, is intrinsically incommensurate with translational symmetry. Interestingly, a large variety of biological systems are constituted by units packed in two-dimensional (2D) lattices on curved surface. Some examples are viral capsids, pollen grains, insect eyes, silica skeletons of unicellular algaes, etc. Spherical crystallography in general refers to the study of monodispersed particles crystallize on a spherical surface. When these particles self-assemble on curved, spherical surfaces, defect-free hexagonal packing is no longer allowed. Defects are introduced by topological and energetical concerns. Therefore, curvature adds a new fundamental ingredient to classic crystallography. These constraints force particles to form frustrated structures. Understanding how particles pack on spherical surfaces is vital to developing a new generation of Pickering emulsion-based functional materials and soft matter nanoparticles. In this talk, fundamental understanding of defects in spherical crystallography attained from geometry and simulations, and experimental realization will be presentation. Future potential applications will also be discussed.