Bio-inspired Crystal Growth: Interfaces Between Polymers and Crystals

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Biomineralization, the study of how organisms form minerals such as bones, teeth, and shells, provides examples of strategies for controlling the growth of crystalline materials patterned at the nanoscale. In particular, the concept of crystal growth in confinement has led to many interesting synthetic structures. In this presentation, I will focus on our recent efforts to use confinement within track-etched membranes to force the incorporation of a secondary phase with single crystals and the use of block copolymers to template the surface confined precipitation of crystalline transition metal oxides with periodicities on the order of 50 nm. For both of these strategies, I will present results related to the formation mechanisms and internal structures of the resulting nanostructured oxides. I will also our discuss recent fluid cell Atomic Force Microscopy (AFM) studies of calcite growth in the presence of polymeric micelles with varying surface chemistries. These results have the potential to lead to design criteria for polymer-reinforced crystalline materials with unique structure-property relationships. In addition, insights provided by this work may help to elucidate the formation mechanism(s) and properties of biogenic single crystals with incorporated organic material.

Short bio: Lara A. Estroff received her B.A. with honors from Swarthmore College (1997), with a major in Chemistry and a minor in Anthropology. Before beginning her graduate studies, she spent a year at the Weizmann Institute of Science in Rehovot, Israel as a visiting researcher in the labs of Profs Lia Addadi and Steve Weiner. During this time, she was introduced to the field of biomineralization and studied chemical approaches to archeological problems. In 2003, she received her Ph.D. in Chemistry from Yale University for work done in Prof. Andrew D. Hamilton's laboratory on the design and synthesis of bio-inspired organic superstructures to control the growth of inorganic crystals. After completing graduate school, she was an NIH-funded postdoctoral fellow in Prof. George M. Whiteside's laboratory at Harvard University (2003-2005). Since 2005, Dr. Estroff has been in Materials Science and Engineering department at Cornell University and in 2012 she was promoted to Associate Professor with tenure. She currently serves as the Director of Graduate Studies in the department. Her group focuses on bio-inspired materials synthesis, in particular, the study of crystal growth mechanisms in gels and their relationships to biomineralization. She has received several awards, including an NSF Early Faculty Career Award in 2009 and a J.D. Watson Young Investigator's award from NYSTAR in 2006.