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Title: Protein Crystal Nanopore Arrays as Molds for Seeded Metal Nanorod Manufacturing

Abstract:
A grand challenge in inorganic nanoparticle synthesis is the manufacture of uniform, asymmetric, 3D nanoparticles. Such particles will find many applications in sensors, solar cells, biological imaging, electronics, energy storage devices and therapeutics. Unfortunately, solution phase synthesis and lithographic approaches have various limitations with respect to resolution, control, practicality, and scalability. Template-directed synthesis is one promising approach to retain control over nanoparticle shapes in three dimensions. Proteins have proven to be an attractive template for the growth and positional control of nanoparticles, with researchers growing gold nanoparticles within viruses, protein cages, or lysozyme crystals. In pursuit of greater control over template growth we have engineered a highly porous protein crystal (pore diameter of 13 nm) to serve as a stable, programmable scaffold. We have also aimed to increase control by decoupling nanoparticle nucleation and growth. Specifically, we can adsorb and release intrinsically fluorescent nanocluster seeds from the host crystals, and can grow gold nanorods inside the host crystals. The resulting nanorods can have very high aspect ratios, and can be isolated via enzymatic degradation of the protein crystal mold.