Mesoscale Priority Research Direction

Self-assembly of Inorganic Nanoparticles

Opportunity

Self-assembly of inorganic nanoparticles into larger architectures creates composite functionality and new phenomena of strong basic and applied interest. Architectures can be periodic or glassy, composed of one or various nanoparticle constituents, and extend in 1,2 or 3 dimensions. Phenomena include photonic, electronic, magnetic, catalytic, and acoustic behavior.

Meso Challenge

The challenge is to identify the architectures and compositions that lead to targeted mesoscale phenomena and functionalities, then direct self-assembly to express the desired architecture.

Approach

Various assembly approaches are possible, utilizing electrostatic interactions, dipole attractions, van del Waals forces, hydrogen bonding and hydrophilic/hydrophobic interactions. Polymers or DNA templates that are later removed can force metastable architectures; temperature and laser excitation can be used to promote or limit kinetic exploration of complex assemblies.

Impact

Self-assembled inorganic nanoparticles promise a host of new mesoscale phenomena and functionalities that require minimal material and thus reduce cost, place functional units in close proximity and thus increase speed and efficiency, and provide qualitatively new routes to targeted outcomes.

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