Mesoscale Priority Research Direction

Functional Mesoscale Systems

Opportunity

Mesoscale systems can be self-organized and designed to provide scientific and applications value if they are understood and controlled.

"Self-organized": e.g., high-temperature superconductors or multiferroics.

"Designed": e.g., nanostructured photovoltaics or batteries.

"Self-organized and designed": e.g., vortex pinning in superconductors or giant magneto resistance.

Meso Challenge

Create and exploit materials with electronic or structural complexity that exhibit collective behavior with useful functionality.

Understand how these collective phenomena emerge from the nanoscale and predict their behavior and functionality.

Develop means to control mesoscale systems for applications of their functionality.

Approach

Highly controlled synthesis of crystalline, thin-film, and complex structures (e.g. designed and self-organized systems)

Development of new measurement techniques to detect emergent functional behavior and spontaneous inhomogeneity dynamically, and at multiple length scales.

Development of new computational techniques that incorporate and merge ab-initio and continuum and are cognizant of structural complexity and hierarchy.

Impact

Creat the knowledge base for next generation high performance materials and systems for energy applications.

This multiple-scale and multiple-view approach of computation, synthesis, and measurement will provide a new platform for materials research.

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