Nanotechnology – Synthesis, Functionality, and Applications

Organizers: Michael C. McAlpine, Princeton University, and Xiaohong Fang, Institute of Chemistry, Chinese Academy of Sciences

Abstract: The ability to rationally synthesize, characterize, and hierarchically assemble materials with nearly atomic control is a key underlying principle to next-generation nanotechnologies. Nanomaterials have dimensions on the order of a few nanometers – 1000x smaller than human hair. Establishing new methods for generating nanomaterials, combined with a critical scientific understanding of properties at the nanometer scale, will ultimately enable a variety of revolutionary device applications. As a result, nano research is expanding rapidly and is highly interdisciplinary, drawing on expertise from across the life sciences, physical sciences and engineering disciplines. The focus of this session is on both the techniques necessary for investigations at small dimensions, and the latest research developments in this rapidly evolving area. Much of the excitement in this area of research has arisen from recognition that new phenomena, multifunctionality, and unprecedented integration density are possible with nanometer-scale structures. An incredible variety of nanomaterials have now been rationally and predictably synthesized in high quality form, with key parameters controlled at the point of growth. These include chemical composition, dimensional size, morphological shape, placement control, and surface chemistries. Thus, nanomaterials can achieve the control of bulk materials, but with the inherent electrical, mechanical, and optical performance enhancements provided at reduced dimensions. The unique control over the synthesis of nanomaterial building blocks arises from an excellent understanding of their growth mechanisms and the broad range of chemical compositions achievable. Such control has enabled a wide range of devices and integration strategies which have been rationally pursued. Already, nanomaterials have been utilized in a variety of devices, including transistors, light-emitting diodes, inverters, nanoscale lasers, complex logic gates, chemical and biological sensors, memory devices, and even higher order computational circuits. Overall, research at the nanometer scale is incredibly rich, and this session aims to provide a taste of the scope and promise of nanotechnology.

Speakers:

Ritesh Agarwal, University of Pennsylvania
Watching Nanoscale Phase Change Memory Work in Real Time via In Situ Electron Microscopy

Wencai Ren, Institute of Metal Research, Chinese Academy of Sciences
Large-scale Production and Application of Graphene Materials

Julia Greer, California Institute of Technology
Mechanics and Physics of Nanosolids in Designing 3-D Hierarchical Meta-Materials

Yanlin Song, Institute of Chemistry, Chinese Academy of Sciences
Fabrication and Applications of Nanoparticles