

Carnegie Mellon

Materials Science and Engineering Seminar Series

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“Multi-Component Nanocrystal Assembly: Programming Particulate Matter”

**Friday, February 19, 2010
11:30 A.M. Seminar in Scaife Hall 125**

The synthesis of colloidal nanocrystals with controlled crystal shape, structure and surface passivation provides a rich family of nanoscale building blocks for the assembly of new solid thin films and novel devices. The tunability of the electronic, magnetic, and optical properties of the nanocrystals has lead to them being compared to a set of "artificial atoms". This talk will briefly outline some of the current "best practices" in preparation, isolation and characterization of semiconducting quantum dots and magnetic nanoparticles. I will next discuss the organization of monodisperse nanocrystals in to single component superlattices that retain and enhance many of the desirable mesoscopic properties of individual nanocrystals. The potential to design new materials expands dramatically with the creation binary nanoparticle superlattices BNSLs. I will show how we synthesized differently sized PbS, PbSe, CoPt₃, Fe₂O₃, Au, Ag and Pd nanocrystals and then these nanoscale building blocks into a rich array of multi-functional nanocomposites (metamaterials). Binary superlattices with AB, AB₂, AB₃, AB₄, AB₅, AB₆ and AB₁₃ stoichiometry and with cubic, hexagonal, tetragonal and orthorhombic packing symmetries have been grown. The opportunity to optimize materials for applications in solution processable photovoltaic systems and phosphor based luminescent concentrators will be highlighted. We have also identified a novel method to direct superlattice formation by control of nanoparticle charging. Although modular nano-assembly approach has already been extended to a wide range of nanoparticle systems, we are confident that we have produced only a tiny fraction of the materials that will soon accessible. Recent progress in the extensions to the formation of quasicrystalline colloidal phases will be shared.

Dr. Christopher B. Murray holds the Richard Perry University Professorship in Chemistry and Materials Science at the University of Pennsylvania in Philadelphia PA where his research focuses on the preparation, characterization and integration of nanomaterials. Prior to joining Penn Chris was a staff scientist and Manager with IBM's Research Division from 1995 to 2006 where he lead the "Nanoscale Materials & Devices" department at The T. J. Watson Research Center. He was recognized as one of IBM's "Master Inventors" and he also served as a patent evaluator working to strengthen IBM's nanotechnology portfolio. Chris received his B. Sc. degree with Honors in Chemistry from St. Mary's University in Halifax Nova Scotia Canada (1988) and spent a year as a Rotary International Fellow at the University of Auckland New Zealand studying Chemistry and Materials Science before going on to the Massachusetts Institute of Technology. In the Chemistry Department of MIT, Chris' work on the synthesis and characterization of semiconductor quantum dots earning his Ph D. in 1995 and recognition with American Chemical Society's Nobel Laureate Signature Award for his Thesis work. Chris is a pioneer in the synthesis, characterization and integration of nanostructured materials has authored more than 80 scholarly articles, with contributions that are among highest cited and influential in the field of nanocrystal synthesis and self-assembly and he is an inventor on more than 25 patents in this area. Increasingly his research is focused on the application of nanotechnology and materials design to issues that impact energy, health and environmental sciences. Chris has taken his experiences in both applied and basic research beyond the laboratory and the class room leading an international multi-stake holder dialogue as the Founding Chair of the World Economic Forum's Global Councils on Nanotechnology (08/09) and the WEF Global Council on Emerging Technologies (09/10). Chris contributes to broader scientific community in nanoscience and engineering by serving on numerous advisor boards for national and international scientific centers, journals, conferences and professional organizations.