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Structural complexity at nanoscale: From single nanoparticle to membrane

Xiao-Min Lin
Center for Nanoscale Materials, USA

The structural complexity on nanometer scale can have a strong influence on the physical property of materials. This can occur within a single nanoparticle as well as an assembly of nanoparticles. In this talk, I will illustrate this phenomenon through two examples. At the single nanoprticle level, I will focus on our recent magnetic studies of chemically synthesized Fe@Fe_3O_4 core-shell and iron oxide hollow shell nanoparticles. The ability to obtain highly monodisperse magnetic nanoparticles through chemical synthesis has created new opportunities to investigate exchange bias (EB) phenomenon in these systems. By tuning the structural and chemical composition at nanometer scale, I will show that the EB effect in these systems is directly related to the amount of frozen spins in these systems. However, gradual oxidation in air can lead to structural change at the interface between core and shell, and ultimately leads to magnetic decoupling between core and shell. The second example is free-standing membrane made of colloidal nanoparticles. I will describe our recent experiments to study the mechanical properties of these membranes (Young's Modulus and Poisson's ratio) as well as our efforts to use these membranes as nanofiltration membrane. I will show that nano-size holes dominate the molecular transport through these membranes, leading to both size and charge selectivity.

Biography

Xiao-Min Lin has obtained his Ph.D in Physics and M.S. in chemistry from Kansas State University in 1999. After two years of postdoctoral studies at the James Franck Institute at University of Chicago, he became a staff scientist at Argonne National Laboratory. Currently he is a member of Electronic Magnetic Materials Devices Group at Center for Nanoscale Materials at Argonne. His research interest is in synthesis and self-assembly of nanoparticles, particular in magnetic systems.

xmlin@anl.gov