Monodisperse Magnetic Nanoparticles: Chemical Synthesis and Self-Assembly

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Ordered arrays of magnetic nanoparticles are promising candidates for future high-performance magnetic nanodevices. In this talk, I will demonstrate that monodisperse iron-based nanoparticles, such as magnetite (Fe_3O_4), and iron-platinum (FePt) nanoparticles, with controlled size, composition and structure can be readily synthesized by chemical methods, and subsequently induced to form 2-D and 3-D magnetic nanoparticle superlattice arrays via self-assembly, as shown in figure 1. The interparticle spacing in the array can be adjusted by either surface chemical ligand exchange or thermal treatment. Magnetic properties of these arrays can be tuned from superparamagnetic to ferromagnetic with controlled magnetic moment. Further, the hydrophobic surfactant layer around each nanoparticle can be replaced with bipolar surfactants, rendering the particles hydrophilic and able to be dispersed in water. These well-engineered magnetic nanostructures are of great interest for deep understanding of nanomagnetism and will have great potential in magnetic nanodevice and bio-magnetic applications. Several examples of the potential applications of these self-assembled nanostructures in information data storage, tunnelling devices and permanent magnet will be illustrated.

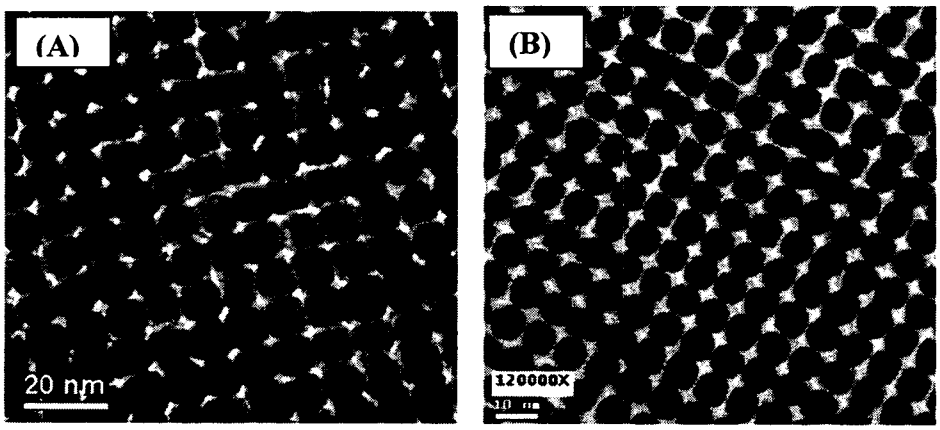

Figure 1. TEM bright field images of self-assembled magnetic nanoparticle superlattices from (A) 10 nm Fe_3O_4 nanoparticles and (B) 6 nm FePt nanoparticles.