Superparamagnetic Core-Shell Nanoparticles for Biomedical Applications

Suk Fun Chin*[a], K. Swaminatha Iyer[b] and Colin L. Raston[b]

[a] *Department of Chemistry, Universiti Malaysia Sarawak, Sarawak, Malaysia*
[b] *Centre for Strategic Nano-Fabrication, University of Western Australia, Australia*
*Email: sfchin@frst.unimas.my

Superparamagnetic magnetite (Fe_3O_4) nanoparticles have been widely studied for various scientific and technological applications such as magnetic storage media, contrast agents for magnetic resonance imaging (MRI), biolabelling and separation of biomolecules, and magnetic targetted drug delivery. In the absence of surface coating, Fe_3O_4 nanoparticles tend to aggregate due to the Van der Waals forces coupled with the magnetic dipole-dipole attractions between the particles. In order to successfully prepare stable magnetite dispersions, any attractive forces between the nanoparticles must be overcome. In this study, magnetite nanoparticles have been prepared by chemical precipitation method. Gold (Au) and silver (Ag) are ideal coating for Fe_3O_4 nanoparticles due to their high chemical stability, biocompatibility, and their affinity for binding to amine/thiol terminal groups of organic molecules. In addition these coatings also render the Fe_3O_4 nanoparticles with plasmonic properties.

The combination of magnetic and plasmonic propertis make these composite nanoparticles very useful for diagnostics and therapeutic applications. However, the current available synthesis methods for Fe_3O_4@Au and Fe_3O_4@Ag nanoparticles are organic based and make them unsuitable for bio-applications. A novel, simple, aqueous based method has been developed to synthesise Fe_3O_4@Au and Fe_3O_4@Ag nanoparticles at room temperature. Fe_3O_4 nanoparticles are simultaneously stabilised and functionalized with amine functional groups with dopamine as a surfactant. Nanoparticles of Au in the range 2 – 3 nm are attached to amine functionalised Fe_3O_4 nanoparticles, acting as seed for the growth of ultrathin Au or Ag shells. The monodispersed core-shell nanoparticles Fe_3O_4@Au and Fe_3O_4@Ag, have a particle size range of 10-13 nm with a shell thickness of approximately 2-3 nm. They are magnetically purified and are superparamagnetic at 300 K with saturated magnetisation values of 41 and 35 emug-1, respectively.

978-1-4244-8854-4/10/$26.00 ©2010 IEEE