Thermosensitive Magnetic Colloids for Optics and Biomedical Application

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Magnetic nanoparticles are emerging nanomaterials which are particularly promising in medicine. Super paramagnetic iron oxide nanoparticles have received increased interest due to their characteristic small size (~4 -10 nm) and excellent MRI contrast properties. By applying an appropriate alternating magnetic field, a local increase of the temperature can be triggered. Such an increase in temperature can kill temperature-sensitive cells, such as some tumour cells, and is usually referred to as hyperthermia. However in targeted drug delivery applications, a control over the drug release is essential. In this project, we deal with synthesis and characterization of magnetic iron oxide nanoparticles with a shell coating of thermo-sensitive poly(N-isopropyl acrylamide) microgel for optics and biomedical application. Monodisperse iron oxide nanoparticles are easily synthesized in organic solvents for industrial applications. However, biomedical applications require that the particles be readily dispersed in aqueous solutions. Magnetic iron oxide nanoparticles synthesized in aqueous environment are prone to aggregation and phase separation due to attractive van der Waals interaction. This necessitates the need for a corona coating on these particles for colloidal stability. Although there are several studies on iron oxide nanoparticles coated with stabilizing agents like dextran and PEG, a detailed study on the effect of molecular weight of these polymers on the colloidal stability is missing. We synthesize iron oxide nanoparticles using co-precipitation method and stabilize them using PEG, Dextran etc. We study the stability of these nanoparticle suspensions as a function of the molecular weight, solvent pH etc. The magnetic nanoparticles are then coated with thermosensitive (PNIPAM) microgels by modifying the nanoparticle surface with a thin silica coating. These core-shell particles are then characterized using light scattering, small angle x-ray scattering (SAXS) and small angle neutron scattering (SANS). These particles will be later tested for optical applications (switchable optical windows) and also in targeted drug delivery.

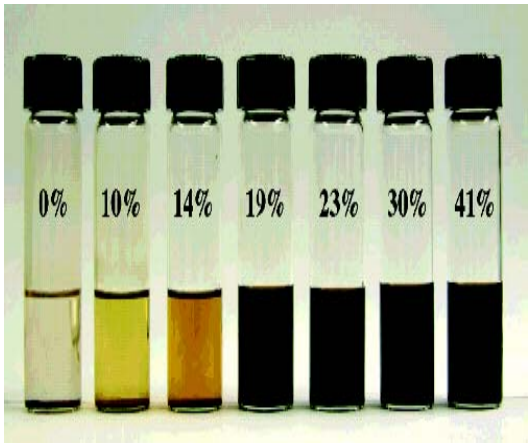

Fig. 1: Stability of the iron oxide nanoparticles as a function of stabilizer volume fraction

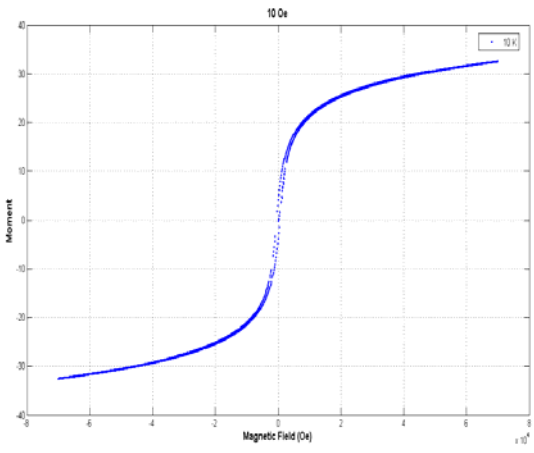

Fig. 2: Magnetization as a function of field for the iron oxide nanoparticles measured at 10 K