

## Synthesis, surface modification and characterisation of biocompatible magnetic iron oxide nanoparticles for biomedical applications

### ABSTRACT

Superparamagnetic iron oxide nanoparticles (MNPs) with appropriate surface chemistry exhibit many interesting properties that can be exploited in a variety of biomedical applications such as magnetic resonance imaging contrast enhancement, tissue repair, hyperthermia, drug delivery and in cell separation. These applications required that the MNPs such as iron oxide Fe<sub>3</sub>O<sub>4</sub> magnetic nanoparticles (Fe<sub>3</sub>O<sub>4</sub> MNPs) having high magnetization values and particle size smaller than 100 nm. This paper reports the experimental detail for preparation of monodisperse oleic acid (OA)-coated Fe<sub>3</sub>O<sub>4</sub> MNPs by chemical coprecipitation method to determine the optimum pH, initial temperature and stirring speed in order to obtain the MNPs with small particle size and size distribution that is needed for biomedical applications. The obtained nanoparticles were characterized by Fourier transform infrared spectroscopy (FTIR), transmission electron microscopy (TEM), scanning electron microscopy (SEM), energy dispersive X-ray fluorescence spectrometry (EDXRF), thermogravimetric analysis (TGA), X-ray powder diffraction (XRD), and vibrating sample magnetometer (VSM). The results show that the particle size as well as the magnetization of the MNPs was very much dependent on pH, initial temperature of Fe<sup>2+</sup> and Fe<sup>3+</sup> solutions and stirring speed. The monodisperse Fe<sub>3</sub>O<sub>4</sub> MNPs coated with oleic acid with size of  $7.8 \pm 1.9$  nm were successfully prepared at optimum pH 11, initial temperature of 45 °C and at stirring rate of 800 rpm. FTIR and XRD data reveal that the oleic acid molecules were adsorbed on the magnetic nanoparticles by chemisorption. Analyses of TEM show the oleic acid provided the Fe<sub>3</sub>O<sub>4</sub> particles with better dispersibility. The synthesized Fe<sub>3</sub>O<sub>4</sub> nanoparticles exhibited superparamagnetic behavior and the saturation magnetization of the Fe<sub>3</sub>O<sub>4</sub> nanoparticles increased with the particle size.

**Keyword:** Iron oxide; Magnetic nanoparticles; Surface modification.