A Study of the Behavior of Magnetite Nanoparticles Coated with Fluorescent-Thermoresponsive Polymers for Magnetic Fluid Hyperthermia (MFH)

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EXTENDED ABSTRACT

Magnetic fluid hyperthermia (MFH) is a cancer therapy in which magnetic nanoparticles are delivered to a cancer tumor and an oscillating magnetic field is applied, resulting on in tumor death due to a localized temperature increase. We have synthesized magnetite (Fe3O4) nanoparticles using the co-precipitation method and grafted with 3-(trimethoxysily)propyl methacrylate (MPS) as surfactanton the particle surface. The nanoparticles were coated with N-isopropylacrylamide (NIPAM) through free radical polymerization in the presence of α,α'-azobisisobutyronitrile (AIBN) initiator, and a fluorescent modified acrylamide monomer (FMA). Poly-NIPAM in aqueous solution undergoes a phase transition at approximately 32˚C; this property in addition to the fluorescence properties of FMA, givethis property, in addition to the fluorescence properties of FMA, gives the nanoparticles the potential to work as magnetic fluorescent-thermometers. These magnetite nanoparticles respond to an external AC magnetic field by energy dissipation. Through the combination of these three properties, the particles could be used as nano-magnetic fluorescent-thermometers to follow temperature increase during MFH applications. Measurements of the hydrodynamic size and fluorescence response of these as a function of temperature demonstrated a decrease in hydrodynamic size of the nanoparticles close to the LCST transition, coupled to an increase in fluorescence intensity. Thermo Gravimetric Analysiszer (TGA) was used to determine the amount of MPS grafted onto the magnetite nanoparticle surface by weight loss percentage. A tTransmission electron microscope microscopy (TEM) was used to determine the size of the synthesized nanoparticle coress and an average particle diameter of 12 nm was obtained. Measurements of the hydrodynamic size and fluorescence response of these as a function of temperature demonstrated a decrease in hydrodynamic size of the nanoparticles close to the LCST transition, coupled to an increase in fluorescence intensity.