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Core-Shell Type Magnetic Nanoparticles for Targeted Drug Delivery

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Abstract : Magnetic nanoparticles such as those made of iron oxide have been widely explored as biocatalysts, contrast agents, and drug delivery systems. However, some of the challenges associated with these particles are agglomeration and biocompatibility, which lead to concern of toxicity of the particles, especially for drug delivery applications. Coating the particles with biocompatible materials such as lipids and peptides have shown to improve the mentioned issues. Thus, these core-shell type nanoparticles are emerging as the new class of nanomaterials for targeted drug delivery applications. In this study, various types of core-shell magnetic nanoparticles are prepared and characterized using techniques, such as Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Vibrating Sample Magnetometer (VSM) and Thermogravimetric Analysis (TGA). The heating ability of nanoparticles is tested under oscillating magnetic field. The efficacy of the nanoparticles as drug carrier is also investigated. The loading of an anticancer drug, Doxorubicin at 18 °C is measured up to 48 hours using UV-visible spectrophotometer. The drug release profile is obtained under thermal incubation condition at 37 °C and compared with that under the influence of oscillating field. The results suggest that the core-shell nanoparticles exhibit superparamagnetic behaviour, although, coating reduces the magnetic properties of the particles. Both the uncoated and coated particles show good heating ability, again it is observed that coating decreases the heating behaviour of the particles. However, coated particles show higher drug loading efficiency than the uncoated particles and the drug release is much more controlled under the oscillating magnetic field. Thus, the results strongly indicate the suitability of the prepared core-shell type nanoparticles as drug delivery vehicles and their potential in magnetic hyperthermia applications and for hyperthermia cancer therapy.

Keywords : core-shell, hyperthermia, magnetic nanoparticles, targeted drug delivery
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