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Superparamagnetic Nanoprobes Based on Core@Shell Structures for Enhanced MRI and Fluorescent Labeling

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Abstract

Because of their specific physic-chemical properties, superparamagnetic nanoprobes have been widely applied for biomedical applications in drug delivery, magnetic resonance imaging (MRI), magnetic fluid hyperthermia, diagnosis, and so forth. However, the synthesized nanoprobes always have low stability, high toxicity, and unfavorable treatment. In this study, we synthesized a Core@shell architectures with combinations of $CoFe_2O_4$ as core and $MnFe_2O_4$ as shell, and phase transfer into aqueous solution by 2% TAMRA labeled amphiphilic polymer. This monodisperse nanoparticles have uniform size distribution (d_c =15 nm), and the polymer has a thickness of about 2.7 nm. This nanoparticles are then further functionalized with PEG molecules (NH_2-PEG-NH_2, M_W: 2 kDa), and modified with target molecules (folic acid, FA) to finally fabricate the superparamagnetic PMA_{TAMRA}-Co@Mn-PEG_{2k}-FA nanoprobes. This nanoprobes have excellent good biocompatibility, high T_2 relaxation values as well as long-term fluorescence stability. From the result we can see, superparamagnetic PMA_{TAMRA}-Co@Mn-PEG_{2k}-FA nanoprobes can effectively enhance the targeted MRI and fluorescent labeling for gastric cancer regions, which could be applied as a T_2 weighted MR contrast agent to trace the variations of the tumor regions for tumor-targeted MR imaging. Besides, the elements from the nanoprobes could be used for analyzing the cell uptake and tumor targeting pathway in vitro and in vivo.

Keywords: Superparamagnetic nanoprobes; Core@shell architectures; MRI; Fluorescence labeling