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Multifunctional nanoparticles composed of a mixed ferrite core and a mesoporous silica shell for RGD peptide to target α (v) β (3) integrin in cancer therapy and diagnosis

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The integrin αvβ3 plays an important role in angiogenesis. It is expressed on tumor endothelial cells as well as on some tumor cells. RGD peptides are well-known to bind preferentially to the αvβ3 integrin. In this context, targeting tumor cells or tumor vasculature by RGD-based strategies is a promising approach for delivering anticancer drugs or contrast agents for cancer therapy and diagnosis. A key challenge in developing theranostic nanoplatform is to achieve an optimal pharmacokinetic profile to allow sufficient targeting and to avoid rapid clearance by the reticuloendothelial system (RES). Recently, multifunctional nanostructured materials have been applied to multimodal imaging and simultaneous diagnosis and therapy. In this context, the integration of mesoporous silica with superparamagnetic monodisperse nanocrystals to form uniform core–shell composite particles has great potential for simultaneous bioimaging and drug delivery. In the present study, mixed ferrite ($MnFe_2O_4$) were coated with a mesoporous silica and polyethylene glycol (PEG), making them water soluble and function-extendable for future bioconjugation with RGD peptide. $MnFe_2O_4$@$mSiO_2$-PEG particles were characterized by DRX, TEM, DLS and VMS. Results showed that a spherical, highly-ordered $MnFe_2O_4$ nanoparticles with a diameter of around 10 nm, and a narrow size distribution. Dynamic light scattering (DLS) analysis revealed that such $MnFe_2O_4$@$mSiO_2$-PEG has a hydrodynamic size of ˜20 nm in aqueous solution. The field dependent magnetism of 300 K shows no hysteresis, demonstrating a superparamagnetic behavior, which is a desirable characteristic for T_2 MR contrast agents. The integrated capability of the core–shell NPs to be used as MR and fluorescence imaging agents, along with their potential use as a drug delivery vehicle, make them a novel candidate for future cancer diagnosis and therapy

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