

A novel amino phosphonate-coated magnetic nanoparticle as MRI contrast agent

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Abstract

The great performance of functionalized Fe_3O_4 nanoparticles (NPs) as contrast agent for magnetic resonance imaging (MRI) is related to the functionalizing agents, once can tune colloidal properties, chemical stability, hydrophilicity, overall toxicity, as well as, dipole interparticle interactions. Phosphonate derivatives have proven to be excellent capping agents due to their ability to control the above parameters. However, the available functionalizing agents do not provide enough both attached and free-form phosphoric acid groups on NPs surface. Herein, we report the use of a commercially available amino-phosphonate compound, diethylenetriaminepenta (methylene phosphonic acid, DTPMP), to functionalize Fe_3O_4 NPs to be potentially applied as MRI contrast agent. For the synthesis of DTPMP-coated Fe_3O_4 NPs, two methodologies were applied, hydrothermal and sonochemical approaches. Several characterization techniques were performed, confirming the success of surface functionalization, which allowed a deep chemical discussion involving the interactions between DTPMP and Fe_3O_4 NPs. Furthermore, relaxivity and cytotoxicity analyses confirmed the MRI contrast agent potential of the DTPMP-coated Fe_3O_4 NPs, presenting non-cytotoxicity profile and high values of transverse relaxivity ($357\text{--}417 \text{ mM}^{-1} \text{ s}^{-1}$). Therefore, this work presents a novel and excellent alternative magnetic material for biological and technological application, mainly considering MRI contrast agent.

Author keywords

Amino-phosphonate
Functionalized magnetic nanoparticles
MRI contrast agent
Sonochemistry