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Optimization of Surface Coating on Magnetic Nanoparticles for Biomedical Applications

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Abstract : Owing to their unique properties, magnetic nanoparticles have been used as diagnostic and therapeutic agents for biomedical applications. Highly monodispersed magnetic nanoparticles with controlled particle size and surface coating have been successfully synthesized as a model system to investigate the effect of surface coating on the T2 relaxivity and specific absorption rate (SAR) under an alternating magnetic field, respectively. Amongst, by using mPEG-g-PEI to solubilize oleic-acid capped 6 nm magnetic nanoparticles, the T2 relaxivity could be significantly increased by up to 4-fold as compared to PEG coated nanoparticles. Moreover, it largely enhances the cell uptake with a T2 relaxivity of 92.6 mM-1s-1 for in vitro cell MRI. As for hyperthermia agent, SAR value increase with the decreased thickness of PEG surface coating. By elaborate optimization of surface coating and particle size, a significant increase of SAR (up to 74%) could be achieved with a minimal variation on the saturation magnetization (<5%). The 19 nm magnetic nanoparticles with 2000 Da PEG exhibited the highest SAR of 930 W•g-1 among the samples, which can be maintained in various simulated physiological conditions. This systematic work provides a general strategy for the optimization of surface coating of magnetic core for high performance MRI contrast agent and hyperthermia agent.

Keywords : magnetic nanoparticles, magnetic hyperthermia, magnetic resonance imaging, surface modification
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