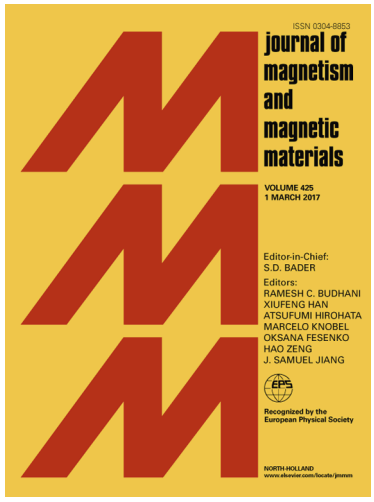

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PII: S0304-8853(18)32018-3
DOI: https://doi.org/10.1016/j.jmmm.2018.09.116
Reference: MAGMA 64398

To appear in: *Journal of Magnetism and Magnetic Materials*

Received Date: 25 June 2018
Revised Date: 17 September 2018
Accepted Date: 28 September 2018

Please cite this article as: V. Zavisova, M. Koneracka, A. Gabelova, B. Svitkova, M. Ursinyova, M. Kubovcikova, I. Antal, I. Khmara, A. Jurikova, M. Molcan, M. Ognjanović, B. Antić, P. Kopcansky, Effect of magnetic nanoparticles coating on cell proliferation and uptake, *Journal of Magnetism and Magnetic Materials* (2018), doi: https://doi.org/10.1016/j.jmmm.2018.09.116

Effect of magnetic nanoparticles coating on cell proliferation and uptake

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Abstract

Magnetic iron oxide nanoparticles (MNPs) are one of the most promising types of nanoparticles for biomedical applications, primarily in the context of nanomedicine-based diagnostics and therapy. They are used as contrast agents in magnetic resonance imaging and magnetite cell labelling. Furthermore, they are promising heating mediator in magnetic hyperthermia-based therapy, and can serve as nanocarriers in targeted gene and drug delivery as well. In biomedical applications, coating plays an important role in nanoparticle dispersion stability and biocompatibility. However, the impact of nanoparticle surface chemistry on cell uptake and proliferation has not been sufficiently investigated. The objective of this study is to prepare magnetic nanoparticles with inner magnetite core and hydrophilic outer shell of surfactant, protein and polymers that are commonly used in biomedical research. MNPs were characterized in-depth by various physicochemical methods. Magnetic hyperthermia, applied to find out the influence of MNPs coating on heating characteristics of the samples, did not show any correlation between layer thickness and specific adsorption rate. To evaluate the impact of surface chemistry on cell proliferation and internalization, the human lung adenocarcinoma epithelial (A549) cells were utilized. Substantial differences were determined in the amount of internalized MNPs and cell viability in dependence on surface coating. Our results indicate that the surface chemistry not only protects particles from agglomeration but also affect the interaction between cell and MNPs.

Keywords: magnetic nanoparticles, magnetic fluid, magnetic hyperthermia, cytotoxicity, cell uptake

1. Introduction

The application of nanotechnology to medicine provides an opportunity to study the biological systems at a subtler level, giving rise to better understanding of disease mechanisms. Moreover, nanomaterials enable more accurate and rapid diagnosis, targeted and effective drug delivery, and novel ways of organ and tissue regeneration. The biocompatibility and colloidal stability of nanoparticles (NPs) in physiological solutions is imperative for their development for clinical use [1]. Surface modification of particles with surfactants or polymers protects particles from aggregation and agglomeration, prolongs the blood circulation time and facilitates their further functionalization (*i.e.* binding of specific ligands, antigen, aptamer, protein etc. on the surface of NPs) to increase their accumulation in a tumour region [2]. Several methods and numerous coating agents have been developed and employed for modifying the surface properties of the magnetite nanoparticles (MNPs) [3−6].