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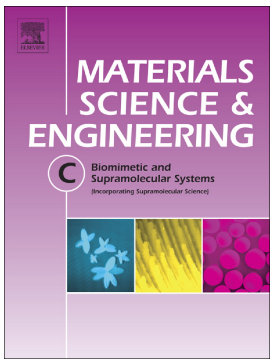

Gadolinium borate and iron oxide bioconjugates: Nanocomposites of next generation with multifunctional applications

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Gadolinium borate and iron oxide bioconjugates: Nanocomposites of next generation with multifunctional applications

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ABSTRACT: The systematic investigations concerning the bioconjugation of $GdBO_3$-Fe_3O_4 nanocomposite and their *in vitro* biocompatibility with cancer cell lines are reported. The nanocomposites were prepared hydrothermally from magnetite (Fe_3O_4), borax or boric acid and a Gd^{3+} salt. Bioconjugation processes were performed with citric acid and fluorescein isothiocyanate-doped silica, followed by the treatment with folic acid. Overall, the procedure involved "bare or PEGylated Fe_3O_4 as the magnetic core" and "vaterite- or triclinic-type of $GdBO_3$ as the surface borate layer" for comparative evaluation of the results. The successful vectorization of the nanocomposite particles was demonstrated by quantitative and qualitative analytical data. All bioconjugates displayed soft ferromagnetic properties and negative zeta potential values that are appropriate for biological applications. The ^{10}B and ^{157}Gd contents were *ca*. 10^{14} atom/μg making them promising agents for BNCT, GdNCT and the combined GdBNCT. The Gd/Fe molar ratios (0.27-0.63) provided the capability for T1- or dual (T1+T2) magnetic resonance imaging (MRI). In vitro studies were conducted to investigate the efficiency of targeted FA-conjugated versus non-FA conjugated nanoformulations on Mia-Pa-Ca-2, HeLa and A549 cells. Fluorescence microscopy and flow cytometry data unveiled the essential role of the zeta potential competing with folate targeting in the uptake mechanism. The bioconjugated nanoplatforms of $GdBO_3$-Fe_3O_4 composite, introduced herein, proved to have potential features of next generation agents for magnetically targeted therapy, fluorescence imaging, magnetic resonance imaging/diagnosis and Neutron Capture Therapy.

Keywords. Multimodal magnetic nanocomposites, magnetically targeted therapy, neutron capture therapy, magnetic resonance imaging, theranostics.

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