Immobilization of boron-rich compound on Fe_3O_4 nanoparticles: Stability and cytotoxicity

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Abstract: Magnetic nanoparticles based on Fe_3O_4 and their modifications of surface with therapeutic substances are of great interest, especially drug delivery for cancer therapy includes boron-neutron capture therapy. The results of boron-rich compound (carborane borate) attachment to previously aminated by (3-aminopropyl)-trimethoxysilane iron oxide nanoparticles are presented. Energy-dispersive X-ray analysis and Fourier transform infrared spectroscopy with attenuated total reflection (ATR) accessory confirmed change of nanoparticles elemental content after modification and formation of new bond between Fe_3O_4 and attached molecules. Scanning and transmission electron microscopy showed that Fe_3O_4 nanoparticles average size is 18.9 nm. Phase parameters were investigated by powder X-ray diffraction, Fe_3O_4 nanoparticles magnetic behavior was evaluated by Mössbauer spectroscopy. Chemical and colloidal stability was studied using simulated body fluid (phosphate buffer – PBS). Modified nanoparticles have excellent stability in PBS (pH = 7.4), characterized by X-ray diffraction, Mössbauer spectroscopy and dynamic light scattering. Fe_3O_4 biocompatibility was elucidated in-vitro using cultured mouse embryonic fibroblasts. The obtained results show the increasing of IC_{50} from 0.110 mg/ml for Fe_3O_4 to 0.405 mg/ml for Fe_3O_4-Carborane nanoparticles. Obtained data confirm biocompatibility and stability of synthesized nanoparticles and potential to use them in boron-neutron capture therapy.

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