Multifunctional $(Mg,Fe)_3O_4$ nanoparticles: Test for possible magnetic hyperthermia and radionuclide carriers applications

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Abstract (Arial 10)

$Mg_xFe_{3-x}O_4$ magnetic nanoparticles ($0 \le x \le 0.6$) coated with oleic acid (OA), citric acid (CA), and polyethylene glycol (PEG), were synthesized in the form of ferrofluids. Some of these magnetic nanoparticles (MNPs) were additionally radiolabeled by β-emitter yttrium-90 (^{90}Y). The main objective was to test the MNPS and optimize their characteristics for magnetic hyperthermia and regional radiotherapy, which can be used either individually or simultaneously in cancer treatment. A complete characterization was made for all samples from which information about external morphology of MNPs, their size distribution and magnetic characteristics was obtained.

The cytotoxicity of the coated MNPs was tested in vitro on four cell lines: HeLa (human cervical adenocarcinoma cells), LC174 (human colon cancer cells), A549 (lung cancer cells) and MRC5 (healthy fetal lung fibroblast cells). The obtained results show that the examined cancer lines demonstrate different sensitivity to MNPs and that cytotoxicity depends on the type of nanoparticle coating. It was found that HeLa cells exhibit the highest sensitivity, regardless of the type of coating while at the same time healthy cells are almoust insensitiv to MNPs.

The labeling yield for all MNPs is very high and for PEG coated nanoparticles is almost 100%. Stability of ^{90}Y-labeled MNPs was investigated in both saline and human serum at 37^{o}C up to 72h. It was found that MNPs/PEG/^{90}Y stability is almost 100% while citric acid nanoparticles (MNPs/CA/^{90}Y) demonstrate lower stability of 65%.

Magnetic hyperthermia measurements show that all samples have good heating ability. SPA values of MNPs doped with Mg are increasing with concentration x and applied frequency, showing improvement of heating efficiency comparing to pure magnetite. Measured SPA values are comparable or higher with so far known commercial ferrofluids.