

Synthesis and characterization of cobalt-zinc and manganese-zinc ferrite nanoparticles uncoated and coated with silver as MRI contrast agents

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To obtain high-resolution magnetic resonance imaging (MRI) contrast agents are needed. The studies carried out on ferrite nanoparticles showed an excellent magnetization and longer circulation times compared to conventional contrast agents and that multi-substituted ferrites are a great choice for this purpose. Generally, ferrite nanoparticles require to be coated with biocompatible materials for successful MRI applications to stabilize their dispersions in a liquid.

We report our scientific results obtained on ferrite nanoparticles with chemical formula $\text{Co}_x\text{Zn}_{1-x}\text{Fe}_2\text{O}_4$ and $\text{Mn}_x\text{Zn}_{1-x}\text{Fe}_2\text{O}_4$, $x = 0.6 - 0.8$. The nanoparticles were synthesized by using the coprecipitation method and were coated with Ag by reducing Ag from AgNO_3 with glucose. Uncoated and coated nanoparticles were structurally and morphologically characterized by XRD and TEM techniques and the chemical composition and magnetic properties were verified with XPS and VSM. Stock suspensions were prepared from 15 mg nanoparticles, 12 ml ethanol, 6 ml carboxymethyl cellulose and 12 ml distilled water.

From these stock solutions contrast agents were prepared by diluting 0.0 ml - 0.25 ml in 19.99 ml - 19.75 ml distilled water and were scanned with the MRI machine ($B=1.5$ T). In T1 (spin-lattice relaxation) and T2 (spin-spin relaxation) scan sequences obtained for $\text{Co}_x\text{Zn}_{1-x}\text{Fe}_2\text{O}_4$ and $\text{Co}_x\text{Zn}_{1-x}\text{Fe}_2\text{O}_4@Ag$ suspensions, the positive contrast was highlighted for dilutions of 0.01 ml and 0.05 ml. In the case of $\text{Mn}_x\text{Zn}_{1-x}\text{Fe}_2\text{O}_4$ and $\text{Mn}_x\text{Zn}_{1-x}\text{Fe}_2\text{O}_4@Ag$ diluted suspensions, the positive contrast in T1 sequence was highlighted for dilutions of 0.05 ml and 0.1 ml and the positive contrast in T2 sequence was highlighted for dilutions of 0.01 ml and 0.05 ml. The obtained results recommend these suspensions as MRI contrast agents.