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Magnetic-luminescent nanocomposites based on $CoFe_2O_4$ nanoparticles and Eu^{3+} and Tb^{3+} coordination compounds

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Recently obtaining and research of multifunctional nanoobjects arouse great interest because of wide prospects of application of such materials. In particular, magnetic-luminescent nanocomposites are promising materials for targeted drug delivery, hyperthermia, magnetic separation of biomolecules and biological objects, in diagnosis combining MRI method with confocal fluorescence microscopy.

We developed a method for the synthesis of magnetic-luminescent nanocomposites by ligand (oxalic acid, H_2Ox) immobilization on the surface of $CoFe_2O_4$ magnetic nanoparticles with further engrafting of luminescent coordination compound Tp_2LnCl (Ln = Eu and Tb, Tp = tris(pyrazolyl)borate).

Characteristic lanthanide emission bands are observed on photoluminescence spectra of nanocomposites. On $CoFe_2O_4$-$OxEuTp_2$ nanocomposite spectra bands at 591, 616, 694 nm are characteristic for $^5D_0 \rightarrow {}^7F_1$, $^5D_0 \rightarrow {}^7F_2$, $^5D_0 \rightarrow {}^7F_4$ transitions of Eu^{3+} ion. On $CoFe_2O_4$-$OxTbTp_2$ nanocomposite spectra bands at 488, 544, 585, 621 nm are characteristic for $^5D_4 \rightarrow {}^7F_6$, $^5D_4 \rightarrow {}^7F_5$, $^5D_4 \rightarrow {}^7F_4$, $^5D_4 \rightarrow {}^7F_3$ transitions of Tb^{3+} ion. The intensities of luminescence bands are low due to quenching because of interaction with $CoFe_2O_4$ magnetic core that leads to the splitting of energy levels.

According to decay kinetics curves, luminescence lifetimes for composites $CoFe_2O_4$-$OxLnTp_2$ (Ln = Eu and Tb) are 0.59 and 0.27 ms correspondingly; and for complexes $(Tp_2Ln)_2Ox$ - 2.00 and 2.21 ms. Luminescence lifetime of composite is lower, comparing with free complexes, that may be explained by faster relaxation of excited state in composite. This may be due to reduction of forbidding of *f-f* transitions because of interaction with magnetic core.