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Synthesis of the FePt nanosystem: comparison of the synthesis methods

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Abstract

In this work, using the example of the synthesis of nanoparticles of the mutual FePt system, obtained in an aqueous medium by the method of co-reduction of solutions of metal precursors, the effect of reducing agents is considered: an alkaline solution of hydrazine hydrate and sodium tetrahydroborate in combination with a stabilizer of sodium-potassium tartrate. The main characteristics of the obtained nanosized particles of the iron-platinum system were studied by means of a complex of physicochemical methods of analysis. The shape and morphology of the obtained nanosized particles were studied by transmission electron microscopy, phase analysis and X-ray structural parameters – by X-ray diffraction methods. It was approached to reveal the dependence of the particle size on the type of reducing agent used. It was found that nanosized FePt particles obtained with different reducing agents have similar physicochemical characteristics. The use of sodium tetrahydroborate, in the presence of a stabilizer sodium-potassium tartrate, allowed to obtain more dispersed particles with a size of 14.3±2.1 nm. FePt nanoparticles reduced by hydrazine hydrate were characterized by large sizes of 16.7±4.0 nm, and the particles form large dense agglomerates. Chemical analysis showed that when reducing with sodium tetrahydroborate, the target product contained 0.4 mol. % boron. When reducing FePt nanoparticles with hydrazine hydrate, it was found that the target product was contaminated with iron oxide, which was also confirmed by X-ray phase analysis. X-ray diffraction analysis showed that the iron-platinum nanosystem was represented by a solid-solution phase with a face-centred cubic lattice. The parameters of the crystal lattice were estimated, 3.908 Å and 3.894 Å, respectively, for FePt nanoparticles obtained using $NaBH_4$ and $N_2H_4 \cdot H_2O$.

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