THE STRUCTURE AND TEMPERATURAL TRANSFORMATIONS OF SYNTHESIZED MAGNETINE NANOPARTICLES

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One of the most promising of nanomaterials is the ferrite nanoparticles of different compositions. Ferrite nanoparticles offer exciting opportunities in fundamental study and technological applications, such as biomedical applications, bio processing and catalysts, among many others. Magnetite (Fe_3O_4) nanoparticles have attracted much interest in the areas of medical care such as drug delivery systems, magnetic resonance imaging, hyperthermia treatment of cancer, biomedical optical imaging, biosensors. Different synthetic methods such as mechanosynthesis, hydrothermal synthesis, coprecipitation, combustion synthesis, sol-gel methods, microwave processing, and thermal decomposition, have been used so far to produce magnetic nanocrystals. Among these methods, coprecipitation in the water solution has been demonstrated as a reliable route for preparing ferrite nanocrystals with uniform size, a high degree of crystallinity, and a clearly defined phase structure.

Due to the presents of iron (II) cation in the structure of magnetite, it can be oxidized to iron (III) oxide. It is therefore important to study the energy balance of the processes, that take place in magnetite particles at different temperatures and determine the final properties of the substance.

Ultrafine particles of $FeFe_2O_4$ were prepared by co-precipitating aqueous solutions of iron (II) and iron (III) salts in an alkaline medium. Thermographic and X-ray analyses were used. Simultaneous thermogravimetric and differential thermal analysis (TG–DTA) traces were obtained from Q-1500D instruments (MOM, Hungary) at a heating rate of 10°C/min. The X-raydiffraction (XRD) patterns of the samples were recorded on a SiemensD500 X-ray powder diffractometer using copper radiation. Slow scans of the selected diffraction peaks were carriedout in the step mode (step size 0.03°, measurement time 75 s). The crystallite size of the nanocrystal line samples was measured from the X-ray line broadening using the Debye-Scherrer formula after accounting for instrumental broadening.

At the temperature of 695°C a transition structure of the as-synthesized particlesof magnetite into its nonmagnetic modification was determined. The fixed effect should be used to determine the temperature working range of the synthesized nanoparticles of magnetite in its further usage in medications. It is important to determine the upper limit of this range highly enough. As a result of studies with using thermography methods and X-ray phase analysis structure of the synthesized magnetite nanoparticles and their transformation temperature were investigated. It is proved that the chosen method of synthesis allow to obtain particles of magnetite colloidal size without impurities, with the correct parameters of the crystal lattice. This can be used to create medications with magnetic properties.