Nanocomposites and nanomaterials

Plasma-chemical synthesis and functional properties of ferrites $Ni_{x-1}Mn_xFe_2O_4$

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At present, ferrites are promising materials for various practical applications. Ferrite materials are widely used in modern electronics, such as magnetic recording media and magnetic fluids for storing and retrieving information, as catalysts, microwave absorbers, sensors and pigments for the delivery of drugs with magnetic control, in magnetic resonance imaging (MRI). These ferrites are promising in microwave technology, and they are used as a magnetic component in composite magnetoelectric materials. In recent years, a new trend has appeared in microwave technology in materials science - the synthesis of various substances with nanometer-sized particles. This problem is the result of the creation of nanocrystalline materials that have unique properties compared to macro crystalline materials of the same chemical composition. During the synthesis of ferromagnetic oxide nanomaterials special attention is paid to the chemical methods of homogenization of ferrite components. This ensures high chemical homogeneity and activity of ferrite powders. Ultrasonic synthesis, sol-gel, reverse micelle method and plasma technologies are the most popular among these methods. Plasma technology is simpler and more economical compared to the ceramic method. This method makes it possible to produce nanocrystalline materials with high homogeneity, which increases their electromagnetic and mechanical properties. Ferrite nanoparticles of the composition $Ni_{x-1}Mn_xFe_2O_4$ (x = 0; 0.2; 0.4; 0.5; 0.6; 0.8; 1.0) have been obtained using contact non-equilibrium low-temperature plasma. The structural characteristics of ferrite powders have been investigated on a DRON-2 diffractometer with CoKα radiation. According to the results of X-ray diffraction analysis, the obtained Ni-Mn ferrite powders consist of a spinel-like phase. Technological conditions for the synthesis of Ni-Mn nanoferrits have led to the change in the phase composition of the products formed. The particle size of the Ni-Mn ferrite powders obtained, calculated according to the Scherrer formula, lies within the range of 30-40 nm. The magnetic properties of the obtained products have been studied. The saturation magnetization and the coercive force have been established to decrease with the increasing value of $x=0,5$ because of the formation of nonmagnetic phases.