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PLASMA-SOLUTION SYNTHESIS OF A SOLID PHASE FROM SOLUTIONS OF IRON AND COBALT NITRATES OF VARIOUS CONCENTRATIONS*

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In recent years, magnetic nanoparticles (MNPs) have attracted a considerable amount of attention due to their special superparamagnetic (SPM) properties, high adsorption capacities and surface area to volume ratio. In particular, transition metal oxides with spinel structures commonly referred to as ferrite are among one of the most important MNPs. Based on their crystal structures and magnetic properties, ferrites are classified as spinel [1-2]. This is mainly due to their excellence magnetic properties, simple chemical composition, and wide applications in several areas, which include water and wastewater treatment, biomedical, catalyst and electronic device. There are a large number of different methods for obtaining spinels, one of the new and promising ones is the synthesis from a solution under the action of a low-temperature nonequilibrium plasma.

In this work, we used aqueous solutions of ferrum and cobalt nitrates (analytical grade) with a different concentration for each component (Table1). We describe the experimental setup used in the study in detail in [3]. External electrodes were made of titanium. The electrode-solution distance was 5 mm. The discharge current could vary within 30-70 mA. Obtaining and analysis of particles can be conventionally divided into two stages. First: plasma-solution synthesis (analysis of particles in solution and after drying); Second: calcination of the particles after drying and examination of the resulting oxides.

Table 1. Designation of samples depending on the initial concentration of the components.

Raw materials	**Fe2Co1**	**Fe1Co2**	**Fe2.5Co50**	**Fe3Co50**	**Fe5Co50**
$Fe(NO_3)_3$	3.3 mmol	1.7 mmol	2.5 mmol	3 mmol	5 mmol
$Co(NO_3)_2$	1.7 mmol	3.3 mmol	50 mmol	50 mmol	50 mmol

The average effective particle size was determined by dynamic light scattering (DLS) using a Photocor Compact-Z size analyzer (Photocor, Russia). Immediately after plasma treatment (50 mA, 10 minutes), particles of two characteristic sizes can be isolated in the solution. The first fraction: 92.91 nm and the second: 1.46 μm, while the zeta potential ζ= 24.76 mV.

X-ray phase analysis (XRD) (DRON 3M) of powders showed the presence of a large number of pronounced reflections, which indicates the crystallinity of the structure of the synthesized substances. Elemental analysis data (Aztec EDS, Oxford Instruments Ltd., England) showed that the synthesized powders after high temperature treatment have a complex composition as shown in Table 2.

Table 2. EDS analysis of the composition of the resulting powders.

Fe2Co1	**Fe1Co2**	**Fe2.5Co50**	**Fe3Co50**	**Fe5Co50**
$(Fe_2O_3)_{0,99}(CoO)_{0,01}$	$(Fe_2O_3)_{0,76}(CoO)_{0,24}$	$(Fe_2O_3)_{0,26}(CoO)_{0,74}$	$(Fe_2O_3)(CoO)$	$(Fe_2O_3)_{0,60}(CoO)_{0,40}$

We found that by varying the initial concentrations of the initial salts in the solution, it is possible to obtain spinels of a given composition. These materials are of great interest for various applications.

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