# PRODUCTION OF MAGNETIC NANOPARTICLES BASED ON 3-D METALS AND STUDY OF THEIR MAGNETIC PROPERTIES AT ROOM TEMPERATURE

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**Abstract:** In this paper, magnetic fluids based on metal ferrite, namely NiFe2O4, CoFe2O4 and FeFe2O4 magnetic nanoparticles, were prepared. The sizes of the resulting magnetic nanoparticles were studied using a transmission electron microscope and were found to be approximately 40 nm. This size was found to be consistent with the results obtained by X-ray diffraction. The magnetization of the resulting magnetic nanoparticles was also measured using a vibrational magnetometer.

**Keywords:** Nanoparticle, powder, iron, cobalt, nickel, analysis, temperature, magnetization, condensation, dispersed system, concentration, magnetic fluid.

Magnetic fluids currently offer a variety of solutions and applications in aerospace, electronics and electrical engineering, mechanical engineering, biomedicine, water and oil purification. This, in turn, is of great interest to the general public. Therefore, the synthesis of magnetic fluids and the study of their physicochemical properties have become an urgent task for scientists around the world [1,2].

In particular, in order to use magnetic fluids in various fields of materials science and engineering, it is important to know their structure and their mechanical, optical, electrical, magnetic, and galvanomagnetic properties [4-6].

The chemical formula of magnetic nanoparticles is $MFe_2O_4$, which is mainly spinel ferrite materials. In this research work, we synthesized magnetic nanoparticles based on $MFe_2O_4$ (M=Ni,Co,Fe) by chemical condensation method and studied their size, morphology and crystal structure, chemical composition and magnetic properties of magnetic fluid formed on the basis of synthesized magnetic nanoparticles at room tePowdered nanoparticles were prepared by chemical sputtering of 3-d metal-based nanoparticles, namely MFe2O4 (M=Ni,Co,Fe). The elemental composition of the powdery FeFe2O4, CoFe2O4, and NiFe2O4 samples was investigated by energy-dispersive X-ray spectroscopy (EDX) [7]. The size and morphology of the FeFe2O4, CoFe2O4, and NiFe2O4-based magnetic fluid particles were studied using a transmission electron microscope (TEM). The results are shown in Figure 1. It can be seen from the TEM images that the particles of the samples are spherical. Also, the diameters of the FeFe2O4, CoFe2O4, and NiFe2O4 magnetic nanoparticles correspond to 25-38 nm, 10-30 nm, and 7-30 nm, respectively.mperature (T=300K) [3,5].

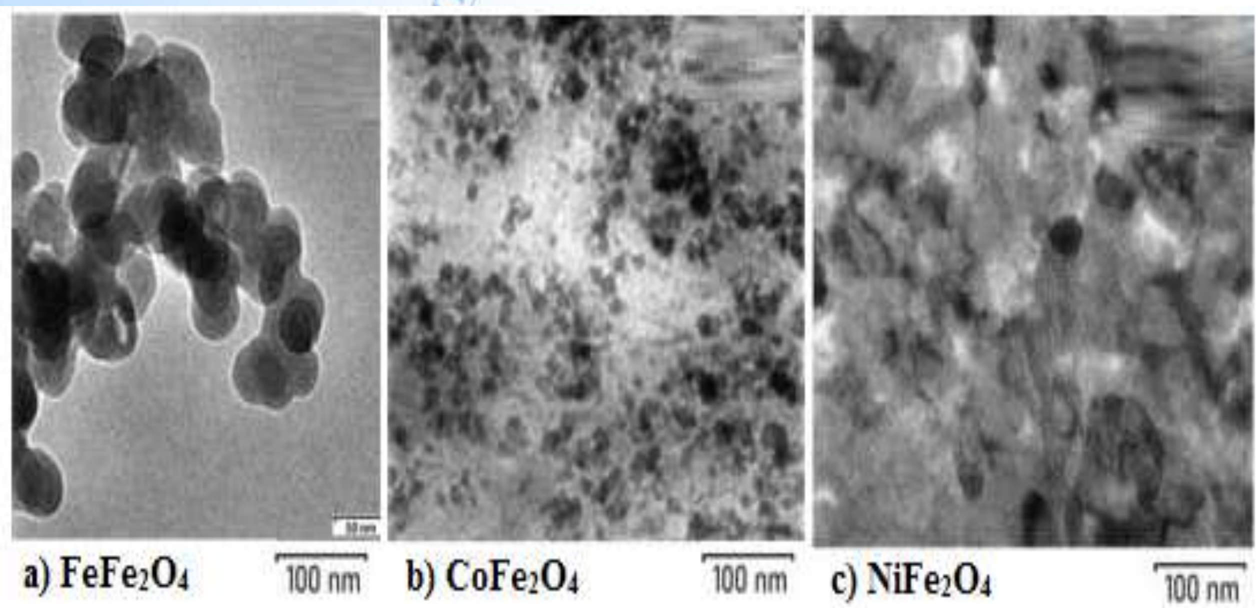


***Figure 1. Transmission electron microscope photographs of FeFe2O4, CoFe2O4, and NiFe2O4 magnetic nanoparticles.***

In Figure 1 above, the size and morphology of FeFe2O4, CoFe2O4, and NiFe2O4 magnetic nanoparticles were photographed using a transmission electron microscope, and we can confirm that the appearance of FeFe2O4, CoFe2O4, and NiFe2O4 magnetic nanoparticles is spherical [8].

The dependence of the magnetization of magnetic fluids based on FeFe2O4, CoFe2O4 and NiFe2O4 magnetic nanoparticles on the external magnetic field was measured at room temperature, i.e. at a temperature of T=300K. The results are presented in Figure 2. As can be seen from Figure 2, the magnetization of magnetic nanoparticles increases with increasing external magnetic field and reaches saturation at strong external magnetic fields.

The maximum magnetization achieved in an external magnetic field of 15000 Oe can be considered as Ms (saturation magnetization). From Figure 6, we can determine that the saturation magnetization of the FeFe2O4 magnetic nanoparticle is 37.5 emu/kg, the saturation magnetization of the CoFe2O4 magnetic nanoparticle is 29 emu/kg, and the saturation magnetization of the CoFe2O4 magnetic nanoparticle is 24 emu/kg.

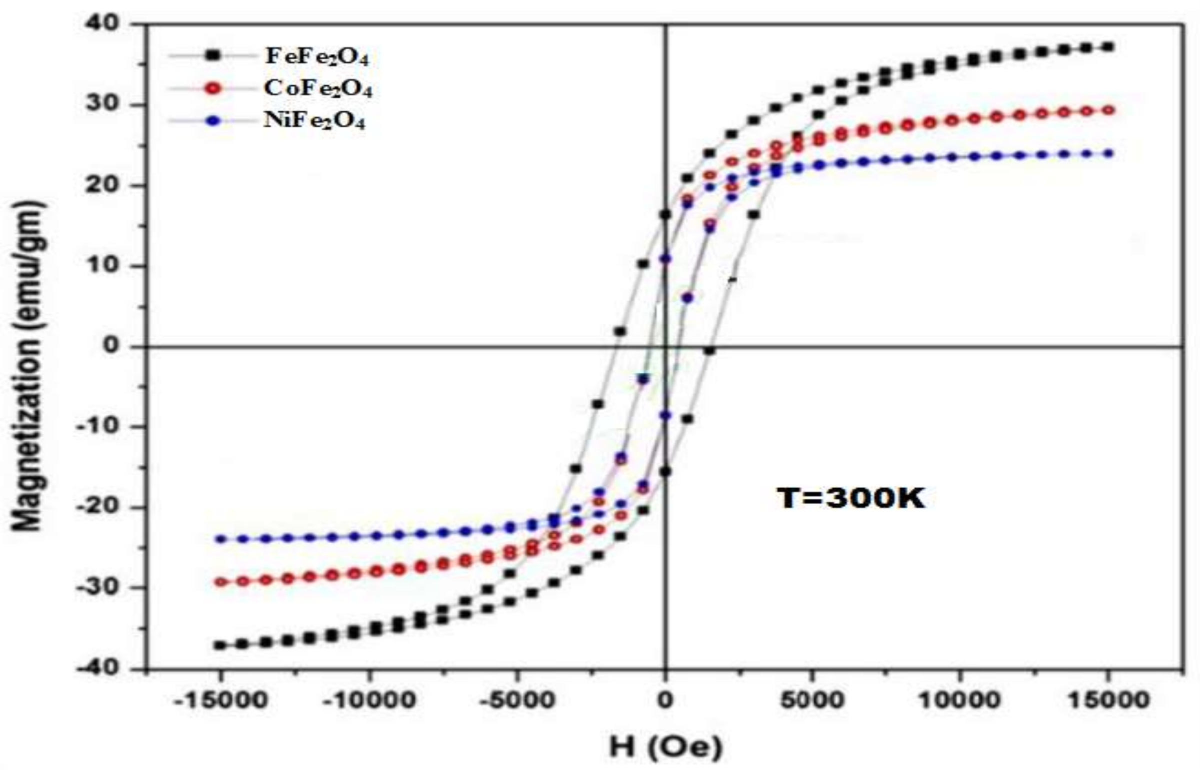


***Figure 2. Dependence of the magnetization of FeFe2O4, CoFe2O4, and NiFe2O4 magnetic nanoparticles on the external magnetic field measured in a vibration magnetometer.***

FeFe2O4, CoFe2O4 and NiFe2O4 magnetic nanoparticles were successfully synthesized by chemical condensation method. The obtained nanoparticles showed that all diffraction peaks of the X-ray diffraction spectrum were formed in the single-phase inverted cubic spinel structure of FeFe2O4, CoFe2O4 and NiFe2O4 magnetic nanoparticles, which was consistent with the results obtained in previously published scientific papers. The size of these obtained magnetic nanoparticles was determined from the electron microscope photograph and the Debye-Scherer equation, and the diameter of the nanoparticles was determined to be 25-38 nm, 10-30 nm, 7-30 nm. The saturation magnetization measured at room temperature was 37.5 emu/kg for FeFe2O4, 29 emu/kg for CoFe2O4, and 24 emu/kg for NiFe2O4.

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