# Structural and Magnetic Properties of Cobalt Ferrite Nanopoweders Synthesis with Using Contact Non-Equilibrium Plasma

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Nanosized ferrites have been attracting extensive attention due to their wide applications, such as magnetic memory, MRI contrast agents and catalysts etc. Among these magnetic materials, spinel-type ferrite nanoparticles [1-5]. These properties of the nanoferrites are affected by the preparation conditions, chemical composition, sintering temperature and the method of preparation [6, 7]. So far, various synthetic routes have been explored for the preparation of $CoFe_2O_4$ nanoparticles, such as hydrothermal, coprecipitation, microemulsion, forced hydrolysis, reduction–oxidation route [8-9]. In order to avoid the drawbacks from this methods ferrite have been synthesized by wet-chemical method with using contact nonequilibrium plasma (CNP). Among the most promising methods of using electrical discharges, there's one based on CNP of reduced pressure contact influence on the disperse environment.

Numerous studies have shown that aqueous solutions non-equilibrium plasma treatment causes oxidation and reduction of solution components. Thus, metal ions oxidize and form insoluble or sparingly soluble compounds. The aim of this work was to study the effect of CNP on the structure and magnetic properties cobalt ferrite. To carry out the task samples were synthesized under different conditions: the ratio of cations cobalt and iron, pH, reaction time, parameters glow discharge. Synthesis conditions were varied so that it was possible to find the mechanism of glow discharge ferritization effect.

Structural identification of the samples was carried out using the method of differential thermal analysis (DTA) and differential thermogravimetric analysis (DTGA), X-ray diffraction, Fourier transform infrared spectroscopy, Scanning electron microscopy. Vibrating sample magnetometer was used for the magnetic investigation of the samples. Magnetic properties of nanoparticles show strong dependence on the phase composition. The magnetic properties increase with pH of the precipitating medium. The coercivity also increases with increasing pH, goes through a maximum, peaking at around 12. It was found that the characteristic of products depended on pH, temperature, mole ratio (x) of $Co^{2+}$ to $Fe^{3+}$. The products were $Co_xFe_{3-x}O_4$ at $1 \le x \le 2$. Pure $CoFe_2O_4$ nanoparticles with uniform size were synthesized at 35 °C, pH 12 and x = 0.5-1. The maximum coercivity and saturation magnetization of $CoFe_2O_4$ prepared by the present method were 502.6 Oe and 58.9 emu/g, respectively.

[1] Y. Wang, D. Su, A. Ung, J.H. Ahn, G. Wang, *Nanotechnology* **23**(5) (2012) 055402.
[2] M. George, S.S. Nair, K.A. Malini, P.A. Joy, M.R. Anantharaman, *Journal of Physics D: Applied Physics* **40**(6) (2007) 1593.
[3] M.V. Limaye, S.B. Singh, S.K. Date, D. Kothari, V.R. Reddy, A. Gupta, S.K. Kulkarni, *The Journal of Physical Chemistry B* **113**(27) (2009) 9070-9076.
[4] M. Sangmanee, S. Maensiri, *Applied Physics A* **97**(1) (2009) 167-177.
[5] T.E. Torres, A.G. Roca, M.P. Morales, A. Ibarra, C. Marquina, M.R. Ibarra, G.F Goya, *Journal of Physics: Conference Series* **200** (2010) 072101.
[6] B. Liu, Q. Li, B. Zhang, Y. Cui, H. Chen, G. Chen, D. Tang, *Nanoscale* **3**(5) (2011) 2220.
[7] M. Rajendran, R.C. Pullar, A.K. Bhattacharya, D. Das, S.N. Chintalapudi, and C. K. Majumdar, *J. Magn. Magn. Mater.* **232** (2001) 71.
[8] C. Cannas, A. Falqui, A. Musinu, D. Peddis et al., *Journal of Nanoparticle Research* **8**(2) (2006) 255.
[9] M. A. Hamad, *Journal of superconductivity and novel magnetism* **26**(3) (2013) 669.