# Laplace pressure on Co nanopaticles distributed in alumina matrix ($Co/Al_2O_3$)

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Ferromagnetic nanocomposites (FMNC) represent nanoparticles (NP) of ferromagnetic metal (FMM) distributed in diamagnetic matrix. They are related to diluted magnetic semiconductors exposed spinodal decomposition of d-transition metal solution in diamagnetic semiconductors. FMNC layers were deposited by two crucible electron beam evaporation on polycore substrates.

Studies of their magnetic and galvanomagnetic properties demonstrated essential negative magnetoresistivity, obliged to spin-dependent electron tunneling between FMM NP′s through dielectric layer. During our FMNC researches we discovered the following phenomena in these materials: the transition to the spin-glass state, giant thermoelectric power in magnetic field. FMNC layers growing in magnetic field changes the percolation threshold and a temperature of the transition to spin-glass state. Such abundance of spin-dependent phenomena generates the interest to the influence of FM NP′s dimensions on interatomic distances between FMM atoms in NP.

Diminishing of unit cell dimension for NP′s is due to surface tension what leads to Laplace pressure. For the investigation of Laplace pressure effect on Co NP′s we carried out XRD studies of FMNC with Co content of 16,3 and 25,6 at. %, what corresponds to evaluated dimensions of Co nanoparticles about ~ 10 nm[1]. For XRD studies of the facility ARLX′tra (thermo scientific) CuKα irradiation was used. Scanning was fulfilled with a step of 0,005° and signal accumulation time of 1,5 s. The results were compared with the reference XRD in ICDD for bulk Co with hexagonal singony. XRD reflexes of γ-Co are spreaded due to nanosize dimensions of Co NP′s in the accordance with Debye-Sherer equation. On the background of signal fluctuations the generalized diffraction maximum is clearly seen. It is shifted to the side of larger angles for the magnitude of $\Delta 2\theta = 0{,}77^\circ$ in a comparison with the maximum of the reference XRD envelope of bulk γ-Co and testifies to the existence of Co NP′s compression.

The evaluation of surface tension σ according to [2] gives the value about 20kJ/m$^2$ what is close to the magnitude of 27 kJ/m$^2$ for Co NP′s in[3]. For their dimensions about ~ 10 nm one receives the Laplace pressure of 8000GPa.

Thus the fulfilled evaluations demonstrate extraordinary high pressure, acting on Co NP′s crystal lattice magnified possibly by the pressure from the side of $Co/Al_2O_3$ matrix.

Such high pressure leads to diminishing of interatomic distances and to the influence on Curie temperature for Co NP′s.

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