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Chemical tailoring of the magnetic properties of core/shell nanoparticles

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The magnetic properties of nanoparticle assemblies are determined by a number of their characteristics, such as individual particles morpho-structural properties (i.e., size, composition, etc.) and properties of the whole particles system (i.e., particle concentration, matrix properties, etc.). Controlling such features, it is possible to design suitable magnetic properties of the materials for specifical applications. This communication focuses on magnetic properties of the core/shell magnetic nanoparticles (MNPs) produced by high-temperature decomposition of metalorganic precursors with controllable structural properties [1,2]. One of studied systems is core/shell MNPs made of magnetically soft nickel ferrite and magnetically hard cobalt ferrite with different order of layers. An experimental study of the magnetic properties supported by computer simulations of the obtained systems (Fig.1) shows that the nanoparticle core has a determining role in the formation of magnetic anisotropy, while the shell material significantly modulates the surface properties. Moreover, we have shown how changing the individual magnetic properties of MNPs affects magnetic interparticle interactions and the magnetization reversal processes in their assembly.

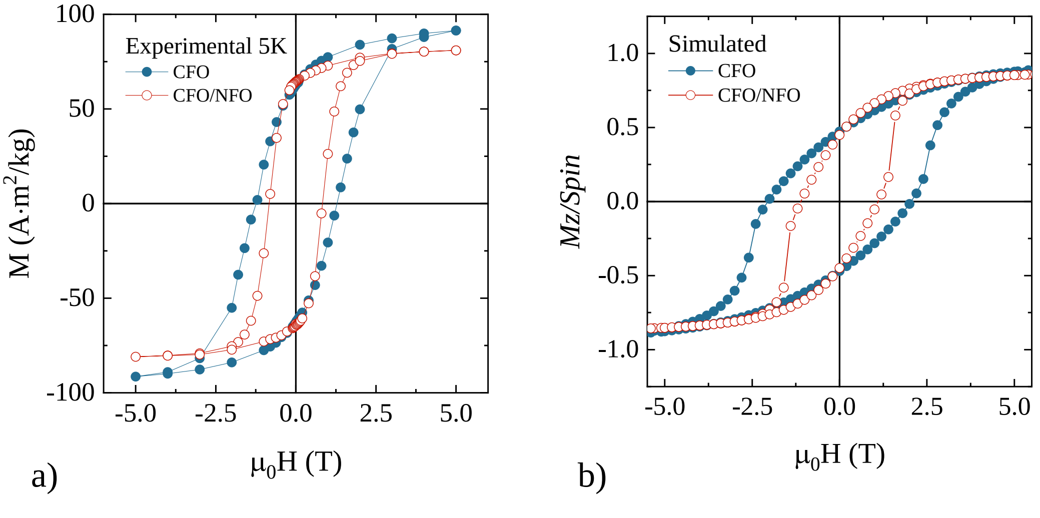

Figure 1 – a) M-H loops recorded at 5 K and inset is the low-field region at 300 K; b) Monte Carlo simulation results of the hysteresis loops for $CoFe_2O_4$ and $CoFe_2O_4/NiFe_2O_4$ particles.

[1] Omelyanchik, A., et al. Nanoscale Advances 3.24 (2021): 6912-6924.
[2] Omelyanchik, A., et al. Magnetochemistry 7.11 (2021): 146.