The effect of surface and dipole-dipole interactions on the magnetic properties of novel nanoparticle systems

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Surface and finite size effects in magnetic nanoparticles (NPs) are the subject of growing interest both from basic as well as technological point of view. Despite of a large number of investigations, there are still many unanswered questions regarding the influence of surface and interparticle interactions on the internal magnetic order in nanoparticles, and their subsequent macroscopic properties. In the present talk, this topic will be discussed considering some novel systems consisting of Ni-oxide, and NM@$TMFe_2O_4$ (where NM= Ag and Au, TM= Fe, Co), $TMFe_2O_4$@CoO dimer NPs, prepared by means of alternative synthesis methods. In the first system, three samples of naturally mixed Ni (>100 nm) and NiO (~ 10 nm) were prepared using thermal decomposition of metal precursor in a high boiling point organic solvent with different particle diameters/distributions and concentration of metallic Ni. Exchange bias effect has been observed, and it strongly depends upon both particle diameters and concentration of Ni, achieving the highest value (~2.2 kOe at 5 K) for the pure NiO, while the corresponding value for the sample with maximum concentration of Ni is ~ 0.07 kOe, whereas the dimer NPs were prepared using a two-step process and it is found that the thermal stabilization of dimer NPs is enhanced, when compared to $TMFe_2O_4$ nanoparticles. The results are discussed taking into account the role of surface effects and interparticle dipolar interactions on the macroscopic magnetic properties of the nanoparticles.