**Size and surface effects on the magnetic properties of NiO nanoparticles**

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NiO nanoparticles (NPs) were prepared by a sol-gel process using the citrate route. The sol-gel parameters were tuned to obtain samples with different average particle sizes, ranging from 12 to 70 nm. Magnetic characterization revealed an increase in the blocking temperature with the diameter of the NPs and an increase in the effective magnetic anisotropy ($K_{eff}$) with decreasing particle size [1]. The magnetic moment per particle was calculated for all samples using the susceptibility value at T=300 K. The number of uncompensated spins per NP was found to be proportional to $n_S^{1/3}$ ( $n_S$ = total number of spins), indicating that they are randomly distributed on the NP surface [2]. For small diameters (<30 nm) the surface anisotropy constant was estimated, using, for NiO NPs, a recent model describing the evolution of $K_{eff}$ with particle size [3]. Hysteretic loops performed at low temperatures after field cooling displayed loop shifts (~6.5 kOe in the field axis and ~0.18 emu $g^{-1}$ vertically), coercive field enhancement ($H_C$~4.8 kOe) and training effects for the smaller NPs. The sample with NPs of larger diameters presented magnetic properties close to those of bulk NiO.

## References

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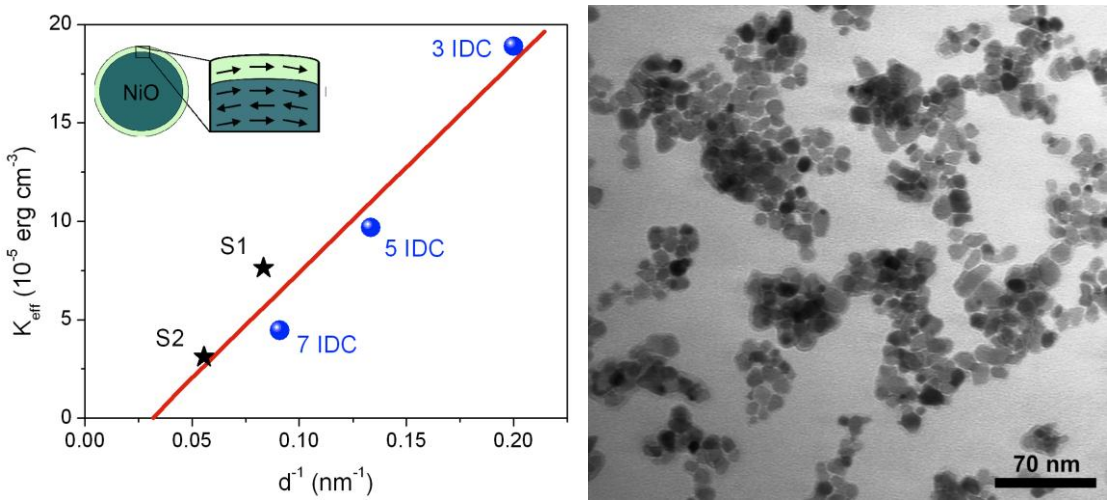
[2] L. Neel, Compt. Rend., **252** (1961) 4075.
[3] D. Tobia, E. De Biasi, M. Granada, H. E. Troiani, G. Zampieri, E. Winckler and R. D. Zysler, J. Appl. Phys., **108** (2010) 104303.

## Figures




*On the left: Variation of the effective magnetic anisotropy with the inverse diameter of small NiO nanoparticles. Inset scheme illustrates the NiO nanoparticle formed by a shell of uncompensated spins with ferromagnetic correlations and an antiferromagnetic core. On the right: TEM image of NiO nanoparticles.*