Oral PhD

Spin configurations of individual $Fe_{3-x}O_4$ nanoparticles

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Magnetic nanoparticles (MNPs) are attractive materials object of many studies in the recent past years due to their potential applications in nanotechnology, such as data storage, magnetic resonance imaging, catalysis or environmental remediation [1], and in biomedicine, including biomolecule detection, magnetic hyperthermia or targeted drug delivery [2]. Not only reliable and reproducible methods of nanocrystal synthesis are of key importance in order to obtain uniformly sized MNPs but also high resolution characterization techniques with accurate magnetic sensitivity are necessary to unveil their domain configurations and magnetization reversal processes.

In this work, we present synthesis [3] and magnetic domain characterization of $Fe_{3-x}O_4$ nanoparticles – ranging from 15 to 100 nm – by organic decomposition methods, using iron (III) acetylacetonate as precursor and decanoic acid as surfactant and stabilizer. Domain structure of clusters and individual nanoparticles were obtained by magnetic force microscopy (MFM) under variable in-plane or out-ofplane magnetic fields. In addition, micromagnetic simulations were performed with the OOMMF code to help with the interpretation of the sometimes non-trivial contrast in MFM images.

Furthermore, some hints are provided about artifacts that might be present when measuring magnetic nanoparticles with MFM, such as influence of the topography and/or electrostatic overlap [4]. Their contribution should be taken into ccount for a correct interpretation of MFM data.

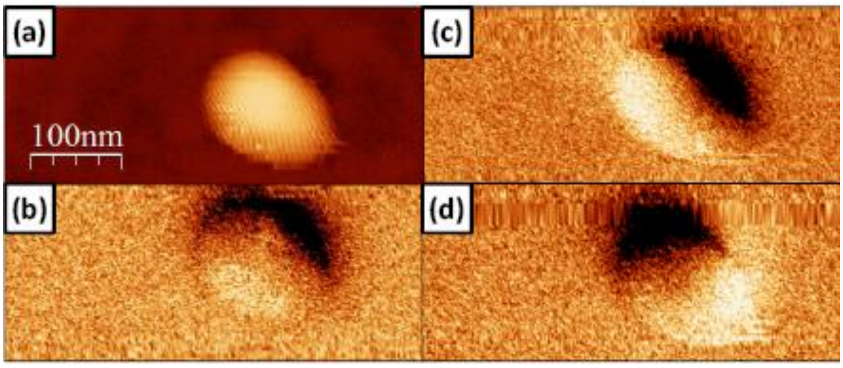

Figure 1. (a) Topography of a single $Fe_{3-x}O_4$ nanoparticle (d≈30 nm). MFM images show different orientations of a single domain (b) at remanence and under horizontal fields of (c) + 23 mT and (d) -23 mT.

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