08-08 **Magnetic Characterisation of Iron Nanocubes**

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Single-crystalline Fe/Fe_xO_y core-shell nanocubes (Fig. 1) with (100) facets and 13.6 nm edge-length were prepared by wet-chemical methods. While the core is metallic, the shell is composed of either Fe_3O_4 or γ-Fe_2O_3.

The cubes were deposited onto GaAs substrates with monolayer coverage as shown by scanning electron microscopy. Oxygen and hydrogen plasma were used to remove the ligands and the oxide shell. The oxide free Fe-nanocubes were investigated by ferromagnetic resonance (FMR).

Fig. 2 (b) shows the FMR spectrums of these nanocubes for in plane and out of plane measurement. To interpret the observed spectra we have calculated the absorptive part χ'' of the high frequency susceptibility $\chi(\omega)$ as function of the external magnetic field. From this simulation, the derivative $\partial\chi''/\partial B$ was computed numerically (Fig. 2 (a)). The result of the calculation of $\partial\chi''/\partial B$ for different directions of the external magnetic field in the sample plane with respect to

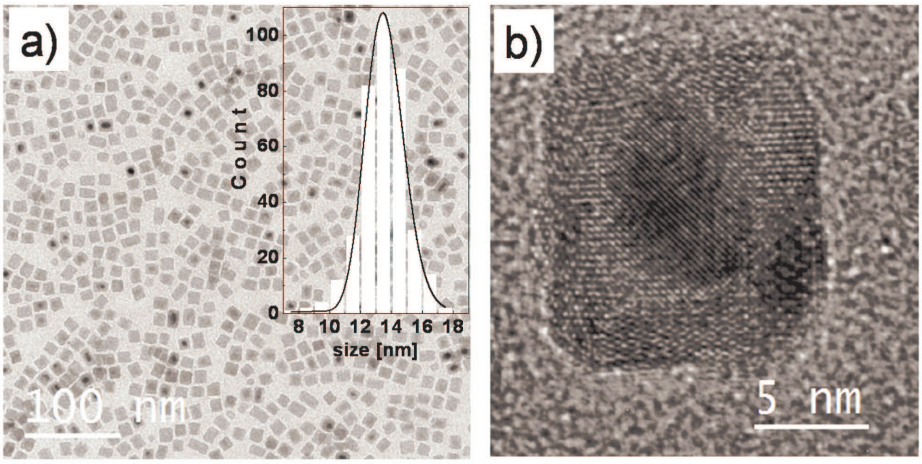

Fig. 1. (a): Bright-field TEM image of Fe nanocubes assembled on a carbon-coated Cu-grid and their size distribution. (b): A typical high-resolution TEM image of an individual as-prepared iron/iron oxide cube with core-shell contrast

the easy and hard direction of the particle magnetizations is shown in Fig.2 (b). The black curve is a sum of all resonance modes shown with the coloured data. The parameters for the fit are the crystalline anisotropy $K_1 = 4.8\times10^4$ Jm^{-3}, the g-factor $g = 2.09$, the damping parameter $\alpha = 0.03$, and $M(B_{Res}) = (0.67 \pm 0.12)\times10^6\,Am^{-1}$, the latter which was independently determined from magnetization measurements.

While the g-factor ($g = 2.09$) and the crystalline anisotropy ($K_4 = 4.8\times10^4\,Jm^{-3}$) of the pure iron cubes show bulk values, the saturation magnetization is reduced to ($M(5K) = (1.2 \pm 0.12)\times10^6\,Am^{-1}$) 70% of the bulk value and the effective damping parameter ($\alpha = 0.03$) is increased by one order of magnitude with respect to bulk Fe [1].

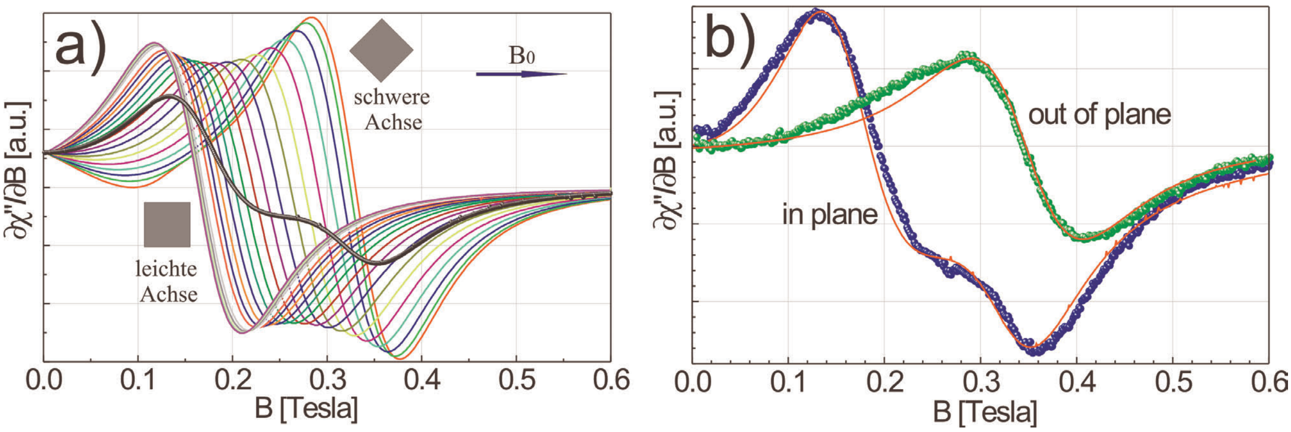

Fig. 2. (a): Theoretical simulation of crystalline anisotropy distribution from easy to hard in-plane direction (shown as grey cubes). The black curve is a sum of all coloured resonance modes. (b): theoretical fits (lines) to the in plane and out of plane experimental FMR spectra (symbols).

References

1. A. V. Trunova, R. Meckenstock, I. Barsukov, Ch. Hassel, O. Margeat, M. Spasova, J. Lindner, M. Farle, J. Appl. Phys. **104**, 093904 (2008).