FABRICATION OF NANOSPHERES FROM Mn12 ACETATE SMM: DO THE CHEMICAL PROPERTIES OF THE ORIGINAL CLUSTER SHOW CHANGES?

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Micro- and nanoparticles have recently shown prosperous fields of application in diverse technological areas ranging from data storage, catalysis, and lithography to biosensors.[1] Considering the interest on these materials, a current goal in this area is the fabrication of particles with novel compositions that can offer interesting properties for new applications. In this field, we have recently published a precipitation-based methodology for fabricating sub-50 nm metal-organic spheres from macroscopic crystalline Mn_{12} acetate SMM of formula $[Mn_{12}O_{12}(CH_3COO)_{16}(H_2O)_4]\cdot 2CH_3COOH\cdot 4H_2O$ (see Figure 1).[2]

The magnetic properties of the synthesized Mn_{12}-based nanoparticles clearly indicate that particle formation does not affect the molecular composition of $Mn_{12}O_{12}$ clusters, although some interesting differences appear when the magnetic behaviour exhibited by such nanoparticles is compared with a polycrystalline sample of $[Mn_{12}O_{12}(CH_3COO)_{16}(H_2O)_4]$ (see Figure 2) [3].

In this contribution, a general overview of the magnetic properties of these novel Mn_{12}-based nanospheres will be shown. The comparison of the magnetic behavior of these nanoparticles and the starting crystalline Mn_{12} acetate will give important information about how changes in the environment influence the resulting magnetic properties of SMMs. This fundamental knowledge can prove useful in order to control the behaviour of these clusters when we try to build useful devices for quantum computation and data storage since the degree of decoherence as well as the lifetime of the data stored strongly depend on the magnetic relaxation.

References:

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Figures:

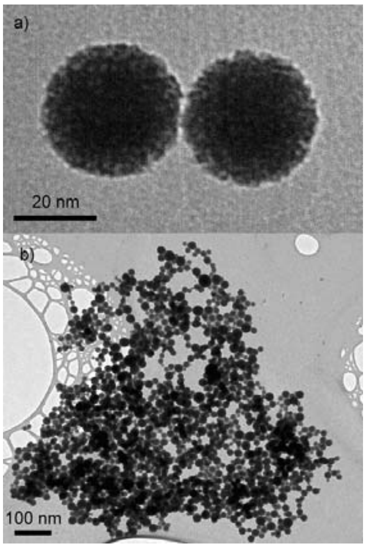

Figure 1. TEM images of nanospheres of Mn_{12} acetate.

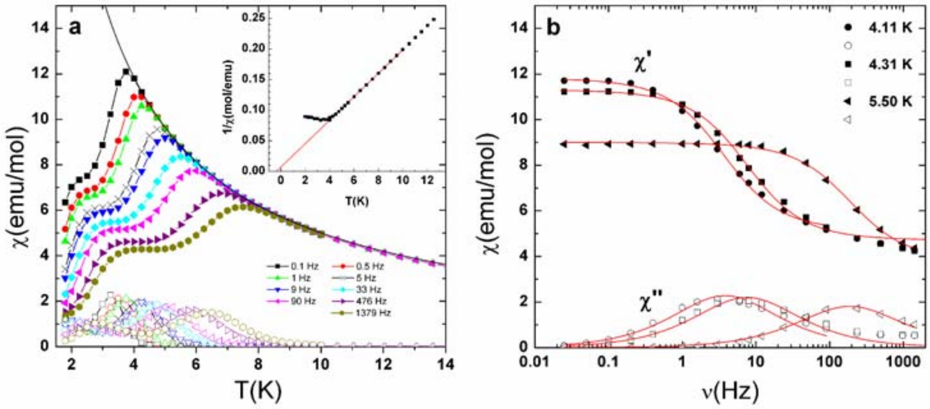

Figure 2. Magnetic ac-susceptibility data (real and imaginary parts) for the Mn_{12}Ac-based nanospheres: (a) as a function of the temperature, inset: $1/\chi$ *vs.* T; (b) as a function of the frequency. Three selected temperatures have been represented. The red line corresponds to the Cole-Cole fit.

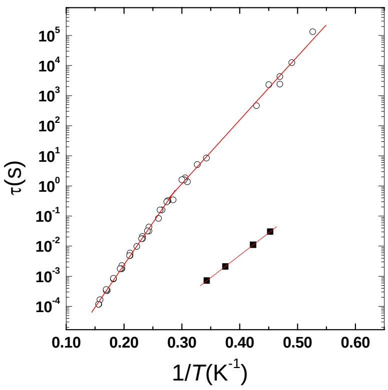

Figure 3. This plot resumes the relaxation times obtained from ac ($0.1 < T^{-1} < 0.3$ K^{-1} range) and magnetic relaxation ($T^{-1} > 0.3$ K^{-1}) measurements. Square symbols represent the data obtained for the fast relaxing species.