Poster

X-RAY MAGNETIC CIRCULAR DICHROISM STYUDY OF MAGNETIC DODECANETHIOL-CAPPED Au NANOPARTICLES.

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From some years now, metallic nanoparticles are acquiring increased scientific importance in fields such as chemistry, physics, biology or medicine. Their useful potential applications, from carriers for cancer-treatment drugs to digital data storage, are rapidly increasing as the scientific studies progress.

Since the first publications about magnetic Au nanoparticles [1,2], various research groups from very different backgrounds have tried to explain this novel behavior. When a metal particle having bulk properties is reduced in size to a few atoms the electronic structure changes dramatically which affects noticeably to the physical properties, this is known as the size effect. This size reduction also increases the surface to volume relation, the surface effect. As a result of both effects, all atoms from a nanoparticle undergo electron redistribution.

In this work, we show a direct evidence of the intrinsic ferromagnetism of dodecanethiol capped Au nanoparticles of an average size of 1.8 nm (Fig 1) by means of element-specific magnetization (ESM) measurements based on the x-ray magnetic circular dichroism (XMCD) technique. XMCD allows the detection of the magnetic moments of a particular element through sensitivity to the difference between the up- and down- spin densities around the Fermi level. XMCD experiments were performed at the beamline BL39XU of the SPring8 Facility.[3] XMCD spectra were recorded in the transmission mode at Au $L_{2,3}$ edges using the helicity-modulation technique.[4]. The XMCD spectra were recorded at room temperature and under the action of an applied magnetic field of up to 10 T (Fig. 2). The spin-dependent absorption coefficient was obtained as the difference of the absorption coefficient $\mu_c = (\mu^- - \mu^+)$ for antiparallel, μ^-, and parallel, μ^+, orientation of the photon helicity and sample magnetization.

Considering the XMCD signal to be proportional to the magnetization, ESM is obtained by recording the peak amplitude of the XMCD spectra at the Au L_3-edge as a function of external magnetic field and temperature. Both the ESM measurement and that measured by means of SQUID magnetometer show similar magnetization process. In either ESM or SQUID curves there is a distinguishable hysteric behaviour and, the magnetization increases when increasing the magnetic field until the saturation is reached which is characteristic of a ferromagnetic material.

References:

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[3] H. Maruyama, J. Synchrotron Radiat. **6**, (1999) 1133.
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Figures:

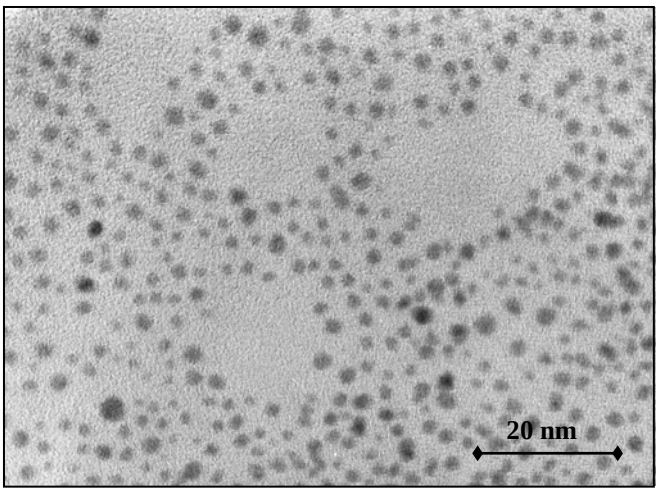

Figure 1. TEM micrograph od dodecanethiol-capped Au nanoparticles.

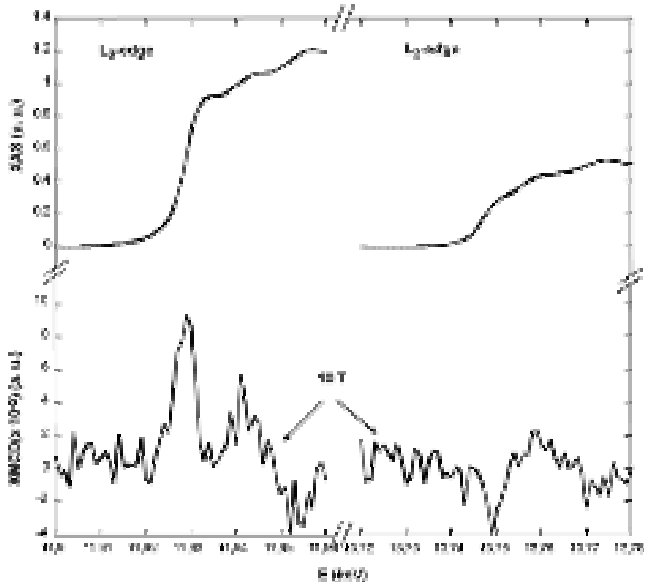

Figure 2. XMCD and XAS spectra at the Au L_3- and L_2-edge with an applied magnetic field of 10 T.