ELyT Labo 講演会のお知らせ

Dr. Florent Tournus, Université de Lyon, France

8 月 2 日 (月) (August 2, Monday) 15:00-
3 号館 6 階セミナー室 (Seminar Room, 3-601, 6F)

Structural and magnetic characterization of CoPt nanoparticles

The fabrication and magnetic characterization of well-defined CoPt nanoparticles chemically ordered in the L10 phase is still highly challenging. The synthesis of particles with a sharp size distribution is indeed not enough: it is difficult to avoid particle coalescence during the annealing step, often necessary, used to promote chemical ordering, and samples carefully designed are mandatory if we want to minimize interparticle interactions. This is the only way to have access to the true intrinsic properties of CoPt nanoparticles. Our cluster source (LECBD technique), which is based on laser vaporization followed by UHV deposition of size selected particles, offers such a possibility.

We have prepared diluted samples of CoPt particles (diameter around 3 nm) embedded in amorphous carbon. The structural properties, before and after annealing, have then been analyzed by high resolution transmission electron microscopy, together with various synchrotron experiments (EXAFS, GIXRD, GISAXS) which provided evidence of L10 chemical ordering, without particle coalescence.

Magnetic characterizations by XMCD and SQUID magnetometry have been used to relate these structural changes to the evolution of the magnetic properties, with a special interest on the magnetic anisotropy. We have indeed applied our recently developed analysis procedure of the magnetic curves which allows a precise determination of both the magnetic size distribution and the magnetic anisotropy energy distribution. A thorough analysis of the magnetization curves (ZFC/FC susceptibility, magnetization loops, IRM/DCD curves?) was also able to prove that the interparticle interactions are negligible and that the chemical ordering is not accompanied by cluster coalescence. Such pieces of evidence are often lacking in the CoPt nanoparticles literature...

Interestingly, we have observed that a 2 hours annealing at 750 K is enough to promote chemical ordering, even for particles as small as 2 nm in diameter. Nevertheless, even if it goes with a magnetic anisotropy increase, the later remains much lower than for the bulk.

Moreover, measurements on size-selected particles have allowed to detect the significant anisotropy constant dispersion, theoretically predicted, and which is due to a nano-alloy effect: this is the first time that a K_{eff} dispersion is experimentally evidenced, showing that the universally used E_anisotropy = K_{eff} V model is not valid in the case of CoPt nano-alloy..

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