ESRF	**Experiment title:** SAXS/GISAXS study of CoCu and FeAg giant magnetoresistance granular alloys	**Experiment number:** HS-2477
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Report:

Granular alloys composed of magnetic granules embedded in a metallic non magnetic matrix present giant magnetoresistance (GMR), that is, their electrical resistance decreases notably under an applied magnetic field. The GMR is closely correlated to the microstructure of the samples, in particular, the magnetic clusters size and size-distribution, concentration and interfacial roughness. Therefore, a complete knowledge of the microstructure of the samples is imperative for understanding the mechanisms that give rise to the GMR response and accordingly find the microstructural attributes that mean an optimum GMR response of the samples [1,2]. The SAXS technique is particularly suited for the analysis of these granular alloys, as it allows to detect the presence of nanoclusters that otherwise are difficult to resolve with XRD or TEM due to their small size (2-3 nm) and the similar atomic number of the elements involved, but both problems could be overcome with the use of SAXS.

The SAXS experiments performed on ID01 were very successful. We got very nice spectra that undoubtely showed that there are nanosized clusters in the samples, up to then only infered from the magnetic analyses, and how these nanoclusters evolved with the annealing temperature for the melt-spun CoCu samples or the deposition conditions in the laser ablated FeAg ones. Figure 1 shows the SAXS spectra for the Co_xCu_{100-x} samples as a function of the annealing temperature for the four compositions studied ($x = 5, 10, 15, 20$).

The quantitative analysis of the data is very complex. To begin with we calculated the correlation distances between the nanoclusters and compared them with the distances inferred from the magnetic analysis. This work has been submitted to J. Magn. Magn.

Mat.. A more complex analysis is being performed at the moment, which consists on fitting the curves to a spherical form factor under the Perkus-Yevik approximation for hard spheres. From this procedure we expect to get very valuable information on the sizes, size-distribution and concentration of the magnetic nanoparticles as a function of annealing temperature and Co concentration. As an example, figure 2 shows the fit of sample Co_5Cu_{95} annealed at 450^{o}C.

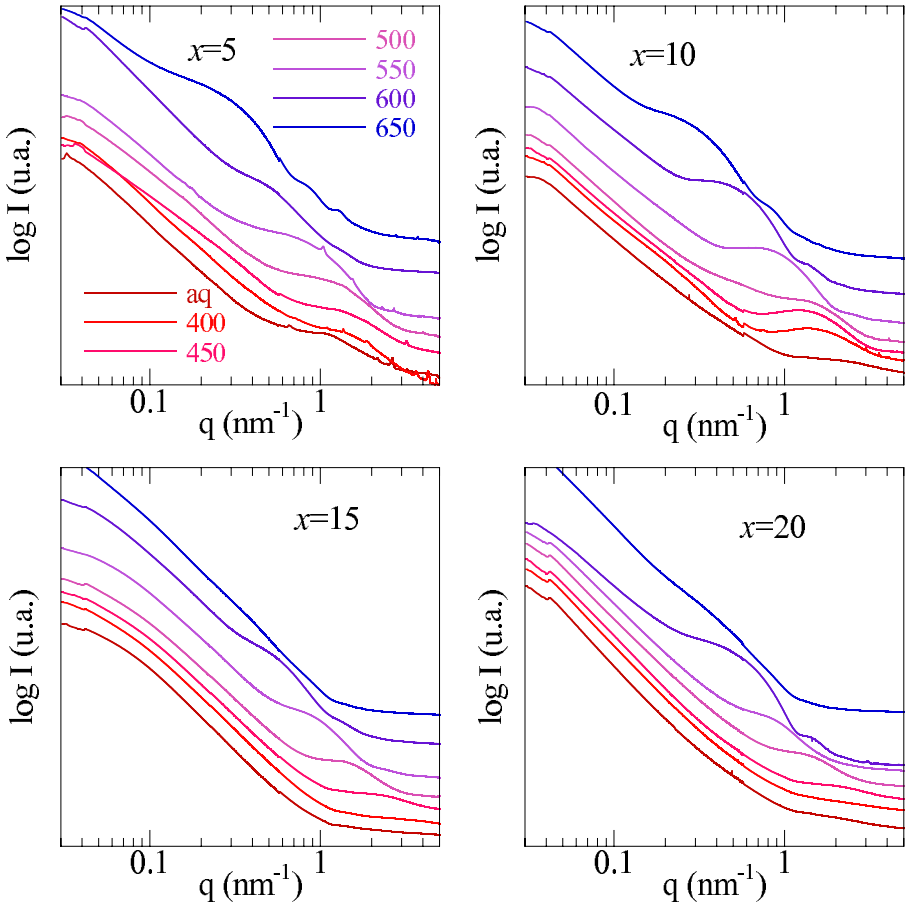

Figure 1: SAXS spectra of the Co_xCu_{100-x} samples as-quenched and annealed between 400 and 650^{o}C for $x = 5, 10, 15, 20$.

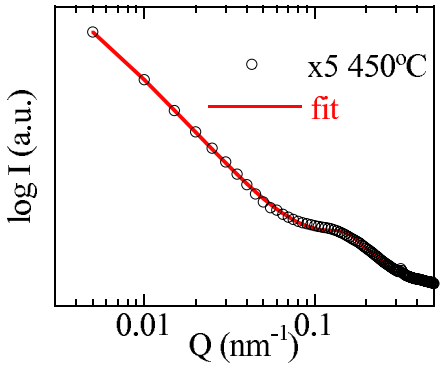

Figure 2: Fit of the $x = 5$ sample annealed at 450^{o}C.

[1] Microstructural and magnetic evolution upon annealing of giant magnetoresistance melt-spun CoCu granular alloys, A. García Prieto, M.L. Fdez-Gubieda, C. Meneghini, A. García-Arribas, S. Mobilio, Phys. Rev. B **67** (2003) 224415

[2] Direct experimental evidence of an anomalous Co segregation in CoCu granular alloys and its influence on magnetoresistance, M.L. Fdez-Gubieda, A. García Prieto, A. García-Arribas, C. Meneghini, S. Mobilio, Europhys. Lett. **59** (2002) 855-861