ESRF	**Experiment title: Structural hierarchy in multilayer stacks of spherical and cubic iron oxide nanoparticles**	**Experiment number**: HC-2222
Beamline: BM26B	**Date of experiment**: from: 23.11.2015 to: 27.11.2015	**Date of report**:
Shifts: 9	**Local contact(s)**: Daniel Hermida Merino	*Received at ESRF:*

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Report:

Magnetic nanostructures are interesting towards application in the fields of spintronics, magnetic sensors, and information technologies [1], but also for their fundamental importance towards investigation of nanomagnetic phenomena such as dipolar interparticle interactions and exchange coupling [2]. Our long term research objective is the dipolar coupling in ordered arrangements of magnetic nanoparticles. Suitable model systems require tunable interaction potentials by variation of particle size and interparticle distance as well as the degree of crystallographic alignment. The multilayer stacks under study consist of highly monodisperse maghemite (γ-Fe_2O_3) nanoparticles and provide precisely tunable interparticle distances in different structural hierarchies along with a shape-induced enhancement of long range order.

Grazing incidence small-angle scattering has been used at BM26B to study multilayer stacks of maghemite (γ-Fe_2O_3) nanoparticle layers with different hierarchies of interparticle separation distances. Uniform layers of monodisperse cubic and spherical iron oxide nanoparticles on Si substrates were obtained by spin coating and evaporation-induced deposition techniques resulting in disordered and ordered colloidal arrays, respectively. Additional structural hierarchy was introduced in four samples by adding separation layers of poly(methyl methacrylate) (PMMA) in between the nanoparticle layers.

We measured 24 samples at an incident X-ray energy of 12 keV, far above the iron K-edge. The Pilatus 300K detector was set up at two detector distances of 2.9 m and 6.5 m, to access the scattering arising from *intra*- and *inter*layer distances.

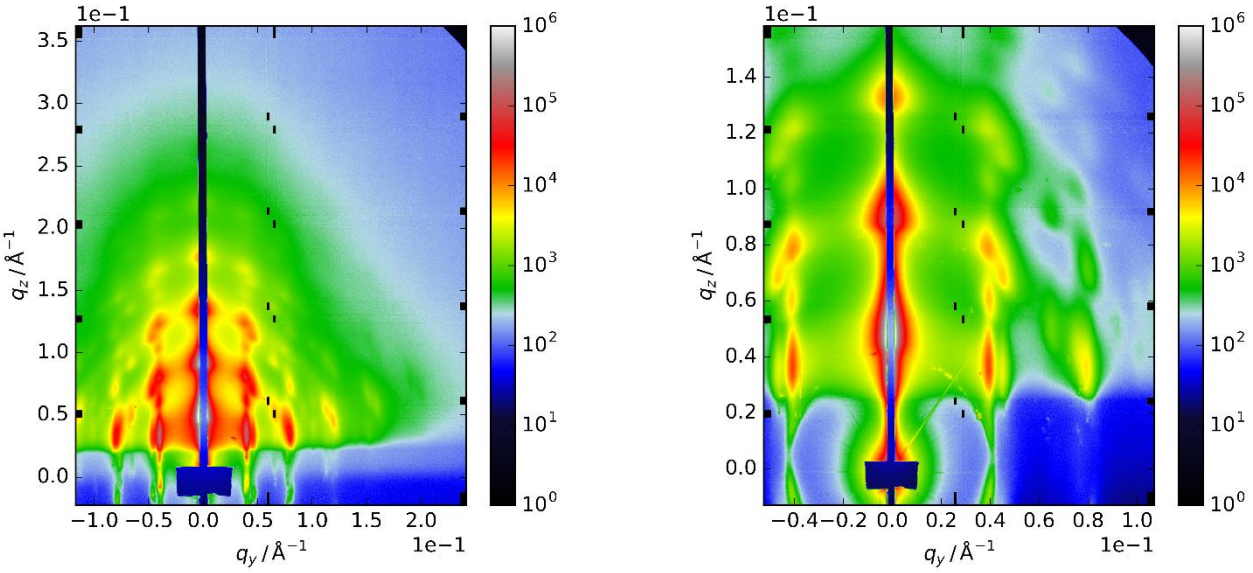

Figure 1: GISAXS of a colloidal crystal formed from cubic particles at small (left) and large detector distance (right) (α_i=0.2°).

The obtained data from ordered colloidal crystal shows distinct peaks (Fig. 1), related to the long-range order within the sample. The data is therefore highly valued for the quantitative analysis and understanding of the different structure found in the prepared samples. Further analysis of the data is ongoing.

References

[1] S. Sun *et al.*, *Science*, **287**, 1989 *(*2000).
[2] S. A. Matjetich, M. Sachan, *J. Phys. D: Appl. Phys.*, **39**, R407 (2006).