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Names and affiliations of applicants (* indicates experimentalists):

F. Eichhorn*, J. Grenzer*

Forschungszentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research, D-01314 Dresden, Germany

Report:

We report on first grazing incidence small angle x-ray scattering test measurements at ROBL.

Grazing-incidence small-angle scattering (GISAXS) is an increasingly important structural characterization technique and finds its application in nanostructures and nanocomposites investigations at surfaces and interfaces. The GISAXS method can be used as a complementary method to conventional surface-sensitive tools such as scanning probe microscopy and electron microscopy. The GISAXS technique is, like any X-ray technique, a non-destructive one and therefore can be easily used in situ and in real time investigations to monitor the formation of the nanostructure or nanocomposite, that is a great advantage to understand the kinetics of nanoassembly processes. Moreover GISAXS can be used to investigate non-destructively structures just below a surface.

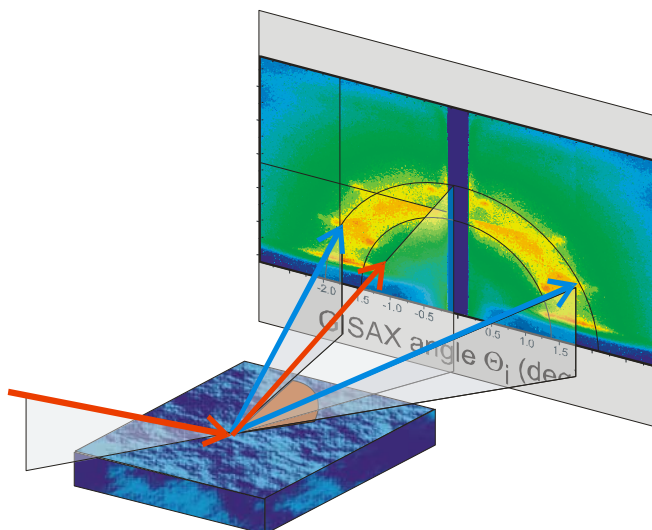


Figure 1: Experimental GISAXS setup; for $|\Theta| > 0$ is the scattering vector almost parallel to the sample surface that allows determining the lateral structure. Using a 2D detector a Q_{inplane} and Q_z reciprocal space map could be recorded at once.

The aim of this test experiment was to expand the experimental capabilities of the ROBL beamline, especially in material research. Therefore, we conducted a series of tests to find out the experimental conditions to operate the beamline for an optimal GISAXS experiment. Figure 1 shows the principal setup of a GISAXS experiment. As a detector we used a MARCCD with a detector radius of 165 mm. The detector was placed 3 m behind the sample. To reduce air scattering, tests were carried out at 11 keV and a He filled flight tube was employed to following the beam path.

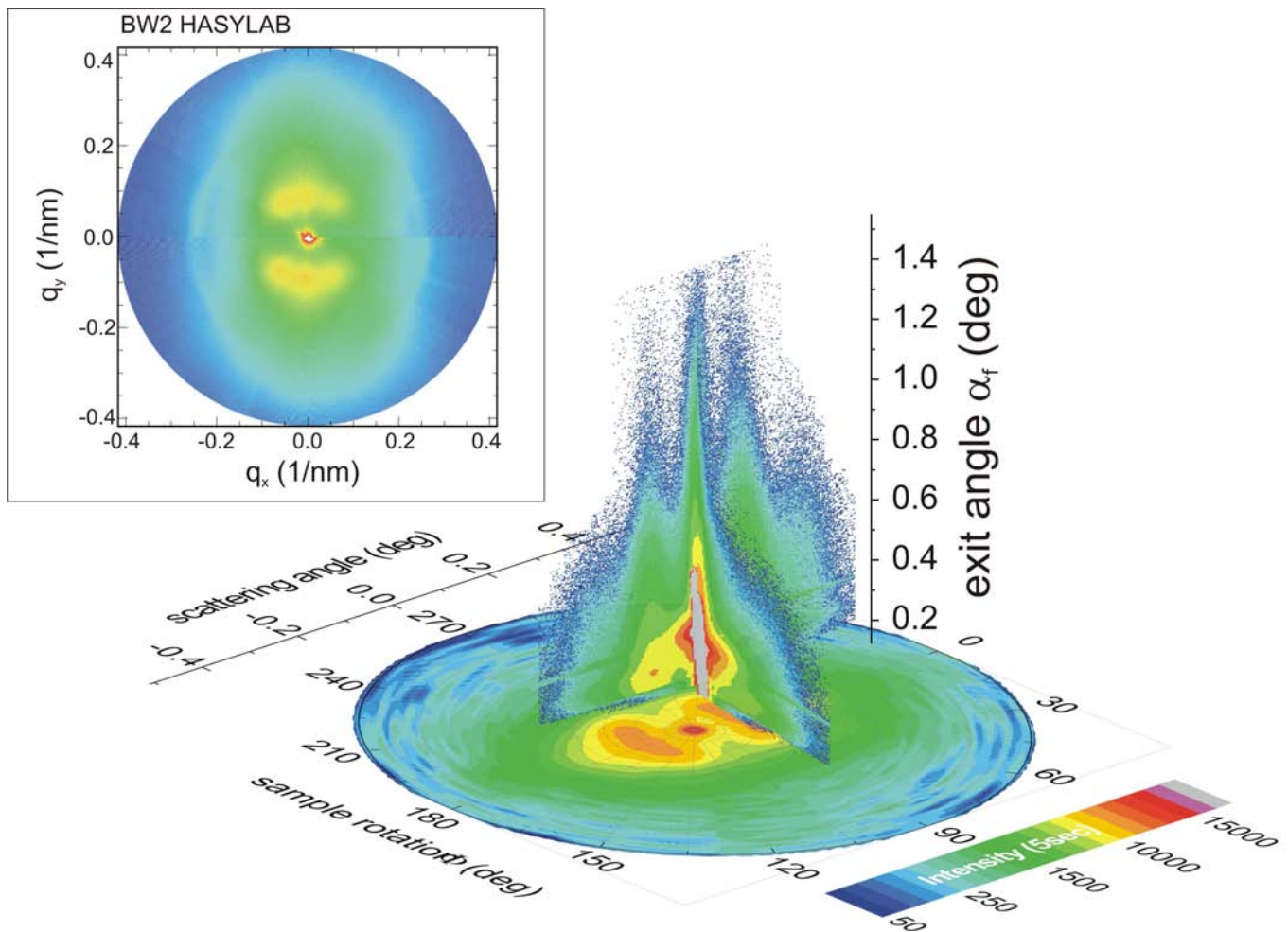


Figure 2: The GISAXS scattering pattern of a free standing InAs quantum dot sample was measured at an incidence angle of 0.3 degree; the out of plane intensity distribution is shown for a sample rotation angle of 0 and 90 degree; the in-plane pattern is composed of 36 scans and shown for an exit angle of 0.3 degree as well. The inset shows a similar in-plane pattern measured at the BW2 at HASYLAB.

Figure 2 shows a GISAXS scattering pattern of a freestanding InAs quantum dot sample grown on a GaAs substrate. The sample was provided by M. Schmidbauer (Institut für Kristallzüchtung, Max-Born-Straße 2, D-12489 Berlin, Germany). The sample shows a clear one dimensional short range ordering with an average dot distance of about 80nm. The inset shows the GISAXS scattering measured under similar conditions ($E = 10\text{keV}$) at the BW2 beamline at HASYLAB.

Therefore, the GISAXS measurements can be carried out at the ROBL beamline taking into account the synchrotron beam characteristics at a bending magnet, the need of a longer counting time and a higher sample - detector distance to increase resolution. For routine operations a double beam stop (for the direct and reflected beam) as well as an optimized flight tube should be installed.