

Workshop on Grazing Incidence Small Angle Scattering at HASYLAB

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From May 10 to 12 the “GISAXS Workshop 2005” was hosted at HASYLAB/ DESY in Hamburg. GISAXS stands for Grazing Incidence Small Angle X-ray Scattering, a surface sensitive technique to observe structures on large length scales up to several hundred nanometers. Organized by R. Gehrke and S.V. Roth from HASYLAB and P. Müller-Buschbaum from the technical University of Munich the workshop attracted more than 50 participants from all over the world, originating a very stimulating atmosphere with invited talks, a contributed poster session and practical training including real data acquisition at beamline BW4.

The lectures were opened by a welcome by R. Gehrke (HASYLAB) introducing the present and future sources at HASYLAB [1]. Especially, he focused his talk to one of the major key parameters in GISAXS experiments, namely brilliance, and he pointed out the significant improvements which the future projects in Hamburg - the PETRA III upgrade and the X-ray Free Electron Laser - will bring in this field. In the next talk M. Rauscher (MPI Stuttgart) provided the theoretical basis for GISAXS with general insights into distorted wave Born approximation (DWBA). For rough surfaces and for layers with an internal structure different ways to choose the unperturbed reference plane and to add the perturbation were discussed [2]. R. Lazzari (University of Paris) demonstrated the wealth of possibilities to simulate GISAXS data by using his freely available program “IsGISAXS” [3]. The influence of form and structure factors was presented as well as different ways of decoupling size-distance correlations. The experimental realisation of GISAXS and grazing incidence diffraction (GID) was shown by M. Schmidbauer (IKZ Berlin). The differences between GISAXS and GID with respect to the achievable information were illustrated by the application of both techniques for the characterization of semiconductor nano-structures [4]. Possibilities, experimental boundary conditions and theoretical considerations of high-resolution GISAXS experiments were addressed in the talk given by P. Müller-Buschbaum (TU Munich). Examples how to extend the accessible q-space by combining high-resolution and standard GISAXS were discussed considering polymer nano-structures [5]. Addressing the kinetics of morphological transitions in thin di-block copolymer films, C.M. Papadakis (TU Munich) pictured the power of in-situ GISAXS investigations. Structural changes in the films during toluene vapour treatment were monitored in real time with temporal resolution of the order of 30 seconds, which allows gathering deeper information about the processes involved [6]. After a poster session with related presentations contributed by the participants, the first day was closed with a workshop dinner in the DESY canteen allowing further fruitful discussion among the participants.

The second day was opened by the lecture of U. Pietsch (University Potsdam) introducing the application of “white beam” techniques in the field of surface scattering, especially GISAXS. Potential advantages of the method were pointed out, like a fixed irradiated sample area and high photon flux allowing shorter exposure times and kinetics investigations [7]. A. Meyer (University Hamburg) showed nice examples of GISAXS measurements of highly ordered nano-structures resulting from di-block copolymers. He also compared data analysis based on the modelling program “IsGISAXS” with a simple analysis performed with the program “SCATTER” developed in his group which has been derived from common small angle X-ray scattering analysis [8]. On the route towards applications J.S. Gutmann (University Mainz) inspected titanium nano-particle

formation in ultra-thin films, being a basis for the production of solar cells. Local real space TEM data were compared with GISAXS measurements [9]. Again following the line of applications, G. Artus (University Zurich) introduced the concept of super-hydrophobic surfaces. He reported on the preparation, characterization, and problems related to the application of this new chemical concept. The lecture part ended with a presentation of A. Gibaud (University Le Mans) about in-situ GISAXS measurements of surfactant templated self-assembled silica thin films. The ordering was followed with a time resolution of 15 seconds, and from a detailed analysis of GISAXS and reflectivity data otherwise inaccessible parameters such as the micro- and meso-porosity of the silica films were determined [10].

After an official safety training, S.V. Roth gave an introduction to the HASYLAB wiggler beamline BW4, which is presently used for GISAXS measurements and allows a very flexible adaptation to the q-space resolution required in a specific experiment. Details of the instrumentation and examples of measurements were presented. The remaining one and a half days of the workshop were reserved for practical training concerning data acquisition and data treatment.

This training was split into three parts devoted to performing real GISAXS measurements at the BW4 instrument, basic treatment of GISAXS data, and simulation and fitting of GISAXS data using the program "IsGISAXS". Each part lasted approximately three hours. Three groups circulated among the stations of the training. In the experimental part the participants practiced the alignment of a sample for a GISAXS experiment, the angular calibration of the instrument, and performed a real data acquisition. In addition, they could closely inspect the details of the BW4 set-up. In the data treatment part, the processing of the raw data and the extraction of the structural information by preparing appropriate one-dimensional intensity cuts was exercised using the common data handling program "Fit2D" [11]. Finally, the installation of the program "IsGISAXS", its handling, and the meaning of the numerous parameters in the input file as well as of the various model options of the program were explained and applied in the simulation part. The participants could also perform some particular examples of modelling GISAXS data.

To conclude, the workshop was a big success. The resonance among the participants was very positive. They pointed out the intense atmosphere of the lectures, the discussions, and the practical part, the excellent presentations covering the whole range from theoretical basics to applications in a variety of different fields from hard to soft matter science, and the practical exercises which really could provide a feeling how to use the tools for this promising technique. In accordance with the intentions of the organizers the workshop brought experts in the field of GISAXS together with young scientists, most of them being PhD students or post-docs who just started working in this field.



Figure 1: A glance into the audience.

References

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