Second International Workshop on Grazing Incidence Small Angle Scattering

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During the recent years, Small Angle X-ray Scattering using grazing incidence geometry (GISAXS) has been established at beamline BW4 as a very powerful tool to study structures on surfaces. Correlations on length scales in the range from 100nm to several micrometers can be investigated by this method. In order to foster this experimental technique and to introduce young scientists into it, a first workshop was held at HASYLAB in 2005. The very positive response encouraged the organizers to have a next workshop on this matter two years later. Thus, the “Second International Workshop on Grazing Incidence Small Angle Scattering” was arranged in 2007 from May 9 to 11. It was organized by S. Roth and R. Gehrke (HASYLAB) and P. Müller-Buschbaum (TU Munich). This time, the workshop attracted more than 100 participants from over 20 countries worldwide, creating a very exciting and stimulating atmosphere with invited keynote lectures, two sessions with more than 50 contributed posters, and practical training including real data acquisition at the BW4 instrument as well as data evaluation and analysis. The workshop was opened with an introduction given by R. Gehrke (HASYLAB) about present and future synchrotron radiation light sources and how increasing brilliance opens new possibilities for GISAXS experiments. The following series of lectures was grouped into five sessions beginning with talks addressing the fundamentals of the GISAXS method. This first session with the title “Modelling” was opened by M. Rauscher (MPI Stuttgart) who presented the theoretical foundation including the Distorted Wave Born Approximation and especially the origin of the Yoneda Peak. Then the basics and capabilities of the commonly used program package “IsGISAXS” for data modelling and fitting were introduced by its creator R. Lazzari (U Paris). He demonstrated the application of the program to analyze the scattering of different thin film morphologies quantitatively. The next session, titled “Quantum Objects”, addressed the first field of GISAXS applications. T. Metzger (ESRF) elucidated current and future applications of combined GID and GISAXS measurements in the field of semiconductor nanostructures. In the next talk, J.-P. Simon (CNRS) showed how to combine SAXS and GISAXS to investigate thin films of dielectrics for ultra large scale integrated microelectronics. The last talk of this session was given by H. Okuda (U Kyoto) about the observation of interdiffusion in nanodot and in metal alloy thin films. “Polymer-Engineered Thin Films” was the title of the next application related session. A. Gibaud (U. Le Mans) presented investigations of mesostructured thin films by X-ray reflectivity and GISAXS, including in-situ experiments of capillary condensation in mesoporous structures. The following lecture by P. Müller-Buschbaum (TU Munich) provided a comprehensive insight into the possibilities to push the limits of GISAXS in both real and reciprocal space. His talk covered GISAXS experiments with nanometer sized beams as well as the potential of GIUSAXS to observe structures with dimensions up to several micrometers. The session was closed by G. Fritz-Popovski (U Graz) who presented GISAXS studies on thin films of copolymers investigating the influence of molecular weight, relative block length, film preparation technique, solvent, and substrate on the obtained nanostructures. The lectures were followed by the first of two poster sessions, in which participants of the workshop presented their research and especially results obtained by using the GISAXS technique. This stimulated many fruitful discussions among the participants and the newcomers could learn from the experienced users of this method. The discussions were continued during the workshop dinner which closed the first day. The first session of lectures of the next day was entitled “Biophysics and Sensors” and had two speakers. D. Constantinu (U Paris) presented GISAXS investigations of peptide pores in lipid bilayers and showed how interaction parameters, which help to understand co-operative effects in antibiotic activity, can be derived by using a simple model. In the following lecture, J. Gutmann (MPI Mainz) demonstrated the application of GISAXS using a micrometer sized beam to sensors, based on a single AFM cantilever, to investigate the quality of polymer brush and gold coatings on the cantilever surface. The last application-oriented session had the title “Nanocomposite Thin Films” and was opened by M. Ree (U Pohang) who talked about nanoscale hard and soft condensed matter films prepared from nanoporous dielectrics, block copolymers, polymers, and molecular assemblies. He showed how to quantitatively derive process parameters, which govern structure formation by using a recently developed scattering theory. Finally, A. Frömsdorf (U
Hamburg) presented the preparation and characterization of various nanostructured materials to be used in electronics, optoelectronics, high-density storage media, catalysis, and biological applications. A last session about "Instrumentation" was about the technical aspects of GISAXS experiments. A. Timmann and S. Roth (HASYLAB) reviewed the BW4 instrument and the new microSAXS/WAXS beamline at PETRA III, which is currently under construction.

For the practical part of the workshop, the participants were separated into four groups, which subsequently moved to three exercise stations: Practical data acquisition at beamline BW4; general data treatment; and modelling of the data using the program IsGISAXS. Each part lasted about two hours. The exercise at BW4 involved a detailed demonstration of the components of the instrument; the participants practised the alignment of a sample for a GISAXS experiment, performed the required angle calibration, and finally collected scattering data. 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 were exercised. The use of the program IsGISAXS and the meaning of the numerous options and input parameters were explained and practiced in the simulation part. The practical training extended over the afternoon of the second day and was continued on the third day of the workshop. It was intercepted by a second poster session in the evening of the second day.

One can conclude that the workshop was very successful, and the feedback of the participants was very positive. The combination of lectures, discussions in the poster sessions and practical training stimulated an intense atmosphere. The presentations covered the whole range from the theoretical basis to applications in a variety of different fields of hard and soft condensed matter science. During the practical exercises, the participants got a sense about how to use the tools of this powerful experimental technique. In accordance with the intentions of its organizers, the workshop brought experts in the field of GISAXS from research and industry together with young scientists, most of them being PhD students or Post-docs who just started working in this field.