MM 14: Topical Session Nanoanalytics using Small-Angle Scattering II

Time: Tuesday 11:45–12:45 Location: IFW A

Invited Talk MM 14.1 Tue 11:45 IFW A

Anomalous small-angle X-ray scattering in material science
— •Armin Hoell — Helmholtz-Zentrum Berlin für Materialien und Energie, Glienicker Strasse 100, 14109 Berlin, Germany.

Anomalous small-angle X-ray scattering (ASAXS) is an element-selective method based on the anomalous variation of the atomic scattering factor near absorption edges. Nowadays, ASAXS is a mature technique to analyse nano-structures as well as their chemical composition fluctuation. It is used in physics, chemistry, biology and soft / hard condensed matter. This talk will elaborate the advantages of ASAXS in the analysis of complex materials. In the first part important technical details and strategies to measure ASAXS will be emphasized. In the second part some material science applications are chosen to illustrate different aspects and benefits of ASAXS. While using the relative contrast variation between SAXS curves measured at different energies near below absorption edges of elements containing in the sample the composition fluctuations are derived in a demixed supercooled liquid state of a ZrTiCuNiBe alloy. The method of partial structure functions derived from ASAXS will be explained by way of the example of an AlNiLa alloy. So, in case of Ruthenium/Selenium based catalysts ASAXS allows to determine characteristic length-scales associated with three different structural elements. Furthermore, it will be shown how a simultaneous nonlinear regression method including physical constrains can be used to resolve the nano-structure of a silver-free photochromic glass.

MM 14.2 Tue 12:15 IFW A

Small Angle Scattering by Magnetic Nanoparticles —
•Sabrina Disch, Raphaël P. Hermann, Peter Busch, Wiebke F. C. Sager, and Thomas Brückel — Institut für Festkörperforschung JCNS and JARA-FIT, Forschungszentrum Jülich GmbH; 52425 Jülich

Intensive research has been dedicated to magnetic nanostructures, both because of their possible applications, e. g. in medical imaging, catalysis, information storage, and owing to the interest in fundamental understanding of their magnetic properties. Magnetic nanoparticles, compared to bulk materials, show unique physical properties such as superparamagnetism or enhanced anisotropy constants. Very little is known about the magnetization distribution within a single particle and magnetic correlations in ordered arrangements of such nanoparticles. Small-angle scattering is the method of choice for investigating both intraparticular phenomena, such as the magnetization distribution or the spin structure of individual magnetic nanoparticles, and interparticular interactions of such nanoparticles in higher dimensional nanostructures. However, before addressing the problems of magnetization distributions or magnetic interactions between magnetic nanoparticles, the availability and the precise structural characterization of highly monodisperse nanoparticles is required. We developed a micellar synthesis route to cobalt nanoparticles with a narrow size distribution and will present latest advances in synthesis optimization and structural characterization along with recent work on highly monodisperse iron oxide nanospheres and nanocubes, including their deposition on substrates and structural characterization by SAXS and GISAXS.

MM 14.3 Tue 12:30 IFW A

Investigation of multiphase systems by small-angle scattering
— •Dragomir Tatchev — Helmholtz Zentrum Berlin, Glienicker Str. 100, 14109 Berlin, Germany and Institute of Physical Chemistry - Bulgarian Academy of Sciences, Acad. G.Bonchev Str., Bl. 11, 1113 Sofia, Bulgaria

The two-phase approximation in small-angle scattering is well known and still dominating the data analysis. The intensity scattered at small angles is proportional to the second power of the difference between the scattering densities of the two phases. Simultaneously, scattering contrast variation techniques are widely used and they obviously target multiphase systems or systems with gradually varying scattering density since if no parasitic scattering contributions are present the scattering contrast variation would only change a proportionality coefficient. However, there are only scarce attempts to generalise the SAS theory for multiphase systems. Here we show that the scattered intensity at small-angles of a multiphase system can be presented as a sum of scattering of two-phase systems and terms describing interference between all pairs of phases. Extracting two-phase scattering patterns, called phase scattering functions, from multiphase samples by contrast variation is possible. These two-phase patterns can be treated with the usual SAS formalism. In the case of anomalous SAXS, the phase scattering functions have significant advantage over the partial structure factors since the later depend on all phases in the sample. The case of gradually varying scattering density is also discussed.