Contribution ID: **5** Type: **not specified**

Characterization and modeling of HAPG's diffraction properties

Wednesday, 17 October 2018 15:00 (30 minutes)

With the advent of synchrotron radiation facilities, scientists became familiar with high end X-ray analytical methods, e.g. X-ray emissions spectroscopy (XES) and X-ray absorption spectroscopy (XAS). Many of these experiments are equipped with crystal monochromators based on diffraction to ensure highest resolving power.
To exploit new users and scientific fields for these methods, laboratory equipment has been developed in recent time. For laboratory X-ray sources usually have a lower brilliance, highly efficient detection concepts had and still have to be developed to ensure the necessary performance. Graphite based mosaic crystals, i.e. Highly Annealed Pyrolytic Graphite (HAPG), have proven to be a suitable component for wavelength dispersive X-ray spectrometers, for they show the highest integrated reflectivity among all known crystals [1]. For example, it can be larger by a factor of 30 compared to Si (111) reflection. This renders XES and XAS possible in laboratory environment with cost efficient setups based on low power X-ray sources while keeping good spectral resolving power (E/ΔE ~ 4000) at moderate measurement times of a few minutes to several hours [2,3].
In contrast to ideal crystals, these mosaic crystals show a more complex diffraction behavior, i.e. penetration effects and focusing errors. Both are depending on the crystal's thickness and the mosaic spread and have to be modeled as they decrease the spectral resolving power. Hence, a good understanding of the diffraction processes in the crystal is of utmost importance not only to evaluate the accumulated spectra but also for the design of optimized optics.
In a collaboration between the HAPG's manufacturer Optigraph GmbH, the Physikalisch Technische Bundesanstalt and the Technische Universität Berlin which was funded in the frame of a Pro FIT project by the IBB, the crystal's properties were investigated by several means. The outcome of this project and further development will be shown. This includes the characterization of the so-called Q-factor, a measure for the reflectivity per crystal layer, the mosaic spread and the homogeneity in dependence of the optic's substrate material [4]. Additionally, a multi reflection-based model to describe and test the crystals behavior in various conficgurations was developed, implemented in a raytracing software and compared with measurements [5].

[1] Legall, H. et al., J.Appl. Crystallogr. (42), 2009, 572-579
[2] Schlesiger, C. et al., J. Anal. At. Spectrom. (30), 2015, 1080-1085
[3] Anklamm, L. et al., Rev. Sci. Instrum. 85 (5), 2014, 053110
[4] Gerlach, M. et. Al., J. Appl. Crystallogr. 48, 2015, 1381-1390
[5] Schlesiger, C. et al., J. Appl. Crystallogr. 50, 2017, 1490-1497

Primary author: SCHLESIGER, Christopher (TU Berlin)

Co-authors: ANTONOV, Alexander (Optigraph GmbH); KANNGIESSER, Birgit (TU Berlin); BECKHOFF, Burkhard (PTB); LEGALL, Herbert (TU Berlin, current affiliation: BAM); HOLFELDER, Ina (PTB); GRIGORIEVA, Inna (Optigraph GmbH); ANKLAMM, Lars (TU Berlin, current affiliation: IAP e.V.); GERLACH, Martin (PTB, current affiliation: HZB); GNEWKOW, Richard (TU Berlin); MALZER, Wolfgang (TU Berlin)

Presenter: SCHLESIGER, Christopher (TU Berlin)

Session Classification: X-ray HAPG optics