In-house X-ray Standing Wave study of LaN/B multilayer mirrors.

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Development of the state-of-the-art periodic multilayer structures requires implementation of ultra-thin anti diffusion and/or contrast enhancing layers. The study of these structures by regular X-ray reflectivity techniques is limited by the lack of optical contrast between the layers. To study this type of objects with a higher precision an atom-sensitive technique is required. The ideal candidate is the X-Ray standing waves (XSW) technique.

The X-rays wave, reflected from a multilayer structure in the Bragg reflection conditions, forms the strong XSW with period equal to the period of this multilayer. By tilting the angle of incidence in the vicinity of the first Bragg angle, the phase of the standing wave is changing and the electric field maximum shifts trough the period. As a consequence atom-specific fluorescent yield form atoms placed at different locations in the multilayer period will be excited at different angles of incidence. The angular dependent intercity of fluorescence measured from the multilayer gives information about the atomic distributions in various regions in the multilayer period.

To get an exact description of the multilayer period an electric field description is calculated[1] inside the multilayer by using an optical constant profile obtained from a GIXR analysis[2].

The XSW measurements from LaN/B multilayer mirrors were performed on in-house PANalytical Empyrean diffractometer equipped with AMPTEC Peltier cooled XRF detector. We will show results of XSW measurements and data analysis from periodic LaN/B multilayer structures.

1. S. N. Yakunin, I. A. Makhotkin, et. al., J. Appl. Phys. 115 (13), - (2014).
2. A. Zameshin, I. A. Makhotkin, et. al., Journal of Applied Crystallography 49 (4), 1300-1307 (2016).