# Reconstruction of interfaces of periodic multilayer structures using model independent GIXR and XSW techniques.

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Development of the state-of-the-art periodic multilayer structures requires advanced interface engineering. Grazing Incidence X-ray Reflectivity (GIXR) is a widely used analysis method sensitive to the structure of interfaces in multilayers. However, conventional so-called model-based approaches of structural reconstruction from GIXRR data are lacking analytical power when dealing with multilayers where interface thicknesses are comparable to total thickness of multilayer period . We have developed the free-form approach that allows to analyze the GIXR data without the need for a priori assumptions on layer or interface parameters. The application of this approach will be demonstrated on the example of analysis of La/B multilayer structures[1].

To study the multilayers with inter-diffusion barriers with a higher precision an atomic-sensitive technique is often required. The ideal candidate is the X-Ray Standing Wave technique (XSW). The X-ray standing wave formed at the Bragg reflection condition in a periodic multilayer structure modulates atom-specific X-ray fluorescence. Previously[2] we have shown that atomic profiles can be recalculated directly from measured X-ray fluorescence yields modulated by XSW. This calculations require the knowledge of the optical constant profile obtained from GIXR analysis. We have demonstrated that, obtained by free-form analysis of GIXR, optical constant profile can be used as an input to calculation of atomic profiles from XSW data, what significantly simplifies the advanced characterization of the structure of periodic multilayers.

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