P-13

Influence of imperfections in a wedged multilayer Laue lens for the focusing of X-rays investigated by beam propagation method

A. Andrejczuk[1]*, J. Krzywiński[2] and S. Bajt[3]

[1]*Faculty of Physics, University of Bialystok, Lipowa 41 Str. 15-424 Bialystok, Poland*
[2]*SLAC National Accelerator Laboratory, 2575 Sand Hill Road MS 29, Menlo Park, CA 94025, USA*
[3]*DESY, Notkestr. 85, 22607 Hamburg, Germany*

Keywords: synchrotron radiation, multilayer Laue lens

*e-mail: andra@alpha.uwb.edu.pl

The Multilayer Laue Lens (MLL) is a new X-ray diffraction element, which connects features of Fresnel Zone Plate (FZP) and a multilayer mirror [1]. It is made by the thin layer deposition technique with layers thicknesses corresponding to the FZP zone radius equation. If the deposition is done in such a way that every layer thickness varies linearly along the beam propagation direction then the efficiency of the focusing substantially increases. Such a lens is called a wedged MLL [1].

In this work we investigated the performance of a wedged MLL focusing 20 keV x-rays in one dimension. The lens had a focal length of 1.25 mm and it consisted of 5500 layers made of less and more absorbing materials. We applied 1D Beam Propagation Method (BPM) [2] to calculate the intensity in the focus plane and at the far screen. According to the simulations a perfect lens will focus the beam to 5 nm FWHM with the intensity increase exceeding $2 \cdot 10^3$ as compared to the intensity of the primary beam. The effect of various random and systematic errors in layer' thickness and their placement was studied in detail. The influence of the scaling of these imperfections on the intensity distributions in the focal plane and in the far field will be discussed.

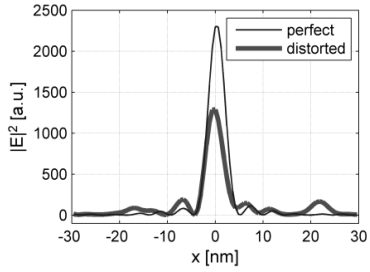

Figure 1. The intensity distribution at focal plane for a perfect lens (thin line) and the lens with random errors of layers thicknesses with standard deviation of 0.07 nm (thick line).

[1] H. Yan et. al., *X-Ray Optics and Instrumentation* (2010) 401854.
[2] O. K. Ersoy, *Diffraction, Fourier Optics and Imaging* New Jersey, John Wiley and Sons (2007).

P-14

Investigation of the thin films properties using X-ray reflectometry and grazing incident X-ray diffraction methods

D. Banaś[1,2], A. Markowska[1], M. Sobisz[1]*, I. Stabrawa[2], A. Kubala-Kukuś[1,2], J. Braziewicz[1;2], K. Dworecki[1], E. Tomal[3], U. Majewska[1,2], M. Pajek[1], J. Wudarczyk-Mońko[2] and S.Góźdź[2,4]

[1]*Institute of Physics, Jan Kochanowski University, Świętokrzyska 15, 25-406 Kielce, Poland*
[2]*Holycross Cancer Center, Artwińskiego 3, 25-734 Kielce, Poland*
[3]*Institute of Biology, Jan Kochanowski University, Świętokrzyska 15, 25-406 Kielce, Poland*
[4]*Institute of Public Health, Jan Kochanowski University, IX Wieków Kielc 19, 25-317 Kielce, Poland*

Keywords: XRR, GIXD, biointerfaces

*e-mail: milenasobisz@interia.pl

The X-ray reflectometry (XRR) [1], which uses the effect of total external reflection of X-rays, is surface sensitive analytical technique for investigation of the near surface regions of different sample systems including single crystalline, polycrystalline and amorphous samples, polymers, organic samples and fluids. Reflectometry pattern obtained for the reflection angles from 0 to about 5 degrees allows the measurement of thin film thicknesses of single and multilayer systems, density profiles of near surface regions and roughness (from 0.1 nm to 5 nm) of the surfaces and interfaces.

The method of grazing incident X-ray diffraction (GIXD) is a modification of standard X-ray diffraction technique, which due to low incident angle of the X-ray beam maximizes signal from the surface and as a result allows for phase analysis on very thin layers and depth profiling of the phase composition of layered samples.

In this work the XRR and GIXD techniques were applied to analysis and characterization of thin gold layers used further for studies of interactions between lipopolysaccharides (LPSs) and gold surfaces. Understanding of interaction of complex biomolecules and different material surfaces (biointerfaces) is important in many research area of biology, biotechnology, diagnostics and medicine. Determination of properties of such biointerfaces is not possible or very difficult without earlier precise characterization of the material surface. The gold layers studied in this work were prepared on a glass slide support covered by evaporation with 2 nm of chromium, which improved the adhesion of the gold film to the glass substrate.

In this work the motivation of the experiment, physical basis of the methods used, experimental setups, results of optimization of the measurement procedure and results of the measurements for gold surfaces of different thicknesses will be presented.

[1] L. G. Parratt, *Phys. Rev,* **95** (1954) 359-369.
[2] H. Kiessig, *Ann. d. Phys*. **10** (1931) 769.