X-ray thin-film interferometry technique using an X-ray microfocus laboratory source

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X-ray reflectometry (XRR) is actively used for thin-film and multilayer systems internal structure study. Nevertheless, this method has a number of limitations associated with high requirements to the sample surface quality and geometric parameters. The advancement of new optics for X-ray laboratory and synchrotron sources increased opportunities for the development of X-ray diagnostics techniques, including reflectometry. In this work, we demonstrate a new X-ray interferometry technique based on compound refractive optics (CRL) for thin-film structures study.

Nowadays, X-ray refractive optics is the most dynamically developing optical field [1-2]. Compound refractive lenses quickly gained popularity among users of synchrotron sources due to their operation simplicity and the applicability in a wide range of energies [3-4]. The combination of modern optical elements with X-ray radiation sources opens up new possibilities for thin-film structures diagnostics, allowing to overcome the limitations of classical laboratory techniques.

The idea of the recently proposed X-ray interferometry technique is to use a simplified experimental setup in which a focused X-ray beam is reflected from the flat plate surfaces creating an interference pattern in a wide angular range without the need to rotate the specimen or detector [5]. The applicability of this technique has been demonstrated using the MetalJet Excillium micro-focus laboratory source, which is a part of Synchrotron-Like facility (IKBFU, Kaliningrad, Russia). A series of interference patterns for thin-film membrane thick of 500 um were observed.

The new X-ray reflecto-interferometry technique opens a wide range of opportunities for the analysis of thin-film and multilayer systems. This technique can be realized using both laboratory and synchrotron radiation x-ray sources. Also, it provides advantages over the conventional X-ray reflectometry because it allows for research with a fundamentally new temporal and spatial resolution.

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