X-RAY REFLECTION TOMOGRAPHY –FIRST RESULTS ON SURFACE IMAGING

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The present talk reports a novel X-ray imaging under grazing-incidence geometry, which enables the observation of surface and interfaces of layered thin films. So far, X-ray reflectivity has been widely used to determine the layer density, thickness as well as the roughness of each interface non-destructively [1]. However, the technique assumes a large sample ($mm^2 \sim cm^2$) with uniform structures, and therefore the lack of spatial resolution has been a limit for many important topics, where one should consider some patterns or specific spatial distributions. Though the use of high-energy synchrotron micro beam can be a strong way for scanning-type X-ray reflectivity imaging [2], it is crucial to develop further methods with a laboratory source as well. The present method employs the image reconstruction, which is well known in X-ray computer tomography [3] and also in X-ray fluorescence imaging [4,5]. The experiments were done with a rotating anode X-ray source (Rigaku UltraX18, Cu anode), a multilayer monochromator and an ordinary $\theta/2\theta$ goniometer. The beam size is 0.05 mm (H) × 9.5 mm (V), which enables irradiating the sample area of 9.5 mm squares for the grazing angle of around 5.3 mrad. The samples measured are patterned gold thin films sputtered on Si wafers. As the glancing angle is between the critical angles of gold and silicon, only gold patterned area can have high reflectivity, leading to some non-uniform profile of X-ray reflection beam. In the present experiments, the intensity profile of reflected X-ray beam was measured by using a 2D detector. By rotating the in-plane angle of the sample from 0 to 180 deg, with the step of 2~10 deg, a lot of such data were collected. Then the filtered back projection method and other similar algorithm were applied to reconstruct the image. In the talk, obtained surface images of various patterns will be presented. Instrumental effects on the results will be also discussed.

References:

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