VISUALIZATION OF BURIED INTERFACES IN THIN FILMS BY X-RAY AND NEUTRON REFRECTIVITY IMAGING

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Exotic functions of thin films are quite often connected to the unique atomic and molecular features of buried layers and interfaces. In reality, they are far from uniform, while seeing such inhomogeneity is extremely difficult. The present talk describes how the difficulties are being solved by ambitious extension of X-ray and neutron reflectometry. Now it has spatial resolution. Ordinary X-ray and neutron reflectometry [1] gives similar information to that from the cross section TEM in a non-destructive manner. One can obtain very precise information such as the number of layers, the density and the thickness of each layer, and the roughness of each interface. As the technique is essentially suitable for the analysis of organized molecular thin film, one could imagine how novel instrumentation to develop X-ray reflectometry with spatial and/or time resolution is important for future research.

Now X-ray and neutron reflectometry can have imaging capability, though in the past it was a method discussing just an average structure, and sometimes led to wrong conclusion for the inhomogeneous case. By combining with the image reconstruction scheme, the data are now in 3D – X, Y and q. While the illuminated area size is around 8 mm × 8mm (in the case of X-ray reflectivity imaging), the obtained typical spatial resolution is below 20 micron. The inhomogeneity can be quantitatively imaged with very high depth-resolution of smaller than nm. The present method can also provide X-ray reflectivity data for all points in the viewing area, even without the use of micro beam [2-4]. The latest success of neutron reflectivity imaging [5] is also an extremely important step for exploring buried interfaces with more realistic scientific problems.

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