Time-Resolved X-Ray Reflectometry using a Laterally Graded Multilayer Focusing Polychromator

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A new method of measuring specular X-ray reflectivity curves with a time resolutions of sub-seconds was developed [1,2]. A horizontally convergent X-ray beam having a one-to-one correlation between its direction and energy is realized when a quasi-parallel white X-ray beam is incident on a laterally graded multilayer on an elliptic substrate. The X-ray beam is then incident on the surface of the specimen placed at the focus in such a way that the glancing angle in the vertical direction is the same for all X-ray components, which are reflected in the vertical direction by the surface and diverge in the horizontal plane. The perpendicular momentum transfer continuously changes as a function of the horizontal ray direction since the wavelength changes. The normalized linear intensity distribution across the beam direction measured downstream of the specimen represents the X-ray reflectivity curve.

Time dependent variations of specular X-ray reflectivity curves were observed with a time-resolution of 1 min from a water surface where a globular protein was spread and then became unfolded. The reflectivity at small q (vertical momentum transfer)-range increased by ~100 - 200 % in approximately five minutes after injecting the protein in to the water and then decreased in another five minutes or so by ~ 20 - 50 %.

We will report the results of these time-resolved measurements and discuss the way to realize a shorter time resolution.

[1] T. Matsushita, Y. Niwa, Y. Inada, M. Nomura, M. Ishii, K. Sakurai, and E. Arakawa, Appl. Phys. Lett. 92, 024103 (2008)
[2] T. Matsushita, E. Arakawa, Y. Niwa, Y. Inada, T. Hatano, T. Harada, Y. Higashi, K. Hirano, K. Sakurai, M. Ishii and M. Nomura, Euro. Phys. J. Special Topics 167, 113 (2009)

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