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ASAXS measurements with soft (tender) X-rays to control the contrast

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The structure and properties of thin soft matter materials might be better examined in detail by scattering measurements when the contrast between the materials and penetration depth are tunable. In the so-called tender X-ray region, there are several elements of interest for small-angle scattering measurements, such as Mg, Al, Si, P, and S. We worked on GISAXS measurements at K absorption edges of Si and P to control contrast and penetration depth for thin block copolymer (SEBS) samples and phospholipid alloy systems comprising of phospholipid (PC, DPPC), cholesterol, and ganglioside, and SAXS at Al for Al alloys. The photon energy used in the present measurements is soft enough to give large anomalous effect in the real part of refractive indices for light elements, yet hard enough so that the scattering vector required for nanostructure analysis can be covered. By choosing the photon energy at the K absorption edge of Si, the contrast between Si substrate and polymer thin film can be suppressed, thereby suppressing dynamical effect in GISAXS intensity caused by reflected beam[1]. Combined with the depth sensitive analysis, this is useful to examine the nanostructures that are changing with the distance from the surface. Concerning the contrast change inside the thin films, change of the GISAXS intensities from PC (phosphatidylcholine)-cholesterol-ganglioside (GD1) films spin-cast on Si substrates have been examined at the K absorption edge of P [2]. ASAXS for P has been examined by Stuhmann and coworkers[3], but the number of works after them is not large. Present measurements using image plates showed that the hexagonal phase appearing in dried phospholipid alloy films suggests a contrast reversal with the photon energy.

[1] H.Okuda et al., *J.Appl.Cryst.* 2012, 45,119., [2] H.Okuda et al., *Jpn.J. Appl. Phys.* 2014, accepted., [3] H.B. Stuhmann, *J.Appl.Cryst.* 2007,40,s23.

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