Local Structural Analyses of Liquids by Soft X-Ray Absorption Spectroscopy

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Soft X-ray absorption spectroscopy (XAS) is an element specific method to reveal local structures of liquids with the K-edges of light elements (C, N, and O). We have investigated local structures of several liquids by using a liquid flow cell for XAS in transmission mode.[1] In this year, we have developed two techniques for applying XAS to the low energy region below 200 eV including K-edges of Li and B and L-edges of Si, P, S, and Cl, as described below.

1. Development of Soft X-Ray Transmission Argon Gas Window

XAS in the low energy region is difficult since transmitted soft X-rays mostly consist of high order X-rays due to the low transmission of first order X-rays. We have proposed the soft X-ray transmission argon gas window that removes high order X-rays by the absorption of Ar L-edges (240 eV).[2]

2. Development of Photoelectron Based Soft X-Ray Detector

We have developed a photoelectron based soft X-ray (PBSX) detector that removes high order X-rays.[3] In this detector, the Au 4f photoelectrons emitted by first order X-rays are separated from those by the high order X-rays using a difference in kinetic energy of photoelectrons.

References

1) M. Nagasaka, H. Yuzawa and N. Kosugi, *Anal. Sci.* **36**, 95–105 (2020). (Review)
2) M. Nagasaka, *J. Synchrotron Rad.* **27**, 959–962 (2020).
3) M. Nagasaka and H. Iwayama, *Rev. Sci. Instrum.* **91**, 083103 (7 pages) (2020).

Award

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Development of a Surface-Sensitive Detection Method for Scanning Transmission X-Ray Microscopy

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A scanning transmission X-ray microscope (STXM) obtains 2-dimensional X-ray absorption of a sample to obtain chemical status. Generally, the STXM gives us integrated (bulk) information of the sample along a path of the X-ray. Alternative approach of the STXM is to detect secondary electron from the sample by using a channeltron. The detection of the secondary electron enables us to obtain information of near surface of the sample because of escape depth of the secondary electrons around a few nm. Additionally, this technique overcomes a main difficulty of the STXM by measuring a thick sample which cannot be penetrated by the X-rays.

A channeltron is used as a detector for the secondary electron and is placed upstream of the sample. This optical system can obtain an X-ray transmission image and a secondary electron image simultaneously. As a test sample, a thin section of blended polymer on a copper grid was measured. The energy of the X-ray was 400 eV and the dwell was 500 ms per pixel. In Figure 1(b), an empty space indicated by a dotted circle also shows higher signals of the secondary electron than those from the blended polymer. This problem is under discussion.

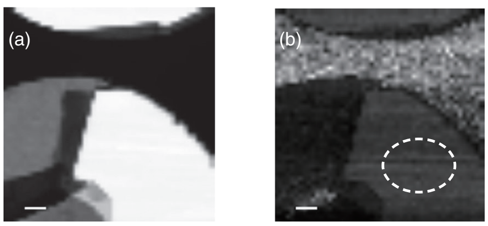

Figure 1. (a) An X-ray transmission image and (b) a secondary electron image of a thin section of blended polymer on a copper grid. Scale bars are 5 μm.