20AG038 BL-13

Soft X-ray Polarization Measurement and Evaluation at HiSOR BL-13 Using Electron Orbitally Oriented Samples

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Linear polarization is an important parameter for the study of sample orientation and anisotropy of reaction dynamics by X-ray absorption spectroscopy (XAS). Therefore, it is necessary to understand in advance the polarization characteristics of the beamline to be used. Usually, for evaluating the polarization of beamlines, however, it is necessary to insert expensive X-ray polarizers into the beamlines, an ion detection system for anisotropic dissociation induced by polarized SR light, or a photoelectron spectrometer for gaseous molecules.

Recently, the evaluation method of polarization using highly oriented pyrolytic graphite (HOPG), a sample with oriented electron orbitals, was reported [1]. This method makes it possible to easily evaluate polarization by simply rotating the tilted sample in-plane. In this study, the polarization of BL-13 was determined from the dependence on the incidence angle and the validity of the obtained polarization was evaluated by using self-assembled monolayers (SAMs).

HOPG is a solid sample with highly oriented electron orbitals that can maintain its planarity, and it was fixed on a sample stand with an tilted angle of 30° (Fig. 1). In a typical sample arrangement, only the horizontal component of the electric field vector can be evaluated.

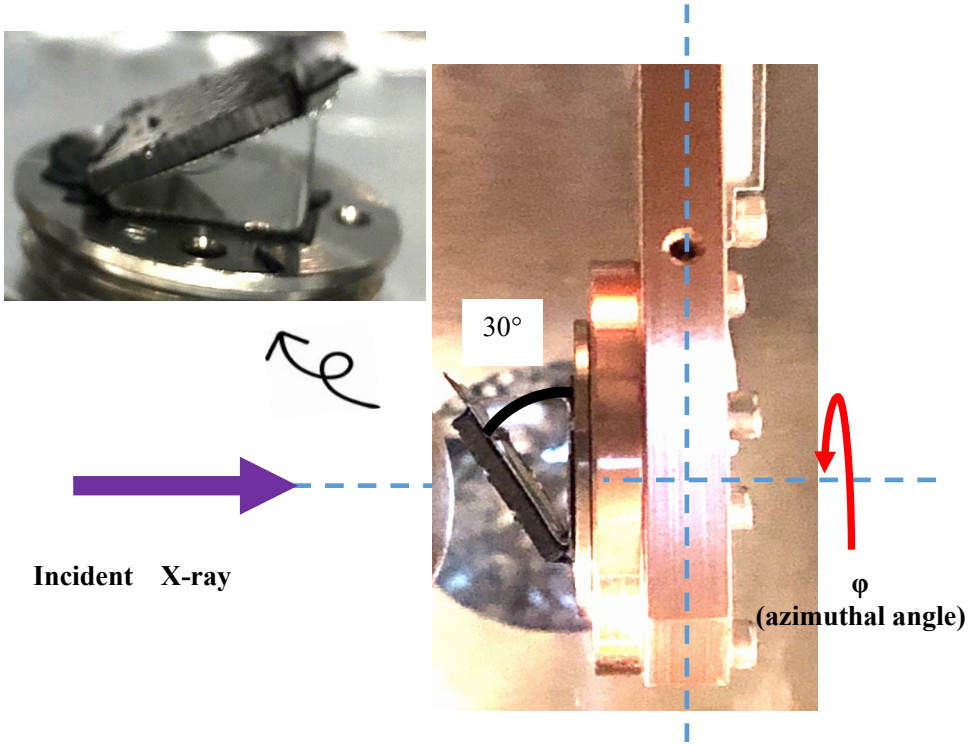

FIGURE 1. Photos of the tilted HOPG sample introduced to BL-13.

The angle dependence of the X-ray absorption fine structure (NEXAFS) spectra was measured at various azimuthal angles (φ) as shown in Fig. 2. The intensity of the π*(C=C) transition peak at 285 eV increases as the azimuth angle increases. On the contrary, the intensity of the peak from the σ*(C=C) transition around 292eV to around 312eV and 330eV decreases as the azimuth angle is increased. The polarization of BL-13 was determined from the analysis of such angle dependence.

The obtained result was applied to the determination of the orientation angle of alkanethiol SAMs with respect to the gold substrate (Fig. 3) and the obtained orientation angles were compared with the literature values. In addition, biomembranes prepared only by dropping lipid solution onto substrates was also evaluated by polarized SR light. The spectra showed clear polarization dependence, indicating the layered conformation of biomembranes formed by such simple method.

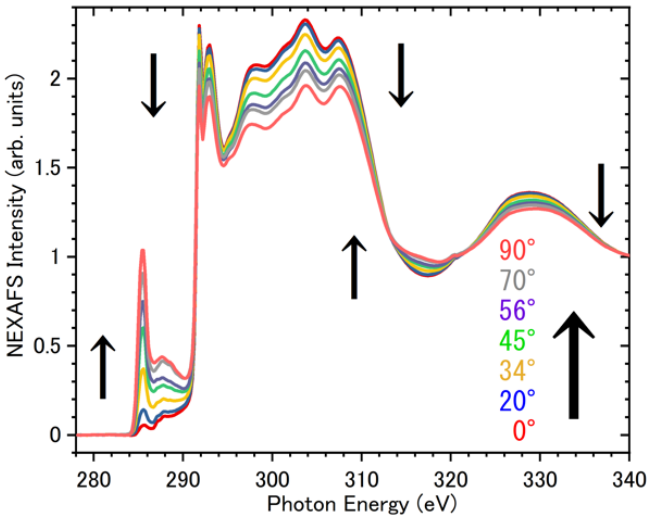

FIGURE 2. Azimuthal angle dependence of NEXAFS spectra of HOPG.

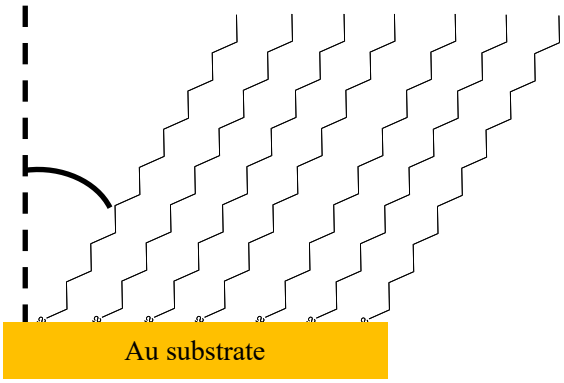

FIGURE 3. Schematic diagram of SAMs.

REFERENCES

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