Ultraviolet Reflectivity Measurement in the 5.8–10.7-eV Region at BL1

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Optical constants of many materials have been studied over wide energy range[1]. In the region from visible to ultraviolet light, optical constants are technologically important in applications such as camera, projector, and lithographic device. Optical constants in this energy range are governed mainly by excitation of electrons in the materials and therefore are strongly related with inelastic electron scattering spectral function[2]. In this article, we report on the experimental setup at BL1 for reflectivity measurement in the energy range between 5.8 and 10.7 eV, which belongs to the so-called far ultraviolet region.

When a grating monochromator is used for optical measurements, higher order diffraction has to be removed. Here, we use MgF_2 crystal as a low-pass filter with the energy cut-off of 10.8 eV.

Intensity of incident beam was monitored by measuring the total photoelectron yield current of the post-focusing mirror. Based on this mirror current, we estimated the photodiode current that should be measured for the incident beam. This procedure was based on the measurement of the direct beam. Figure 1 shows the intensity of the direct monochromatized light measured simultaneously at the post-focusing mirror ($I_{M,test}$) and photodiode ($I_{D,test}$). Intensity above 10.8 eV is apparently cut off by MgF_2. On the other hand, intensity below 5.7 eV is attributed to the second order diffraction of the monochromator. Therefore, the energy region between 5.8 and 10.7 eV is free from higher order diffraction. For this energy region, we calculated the coefficient $F(h\nu)=I_{D,test}(h\nu)/I_{M,test}(h\nu)$.

In order to measure reflectivity, reflected light was measured by the same photodiode as used above (I_R), as the mirror current (I_M) was also monitored. Then reflectivity was calculated as $R(h\nu)=I_R(h\nu)/[I_M(h\nu)\bullet F(h\nu)]$.

Figure 2(a) shows the measured reflectivity of quartz glass in the normal reflection geometry. The measured spectrum is in fairly good agreement with the reflectivity reconstructed based on the literature[1] except for the artifact below 7 eV, taking place because the transmitted light is reflected by the other side of the sample.

We plan to study far-UV reflectivity from both fundamental and technological viewpoints.

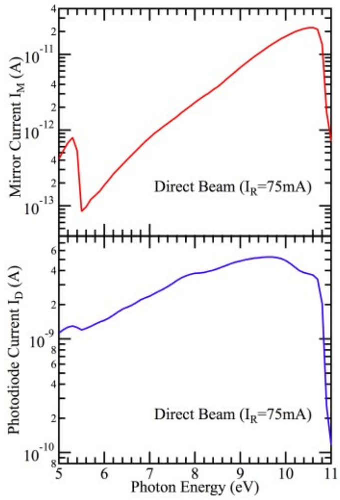

Fig. 1. Direct beam measured by total electron yield of post-focusing mirror (top) and photodiode (bottom) at ring current of 75 mA.

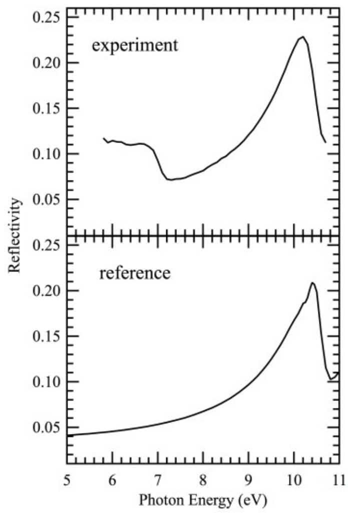

Fig. 2. Measured (top) and reconstructed[1] (bottom) far UV reflectivity of quartz glass in normal reflection.

References

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[2] W. S. M. Werner, K. Glantschnig and C. Ambrosch-Draxi, J. Phys. Chem. Ref. Data, **38**, 1013 (2009).