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Soft X-ray Raman Scattering of $BaTiO_2$(100) by means of Improved Spectrometer at BL-2c

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Introduction

Soft x-ray emission (SXE) spectrometer at BL-2c was improved.

1. Computer and interface for data acquisition were upgraded, and LabVIEW was adopted for data taking programs. This system shows stored 2-dimensional image of detector, so that correction parameter for the spectra can be determined easily.

2. Entrance slit of monochromator was replaced by variable one driven by piezo element controlled from outside the vacuum chamber (Piezo System Jena GmbH). The slit width can be changed from 10 to about 150 µm.

We measured soft x-ray Raman scattering (SXRS) spectra of $BaTiO_3$ using this spectrometer, and compared to the results observed before.

Experimental

SXE spectrometer at BL-2c is Rowland mount type optical system with spherical grating [1]. A 2-dimensional multi-channel detector is equipped on the Rowland circle circumscriptively. Since the detector has a plane shape, focus of the grating is optimized at only the center of the detector. In addition, focal line of the grating is curved line in the Rowland system. Thus, the detected signals (1024×1024 channels) must be integrated along the focal curve. The data processing needs a lot of time.

Ferroelectric $BaTiO_3$(100) of single domain is used in this experiment. The polarization of synchrotron radiation was set to the c-axis of the sample and scattering at right angle was observed. Polarized configuration [1] was selected. Incident angle of irradiation is selected to 10° (grazing) to avoid a strong elastic scattering.

Results and Discussions

Figure 1 shows partial fluorescence yield (PFY) spectrum of $BaTiO_3$. The spectrum was observed by counting total photons detected by the detector (i.e. integrated counts of SXE spectra in Fig.2) with changing excitation energy. Wide slit width of about 100 µm is selected to get enough signals. The spectrum (601 points) can be observed for about 2 hours. In comparison with the total electron yield (TEY) spectra, similar structures were observed. Since considerable elastic scattering was observed in the polarized configuration, the PFY spectrum is including the elastic component. Charge transfer satellites (S) seems to be strong and show additional structures in the PFY.

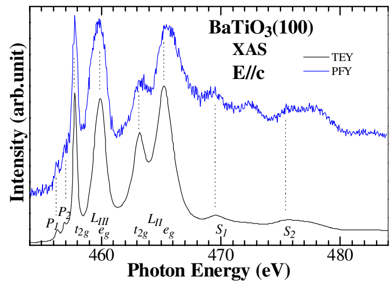

Fig.1. Partial fluorescence yield spectrum (blue) and total electron yield spectrum (black) of $BaTiO_3$.

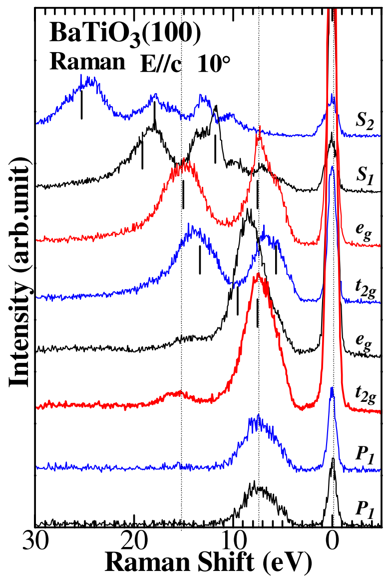

Fig.2 Resonant Raman spectra of $BaTiO_3$. Symbols on the right hand of each spectrum denote excitation energy corresponding to Fig.1. Vertical bars shows fluorescence peak.

Figure 2 shows resonant SXRS spectra of $BaTiO_3$. Since the data processing system was improved and slit width can be selected to suitable value, the measurement efficiency was improved about ten times. The spectra in the figure were observed using 10 µm slit. Each spectrum can be observed for about 10 minutes in spite of low emission sample ($BaTiO_3$ has no 3*d* electron nominally).

Details of the SXRS spectra will be discussed elsewhere.

Reference

[1] Y. Harada, et al., J. Synchrotron Rad. 5, 1013 (1998).

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