Resonant X-ray Emission Spectra by the Electric Quadrupole Excitation at the Ni K-Edge of NiO

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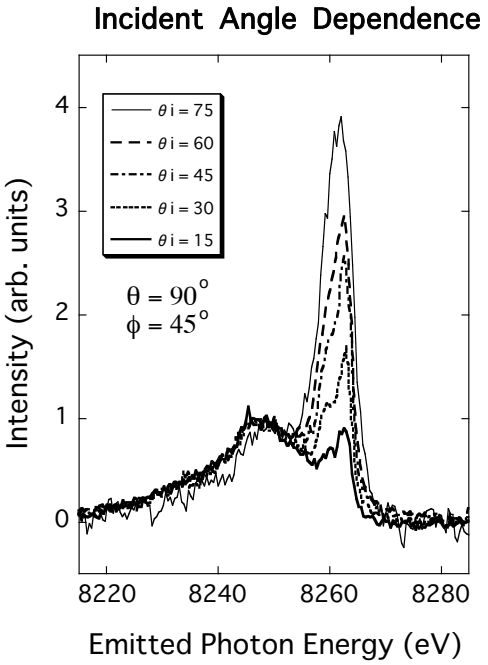
The spectral function of Resonant X-ray Emission Spectroscopy (RXES) is represented by two independent variables, i.e., the incident photon energy and the emitted one, and so RXES gives more detailed information about the ground and excited states of the valence and the conduction bands than the x-ray absorption spectroscopy. One of the concrete advantages is the selectivity in the transition process. When the incident photon energy is tuned to the pre-edge region of K-edge for transition-metal compounds, it is possible to distinguish the emission due to the 1s-3d electric quadrupole excitation from the emission due to the 1s-4p electric dipole one [1]. Recent theoretical study predicted the incident and the scattering angle dependences of electric quadrupole contribution on Mn 3p-1s RXES in a MnF_6^{-4} cluster which has the O_h symmetry [2], and their theoretical prediction were confirmed both experimentally and theoretically using the MnO single crystal whose local symmetry around the Mn atom is the same as the MnF_6^{-4} cluster [3].

In this presentation, we will show the advanced experimental results, i.e., not only the incident, the scattering, and the azimuthal angle dependences but also the polarization dependence of the electric quadrupole contribution on the Ni 3p-1s RXES in NiO, whose local symmetry around Ni is almost O_h.

Experiment was performed at the beamlines 7C and 15B1 of the Photon Factory, Institute of Materials Structure Science with the secondary x-ray spectrometer. Right figure shows the incident angle dependence of Ni 3p-1s RXES under the polarized configuration, when the incident photon energy was tuned to the Ni 1s-3d excitation. The scattering and the azimuthal angles were fixed to 90° and 45°, respectively, and the polarization of the incident photon was parallel to the z' axis (Definition of the angles and a geometrical arrangement are same with those in Ref. 2). Obtained results were well agreement with the theoretical prediction.



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