

Preliminary Test of X-Ray Emission Spectroscopy in Gd-Iron Garnet Single Crystal

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High-brilliance and polarization may be one of the most promising item for material science using 3rd generation SR sources. This is a crucial factor for studying magnetic properties by X-ray emission spectroscopy (XES), and tunability and analysis of polarization will be able to provide advanced information on electronic structure. Hence, we have proposed an extension of the diffractometer to XES experiment, as the setup is shown in Fig. 1. Fluorescence spectrometer will be based on a pseudo-spherical Si(220) crystal [1] sitting on the Rowland circle with $R=450\text{mm}$ as the sample and a detector. Design of a crystal for a range around 7 keV is progressed. In this report, we present a preliminary test of XES using an SSD in a conventional configuration.

The sample used in this work was Gd-iron-garnet ($\text{Gd}_3\text{Fe}_5\text{O}_{12}$: Gd-IG) single crystal of $12\mu\text{m}$ in thickness prepared by the liquid phase epitaxial method, and has a (111) plane parallel to the surface of GGG substrate. Full-width of rocking curve was estimated to be 29 arcsecs. The incident X-ray with π -polarization was radiated at 30° on the sample, and the fluorescence was monitored in the direction nearly

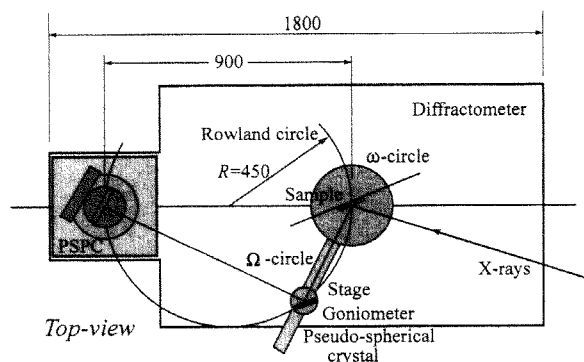


Fig. 1. Schematic drawing of the setup for XES measurements.

normal (77°) to the surface to avoid the elastic scattering.

Figure 2 shows the fluorescent X-ray spectrum, which consists of Gd $L\alpha$, and Fe $K\alpha$ emissions and Raman scattering, when the X-ray with a photon energy around the Gd L_3 -edge was incident. The energy resolution of SSD was so poor (about 224 eV) that it was hardly to separate the profiles into the multiplet. As the incident X-ray energy was increased, Raman shift was observed, that is, the peak position moved to higher energy side. For fluorescence connected with the Gd L_2 -edge, Gd $L\alpha$, Gd $L\beta_1$, and Gd $L\gamma_1$ emission lines were also assigned. When the polarized X-ray is incident on single crystal, anisotropy depending on the azimuthal angle is expectable in the spectrum, however, such effect has not been observed because of the poor resolution.

The pseudo-spherical crystal can provide a better resolution than 1eV and one order higher throughput than that of the conventional curved crystals, so that improved XES spectrum in energy resolution will be expected.

Reference

- [1] M.I.Mazuritsky, A.V.Soldatov and
A.Marcelli, (submitted to Rev.Sci.Instr.)

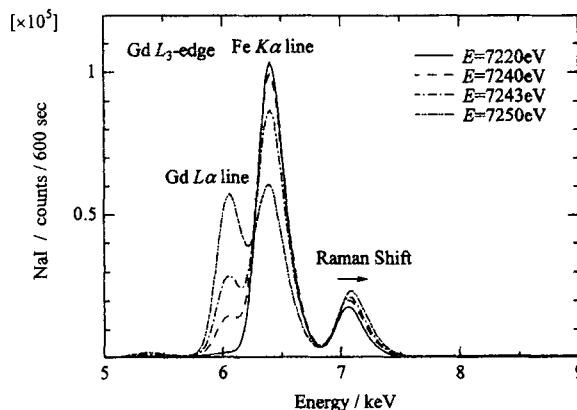


Fig. 2. Fluorescent X-ray spectrum associated with the Gd L_3 -edge in Gd-IG.