

High-Resolution Monochromators for High Energy Region

Yasuhiko Imai^{1,2}, Makoto Seto^{2,3}, Yoshitaka Yoda^{1,2}, Shinji Kitao^{2,3}, Ryo Masuda^{2,3},

Satoshi Higashitaniguchi^{2,3}, Chika Inaba^{2,3}

¹ Japan Synchrotron Radiation Research Institute, SPring-8, 1-1-1 Kouto, Sayo-cho, Sayo-gun, Hyogo 679-5198, Japan

² CREST, Japan Science and Technology Agency, 4-1-8 Hon-cho, Kawaguchi-shi, Saitama 332-0012, Japan

³ Research Reactor Institute, Kyoto University, Kumatori-cho, Sennan-gun, Osaka 590-0494, Japan

High-resolution monochromators (HRMs) for Mössbauer nuclei with excitation energies less than 30 keV have been developed successfully using high angle diffractions by silicon crystals. The widely used silicon crystal, however, is not suitable for high efficient HRM at higher energy region because of the high symmetry of the crystal structure and the low Debye temperature. The high symmetry of the crystal structure gives a small number of permitted diffraction planes due to the extinction rule, which make it difficult to select a diffraction plane that has a Bragg angle near $\pi/2$ at a specific energy of X-ray. The low Debye temperature gives a low Debye-Waller factor at a high Bragg angle, and so a reflectivity becomes low even at low temperature. Therefore, the other crystals having a low symmetry of a crystal structure, a high Debye temperature and a high perfection are required for HRMs at high energy region. An α -sapphire is the most promising crystal. Consequently, quality assessment of a α -sapphire crystal has been performed in order to find better crystals and achieve better energy resolutions.

We have developed a HRM for nuclear resonant scattering (NRS) of synchrotron radiation by Te-125 at 35.49 keV using the backscattering of α -sapphire (9 1 -10 68). We used a high quality α -sapphire and controlled its temperature around 217 K to diffract synchrotron radiation with a Bragg angle of $\pi/2 - 0.5$ mrad at NRS beamline BL09XU, SPring-8. The energy was tuned by changing the crystal temperature under the condition of the constant diffraction angle. We will report on the quality of the α -sapphire and experimental results.