X-ray diffraction spectroscopy of non-irradiated and irradiated functional materials

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1. 背景と研究目的

Exposure to ionizing radiations can result in significantly altered material properties.[1] Depending on the radiation dosage and the material's radiation hardness, radiation exposure may not only be detrimental but also beneficial in enhancing certain structural, optical, and electrical properties for various industrial applications. This research then aims to investigate the effects of low-energy gamma-ray irradiation on undoped and indium-doped (In-doped) zinc oxide (ZnO) bulk single crystals which are considered as potential scintillator materials.[2]

2. 実験内容

Undoped and In-doped ZnO bulk single crystals with 8 x 8 x 0.5 mm^3 dimensions and (001) orientation were subjected to gamma-ray irradiation with an absorbed dose of 1.6 kGy. To investigate the gamma-ray irradiation effects on the surface of the ZnO crystals, grazing incidence x-ray diffraction (GIXRD) measurements were performed at the BL8S1 beamline (1.3543 Å, 9 keV) of the Aichi Synchrotron Radiation Center.

3. 結果および考察

Fig. 1 shows the GIXRD patterns of the (100) and (200) peaks of nonirradiated and gamma-ray-irradiated undoped and In-doped ZnO bulk single crystals. The (100) peak of the nonirradiated undoped crystal is centered at 27.816°whereas that of the irradiated undoped crystal is shifted to 27.866°. Similarly, their (200) peak shifts from 57.518°to 57.572°with gamma-ray irradiation. For the nonirradiated In-doped crystal, the (100) peak is located at 27.854°; for the irradiated In-doped crystal, it is centered at 27.822°. Their (200) peaks also shift from 57.512°to 57.526°after irradiation. The shifts in the (100) and (200) reflection peaks of the undoped and In-doped ZnO crystals indicate a lattice strain along the a-axis induced by gamma-ray irradiation.

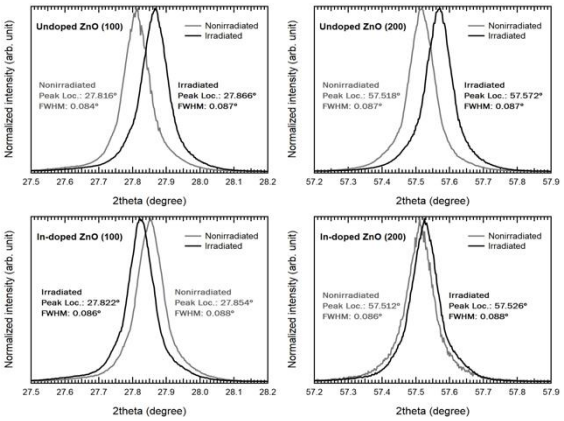

Fig. 1　GIXRD spectra of nonirradiated and gamma-ray irradiated undoped and In-doped ZnO bulk single crystals.

4. 参考文献

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2. M. Kano et al., *Journal of Crystal Growth* **318**, 788 (2011).