

Oxygen defects created in CeO₂ irradiated with 200 MeV Au

K. Ohhara^{1,2}, N. Ishikawa¹, S. Sakai¹, Y. Matsumoto¹, O. Michikami³, Y. Ohta³

¹*Japan Atomic Energy Agency (JAEA), 2-4 Shirane Shirakata, Tokai-mura, Naka-gun, Ibaraki 319-1195, Japan*

²*Ibaraki University, 2-1-1 Bunkyo, Mito, Ibaraki 310-8512, Japan*

³*Iwate University, 3-18-8 Ueda, Morioka, Iwate 020-8550, Japan*

In order to simulate influence of high-energy particles on nuclear fuel ceramics (UO₂), CeO₂ as one of simulation materials has been irradiated with 200 MeV Au ions. From the previous studies, it is already known that ion-tracks are created in various oxides irradiated with high-energy heavy ions. In this study, oxygen behavior inside the ion-tracks is studied by Raman spectroscopy and X-ray diffraction (XRD).

In Raman spectra after the irradiation, a broad peak appeared at the wave number range of 500 to 650 cm⁻¹. The intensity of the broad peak normalized by the sharp peak due to F_{2g} mode of CeO₂ (F_{2g} peak) increases with increasing fluence. It is already known [1] by the previous calculation assuming oxygen defects in CeO_{2-y} that a peak appears near 570cm⁻¹ and the peak intensity increases as y increases. Therefore, the new broad peak appeared after the irradiation can be explained by creation of oxygen defects.

This conclusion is consistent with the following result of XRD after irradiation. In XRD patterns after the irradiation, a shoulder appeared at slightly lower angle side than the peak position of the original (002) peak. The appearance of the shoulder at lower angle side reflects creation of new phase with larger lattice spacing. Therefore, both results of Raman spectroscopy and XRD suggest that oxygen defects are created inside the ion-tracks, and the oxygen defects cause lattice expansion.