

# Study on the microstructure of swift heavy ion irradiated CeO<sub>2</sub> by means of synchrotron radiation X-ray photoelectron spectroscopy and Ce K-edge EXAFS spectroscopy

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To study the effects of swift heavy ion irradiation on cerium dioxide (CeO<sub>2</sub>), CeO<sub>2</sub> sintered pellets and thin films were irradiated with 200 MeV Xe ions at room temperature. For irradiated and unirradiated samples, the spectra of X-ray photoelectron spectroscopy (XPS) were measured at room temperature, and the Ce-K edge spectra of extended X-ray absorption structure (EXAFS) were measured at various temperatures from 8K to 300K. XPS spectra for the irradiated samples show that the valence state of some Ce atoms changes from +4 to +3. This means that the oxygen deficiency is induced by the irradiation. The EXAFS spectra indicate that the irradiation induces the decrease in the coordination number of oxygen atoms around Ce atoms and the increase in Ce-O Debye-Waller factor. The Debye-Waller factor is the sum of a temperature independent static contribution,  $\sigma_s^2$ , and a temperature dependent dynamic contribution,  $\sigma_d^2$ . From the temperature dependence of EXAFS spectra, these two contributions can be separated. For the low fluence irradiation (the order of 10<sup>12</sup>/cm<sup>2</sup>), the contribution of  $\sigma_d^2$  dominates, implying that Ce-O binding is weakened by the irradiation. For the high fluence irradiation (the order of 10<sup>13</sup>-10<sup>14</sup>/cm<sup>2</sup>), the contribution of  $\sigma_s^2$  becomes dominant. The effects of high density electronic excitation on irradiation-induced change in CeO<sub>2</sub> microstructure will be discussed.