

Probing The Electronic Excitation Induced Structural Phase Transition In Nd₂Zr₂O₇ Using X-ray Techniques

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Abstract : Understanding the radiation response of the pyrochlore structured ceramics in the nuclear reactor core-like environment is of quite an interest for their utilization as host matrices. Electronic excitation (100 MeV I⁷⁺) induced crystalline to amorphous phase transition in Nd₂Zr₂O₇ pyrochlore synthesized through three steps solid-state sintering method was investigated. The x-ray diffraction, along with Raman spectroscopy and x-ray absorption spectroscopy experiments conducted on pristine and irradiated pyrochlore, showed an increase in the rate of amorphization with ion fluence. XRD results indicate that specimen is completely amorphized on irradiation at the highest fluence of 5×10¹³ ions/cm². The EXAFS spectra of the K-Zr edge and the Nd LIII edge confirmed a significant change in the chemical environment of Nd upon swift heavy ion irradiation. Observation of a large change in the intensity of K-Zr pre-edge spectra is also a good indicator of the phase transition from pyrochlore to the amorphous phase, which is supported by the FT modulus of the LIII-Nd edge. However, the chemical environment of Zr is less affected by irradiation, but it clearly exhibits an increase in the degree of disorder.

Keywords : nuclear host matrices, swift heavy ion irradiation, x-ray absorption spectroscopy, pyrochlore oxides

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