X-ray diffraction study of the damage induced in yttria-stabilized zirconia by swift heavy ion irradiations

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The lattice damage was investigated by x-ray diffraction techniques in yttria-stabilized zirconia single crystals with the (100) or (110) orientation upon irradiation with swift heavy ions (from 100-MeV C to 2.6-GeV U) in a broad electronic stopping power range (from about 0.3 to 48 keV nm^{-1}). The θ-2θ scans show that no amorphization or change to a new crystalline phase occurs regardless of the ion and crystal features. However, the rocking curves (ω scans) and reciprocal space mappings show evidence of the mosaicity of the crystals, which is produced above a threshold electronic stopping power between 18 and 27 keV nm^{-1}. This threshold is in agreement with our previous Rutherford backscattering spectroscopy/channeling spectroscopy data. Two kinds of damage phenomena are found: (i) nuclear-collision induced clusters of point defects which generate Bragg peak shifts and broadening in the 2 θ-ω and θ-2 θ scans, and (ii) electronic-excitation induced lattice damage yielding broad peaks in the ω scans above the stopping power threshold at high fluences.