

## Swift heavy ion-induced swelling and damage in yttria-stabilized zirconia

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Yttria-stabilized zirconia single crystals were irradiated with a variety of different swift heavy ions (from 145 MeV C to 2.6 GeV U) in a broad fluence range (between  $10^{11}$  and  $10^{15}$  cm<sup>-2</sup>). Surface profilometry measurements show that the out-of-plane expansion of the samples increases versus ion fluence up to an asymptotic value of about 0.2%; the larger the ion mass, the smaller the fluence needed to reach saturation. Rutherford backscattering spectrometry data on irradiated crystals under channeling conditions give clear evidence of lattice damage creation for ions heavier than Br corresponding to a threshold electronic stopping power about 20 keV nm<sup>-1</sup>. In contrast, no threshold is found for the swelling data which scale fairly well with the number of displacements per atom (except for the irradiation with U ions). In all cases we find a linear increase of the out-of-plane expansion versus the concentration of  $F^+$ -type centers (singly ionized oxygen vacancies) measured by electron paramagnetic resonance spectroscopy in as-received and thermochemically reduced samples, regardless of crystal orientation. The nature of the lattice disorder and the respective effects of elastic collisions and electronic excitations on the ion-induced volume expansion and damage are discussed.