Study of the damage produced in CaF_2 by swift heavy ion irradiation

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NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION B-BEAM INTERACTIONS WITH MATERIALS AND ATOMS 191 (2002) 301-305

Pure single crystals of CaF_2 were irradiated with different heavy ion species having energies of several hundred MeV. The induced damage was characterised by means of optical absorption spectroscopy, Rutherford backscattering spectrometry in channeling geometry (RBS-C), and out-of-plane swelling measurements using surface profilometry. For all ion species and energies, the optical spectra of the irradiated CaF_2 samples exhibit a wide absorption band with a maximum around 550 nm, typical for small calcium aggregates. The absolute absorbance depends on the fluence and on the electronic energy loss (S_e) of the ions, but there is no indication for a new band or a specific defect at high S_e values. In contrast to this, profilometry clearly indicates that swelling occurs only above a critical electronic energy loss of about 5 keV nm^{-1}. Furthermore, structural damage as measured by RBS-C starts to become significant above the same threshold. Therefore, swelling is obviously not directly related to the defects detected by optical absorption but is most likely linked to the structural disorder evidenced by the channeling technique.