Damage produced in magnesium aluminate spinel by high energy heavy ions including fission products of fission energy: Microstructure modifications

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The radiation stability of spinel $MgAl_20_4$ against the impact of beams of a fission product at fission energy (70 MeV iodine) and at different fluences was investigated using Transmission Electron Microscopy (TEM). Specimens prethinned before irradiation were analysed by TEM and irradiated bulk specimens were investigated using cross-sectional TEM. Tracks were observed in pre-thinned specimens. Partial amorphisation was observed for the irradiation at the highest fluence. Recrystalization of the amorphous region, induced by the microscope electron beam was observed. A threshold value of 6 keV nm^{-1} was determined for the amorphization of spinel under the above mentioned irradiation conditions. Moreover, profile measurements of the irradiated areas confirmed the large swelling values for this material when irradiated with fission products of fission energy. A thermal spike model was used to calculate the damage threshold for spinel using experimentally measured heavy-ion track radii, including results for other ions of up to very high energies. These accelerator-based fission product irradiations revealed an unexpected poor radiation stability, in contrast to the known good behaviour of the spinel against neutron or alpha particle damage.