

Radiation damage in UO₂ by swift heavy ions

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Specimens of sintered UO₂, a high melting point ceramic with the fluorite structure, were irradiated with heavy ions (¹²⁹Xe, ²³⁸U) with different fluences (5×10^{10} to 7×10^{13} ions/cm²) and energies (173 MeV for Xe ions to 2.713 GeV for U ions). The influence of the electronic energy loss on the mechanisms of damage formation was studied in the range of 29 to 60 keV/nm.

Transmission Electron Microscopy (TEM) was performed to identify and characterize the damage induced by these ions. Tracks produced by U ions of 2713 and 1300 MeV and by Xe ions of 173 MeV were observed. The radii of the observed tracks were calculated using a thermal-spike model, taking into account the thermodynamic parameters of the material and the energy and velocity of the incoming ions. The TRIM code was used to determine the displacement profile and the energy distribution along the ion paths. Good agreement with the experimental results was found. The dependence of damage formation on the ion dose was also studied. For instance, defect clusters and loops were produced in UO₂ irradiated with ¹²⁹Xe of 173 MeV ($dE/dx \sim 29$ keV/nm) between 7×10^{10} and 7×10^{13} ions/cm².