

Heavy-ion irradiation of pyrochlore oxides: Comparison between low and high energy regimes

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Pyrochlore pellets with $\text{Gd}_2(\text{Ti}_{2-x}\text{Zr}_x)\text{O}_7$ stoichiometry were irradiated with heavy ions at energies ranging from a few MeV to a few GeV in order to compare the effects of nuclear collisions and electronic excitations. The damage created by irradiation was characterized as a function of the ion fluence by X-ray diffraction. The structural modifications induced by irradiation were shown to depend on both the sample composition and the type of irradiation. At low energy (4 MeV Au ions), the susceptibility to radiation-induced amorphization exhibits a systematic decrease with increasing Zr content. At high energy (1.5 GeV Xe or 2.6 GeV U ions), similar structural changes are observed at much lower fluences. The lattice parameter increases for low energy irradiation, particularly in the case of amorphizable pyrochlores ($\text{Gd}_2\text{Ti}_2\text{O}_7$ and $\text{Gd}_2\text{TiZrO}_7$), whereas it decreases for high energy irradiation.