

Structure alterations in microporous $(\text{Mg,Fe})_2\text{Al}_4\text{Si}_5\text{O}_{18}$ crystals induced by energetic heavy-ion irradiation

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The microporous framework structure of $(\text{Mg}_{1-x}\text{Fe}_x)_2\text{Al}_4\text{Si}_5\text{O}_{18}$ (=cordierite) has been subject to a comparative study on the effect of structural alterations originating from exposure to high-energy heavy ions. Oriented samples (with $x=0.061, 0.122$, and 0.170) were irradiated with swift ^{124}Xe , ^{197}Au and ^{96}Ru ions with 11.1 MeV per nucleon energy and fluences of 1×10^{12} and 1×10^{13} ions/cm². Irradiated and non-irradiated samples were investigated by means of X-ray diffraction, Mössbauer spectroscopy and optical absorption spectroscopy. Structural investigations reveal an essentially unchanged Al,Si ordering, which appears to be unaffected by irradiation. The most remarkable macroscopic change is the ion-beam induced colouration, which could be assigned to electronic charge transfer transitions involving the Fe cations. Mössbauer spectra indicate an increased amount of $^{57}\text{Fe}^{3+}$ for the irradiated sample. The most noticeable structural alteration concerns irradiation-induced dehydration of extra-framework H_2O , which is accompanied by a reduction in the molar volume by ~ 0.2 vol%.