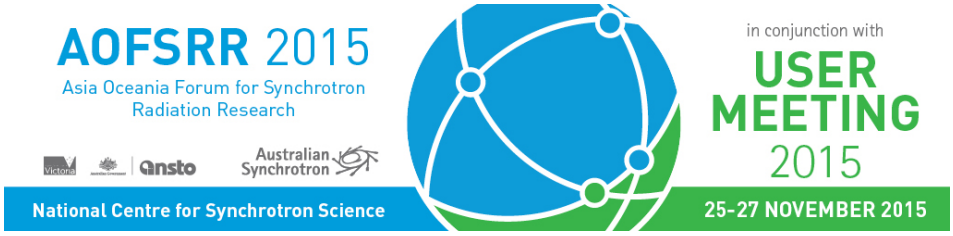

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Characterization of latent and etched ion tracks in apatite by small-angle X-ray scattering (SAXS)

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Ion tracks consist of narrow (~10 nm), long (~10-100 μm) cylindrical defect regions that are left behind by high-velocity heavy ions when they pass through a solids. Such tracks are used for determining the age and thermal history of geological material by studying the number and length distribution of chemically etched tracks that result from spontaneous fission of natural inclusions of uranium in the material. The etching enlarges the original damage area such that the track can be studied using optical microscopy.
The present work investigates how differences in the un-etched track morphology translate into etched ion track dimensions, in particular the influence of different mineral compositions and thermal annealing. Apatite samples were irradiated with 185 MeV Au ions to simulate fission tracks. Subsequently, the samples were chemically etched and the resulting track morphology was investigated using synchrotron SAXS and scanning electron microscopy (SEM). Results indicate that the etching process is highly anisotropic, exhibiting hexagonal etch-pits that depend on the mineral composition and track orientation.
The annealing kinetics of un-etched tracks in different compositions and orientations of apatite were also investigated using SAXS. The results show a dependence on the orientation of the tracks in the crystal; tracks perpendicular to the apatite c-axis recover faster compared to tracks parallel to the c-axis. These results provide important input to develop an understanding of the correlation of etched and un-etched fission tracks and the use of SAXS as a tool for studying etched tracks.

Keywords

Ion tracks, etched, un-etched, SAXS

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