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Recent advances in characterisation of ion tracks using small angle x-ray scattering measurements

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Small angle X-ray scattering (SAXS) provides an interesting tool to study the structure of etched and unetched ion tracks. It is non-destructive and can yield high precision measurements of the track radii in bulk amorphous and crystalline materials. Short acquisition times associated with the high photon flux at 3rd generation synchrotron devices facilitate in situ studies to determine the annealing kinetics of ion tracks as well as the use of diamond anvil cells to investigate track stability under high pressure conditions. Monte Carlo calculations enable advanced SAXS data analysis using complex track shapes.

This presentation will give an overview of our recent advances in characterising ion tracks using SAXS and outline potential future directions. Examples include: In situ annealing experiments of ion tracks in quartz to study a complex elastic behaviour of the tracks [1] as well as their annealing kinetics; the composition dependent annealing behaviour of tracks in natural apatite; etching experiments in apatite which reveal hexagonally shaped etch pits depending on track orientation and apatite composition; ion track formation at elevated temperatures in apatite and quartz showing an increase in the track radii by approximately 1 Å/100°C as a consequence of an increased local temperature leading to a larger melting radius in the thermal spike [2]; the influence of pressure on the formation, stability and annealing behaviour of ion tracks. Increasing pressure during formation leads to increased track radii, while track recovery appears to be enhanced at elevated pressures. Experimental results were complemented by molecular dynamics simulations.

[1] B. Afra et al., Phys. Rev B 90 (2014) 224108

[2] D. Schauries et al., J. Appl. Cryst. 46 (2013) 1558

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