Swift heavy ion tracks in solids: formation and characterization

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The interaction of swift heavy ions with solids is governed by their inelastic collisions with the target electrons. The resulting intense electronic excitation and the concomitant high energy deposition can lead to intriguing nanoscale material modifications mediated by the formation of narrow defect regions along the ion paths, so called ion tracks. Ion tracks have many interesting applications across a variety of scientific areas such as materials science and engineering, nanotechnology, geology, archaeology, nuclear physics, and interplanetary science.

Small angle X-ray scattering (SAXS) provides an interesting tool to study the structure of ion tracks, as it is sensitive to small density changes that often exist in the damaged regions. 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.

The presentation will give an overview of our recent results including: the observation of a fine structure in ion tracks in amorphous SiO_2 [1, 2], amorphous Ge [3], and amorphous Si [4]; measurement of the morphology, temperature dependent formation and elastic behavior of ion tracks in α-quartz [5, 6], and determination of the track recovery kinetics in minerals [7, 8]. First results on the stability of ion tracks under high-pressure conditions will be discussed. The measurements combined with molecular dynamics simulations yield important mechanistic insights into ion track formation.

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