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Ion Track Formation in Silicon Oxynitrides by Swift Heavy-Ion Irradiation

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Amorphous silicon oxynitrides (SiOxNy) are commonly used as barrier material due to their interesting mechanical and chemical properties. However, their application as gradient-index materials makes them also suitable candidates for the synthesis of nanostructures [1].

Here, we present direct evidence for the formation of ion tracks in 1-micron-thick silicon oxynitrides of different stoichiometry. The samples were irradiated with 185 MeV Au13+ ions to create the ion tracks. At such energies, the incident ion interacts predominantly with the system in the electronic regime. The subsequent transfer of energy to the lattice can yield melting along the ion path. While in crystalline materials the rapid quenching freezes in structural disorder resulting in an ion track, in amorphous materials a more complex process takes place [2]. The stoichiometry was determined using spectral Reflectometry and Rutherford backscattering (RBS), while the morphology was characterised by means of Small Angle X-ray Scattering (SAXS) and Fourier Transform Infrared Spectroscopy (FTIR). SAXS measurements indicate a core-shell structure for the ion tracks, with a typical radius between 3-7 nm, following a trend with N content.

[1] Baak, T., Silicon Oxynitride; a material for GRIN optics, Appl. Opt. 21 6 1069 (1982)

[2] Kluth, P. et al., Fine Structure in Swift Heavy Ion Tracks in Amorphous SiO2, Phys. Rev. Lett. 101 175503 (2008)

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Summary

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