Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **3482** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

Density changes in amorphous silicon provoked by swift heavy ions

Thursday 9 June 2022 11:30 (15 minutes)

Pure and gold-doped amorphous silicon membranes were irradiated with swift heavy ions (75 MeV Ag or 1.1 GeV Au ions) and studied by small angle X-ray scattering. The samples that were irradiated with 1.1 GeV Au ions produced a scattering pattern consistent with core-shell type ion tracks of 2.0 ± 0.1 nm (core) and 7.0 ± 0.3 nm (total) radius irrespective of gold doping and consistent with radii previously observed [Bierschenk et al., Phys. Rev. B 88, 174111 (2013)]. However the core must be less dense than the original amorphous silicon, not more dense as argued in the same report, because its density is nearly 4 % different from that of the surrounding material. The compressive stress required to maintain the core 4 % more dense would exceed the yield strength of amorphous Si. The entire track (core + shell) is slightly less dense than the surrounding material, putting it under a lateral stress consistent with the macroscopic "hammering"deformation seen when tracks overlap. No tracks were found in samples irradiated with 75 MeV Ag ions, and no signature specific to the gold impurity doping could be observed.

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Session Classification: R2-4 Quantum Materials II (DCMMP) | Matériaux quantiques II (DPMCM)

Track Classification: Technical Sessions / Sessions techniques: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)