Morphology of swift heavy ion tracks in metallic glasses

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Swift heavy ion irradiated metallic glasses were studied using synchrotron based small angle X-ray scattering (SAXS). Ribbons of $Fe_{80}B_{20}$, Fe_{85} B_{15}, $Fe_{81}B_{13.5}Si_{3.5}C_2$ and $Fe_{40}Ni_{40}B_{20}$ were irradiated with 11.1 MeV/nucleon (MeV/u) ^{132}Xe, ^{152}Sm, ^{197}Au and 8.2 MeV/u ^{238}U ions to fluences between 1×10^{10} and 1×10^{12} ions/cm^2. The SAXS measurements provide evidence for the formation of ion tracks and allow a quantitative analysis of the track ensemble in all studied materials. The ion tracks have been well described by cylinders with abrupt boundaries and an electronic density change of (0.03 ± 0.01)% between track and matrix material. An inelastic thermal spike model was fitted to the experimental track radii to determine the critical energy density required to create an ion track. Despite the similar energy loss and track cross-sections, 30% higher track creation threshold is apparent for the binary alloys.