Contribution ID: **1965** Type: **Poster**

Comparative effects of swift heavy ion irradiation on SiC implanted with Ag alone and Ag + He

Monday 27 October 2025 18:30 (20 minutes)

The effects of SHI irradiation on the structural evolution of Ag-implanted and Ag + He co-implanted SiC were investigated in this work. Silver (Ag) ions at 360 keV were implanted at room temperature (RT) to a fluence of 2×10^16 cm^−2. Some of the as-implanted samples were then irradiated at RT with 167 MeV Xe ions to fluences of 1×10^13 cm^−2, 1×10^14 cm^−2 ,3.4×10^14 cm^−2 and 8.4×10^14 cm^−2. Other samples were first co-implanted with He ions at 17 keV to a fluence of 1×1017 cm−2 at 500℃, followed by irradiation with 167 MeV Xe ions to a fluence of 1×10^14 cm−2 at RT. The samples were characterized using Transmission Electron Microscopy (TEM), Raman Spectroscopy, and Rutherford Backscattering Spectrometry (RBS). Ag implantation amorphized the SiC from the surface to a depth of approximately 270 nm. SHI irradiation at a fluence between 1 × 1013 cm^2 and 3.4 × 1014 cm-2 reduced the amorphous layer to 230 nm, which is a 15% reduction, while irradiating at 8.4 × 1014 cm-2 reduced the amorphous layer to 220 nm, which represents a 19% reduction. These results suggest that the degree of recrystallization is fluence-dependent. No migration of pre-implanted Ag was observed after SHI irradiation. No migration of pre-implanted Ag was observed after SHI irradiation. The co-implantation of 17 keV He to a fluence of 10^17 〖cm〗^(-2) at 500 °C resulted in the formation of nano bubbles and a somewhat recovery of the amorphous region. The irradiated co-implanted sample showed further recrystallization, owning to the effect of SHI causing recrystallization. However, the irradiation of co-implanted samples with SHIs resulted in more recrystallization (as compared to Ag implanted samples irradiated under the same conditions) and a less decrease in damaged layer thickness (i.e., 250 nm), indicating that He enhanced recrystallization and hindered the decrease in damaged layer thickness. Moreover, after He co-implantation and SHIs irradiation, no evidence of Ag migration was observed. However, SHIs irradiation caused the formation of holes in the surface of the co-implanted samples. These findings indicate that He enhanced SiC recrystallization but also caused the formation of holes on the surface after SHIs irradiation. The observed effects highlight the complex interplay between He and SHIs irradiation in altering the microstructural properties of SiC.

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Session Classification: Poster session & Welcome drinks

Track Classification: Nuclear Physics