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Ion irradiation of Tungsten metal target for the study of Pakistan Spherical Tokamak (PST) divertor

The Pakistan Spherical Tokamak (PST) is a small-sized spherical tokamak currently in the design and development phase. A double null divertor configuration is being considered for the steady-state operation of the PST. Two different divertor materials concepts are under consideration for the PST and other devices in the future. The interaction between plasma and tungsten surfaces leads to noticeable alterations in microstructure and material properties. Tungsten is considered as a divertor material in fusion devices, where it can withstand large heat loads. The interaction of high-energy ions and electrons leads to swelling, blistering, and the formation of nano-cracks, ionization, recombination, and voids in the material.

The aim of this research effort involves examining the impact of helium ions irradiation on tungsten material. Tungsten samples were irradiated with high flux (1×10^{14}, 1×10^{15} and 1×10^{16} ions/cm^2) of helium ions to investigate structural changes and surface morphology. Changes in microstructure, residual strain, surface morphology, and hardness of the samples were then observed using XRD (X-ray diffraction), SEM (scanning electron microscopy), and Micro-Vicker hardness techniques. Ion depth profiling was also conducted using SRIM (Stopping and Range of Ions in Matter) simulation for $1 - 10$ MeV energy. It was observed that the penetration depth directly increases with particle energy, and Displacement per Atom (DPA) decreases with an increase in energy.

Primary author: AHMAD, Kamran (Pakistan Atomic Energy Commission (PAEC))

Co-authors: BILAL, Muhammad (Pakistan Tokamak Plasma Research Institute (PTPRI)); GULFAM, Saira (Pakistan Tokamak Plasma Research Institute (PTPRI), P.O. Box 3329, Islamabad, Pakistan); MIAN, Asad Yaqoob (Pakistan Tokamak Plasma Research Institute (PTPRI)); AHMAD, Zahoor (Pakistan Tokamak Plasma Research Institute (PTPRI))

Presenter: AHMAD, Kamran (Pakistan Atomic Energy Commission (PAEC))

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