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Swift Heavy Ions Induced Structural Modifications in Tungsten Carbide (WC) Thin Films

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Radiation resistance of materials is an important area of research, relevant to nuclear reactor technology. Various challenges are associated with this research; one of which is the selection of radiation resistant material for the plasma facing wall of the reactor due to its harsh operating environment.*Recent studies reveal that WC has the potential to be developed as radiation resistant material.** To explore this possibility, WC thin films synthesized using RF Magnetron sputtering at a substrate temperature of 700 K have been irradiated with 100 MeV Ag8+ ions from 15 MV Pelletron accelerator at three different fluence. Glancing angle X-ray diffraction (GAXRD), Atomic Force Microscopy (AFM), Field Emission Scanning Electron Microscopy (FE-SEM) and Raman spectroscopy of the films have been performed to determine structural and morphological changes due to ion irradiation. GAXRD of the pristine and irradiated thin films reveal the reduction in grain size and loss of crystallinity with ion irradiation. FESEM images of the thin films showed no significant change in surface morphology and the thin film continuity is maintained even after ion irradiation of higher fluence. Raman spectroscopy of the WC thin films shows the decrease in intensity of peaks corresponding to Raman shift resulting in the decrease in polycrystalline nature of WC upon ion irradiation. Further, thermal spike calculations are also done to estimate the evolution of lattice temperature with ion irradiation.

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Footnotes

*Linke, J. et al. Challenges for plasma-facing components in nuclear fusion. Matter Radiat. Extrem. 4, 056201 (2019).**Azman, M. N., Abualroos, N. J., Yaacob, K. A. & Zainon, R. Feasibility of nanomaterial tungsten carbide as lead-free nanomaterial-based radiation shielding. Radiat. Phys. Chem. 202, 110492 (2023)

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Primary authors: AVASTHI, Devesh (Inter University Accelerator Centre); PANDEY, Ratnesh (University of Petroleum and Energy Studies); BIST, SHRISTI (University of Petroleum and Energy Studies)

Presenter: BIST, SHRISTI (University of Petroleum and Energy Studies)

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