Seminar

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Institute for Plasma Research

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Title: Investigation of radiation impact on Cu alloys for its application in Neutral Beam systems

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Date: 12th August 2025 (Tuesday)

Time: 11:00 AM

Venue: Seminar Hall, IPR

Abstract

CuCrZr is widely used in Beamline components of Neutral beam systems of ITER. The mechanical performance of this alloy is well established. However, the impact of radiation on the structural and mechanical properties of the materials remains to be investigated thoroughly. In the current work, we have performed neutron and ion beam irradiation studies on solution annealed CuCrZr alloy.

Precipitation hardened CuCrZr samples were prepared by wire cut EDM and were irradiated with 14 MeV neutrons at a flux of 5.13 x 10^9 n/cm² for 100 minutes. These samples were then analysed to understand its structural and mechanical performance. Neutron irradiated samples were found to have Cr rich zones identified by SEM and supported by EDS analysis. Apart from the Cr rich zones. Furthermore, XRD analysis supported an increase in Cr precipitation. Additionally, XRD peak broadening and shifts indicated the presence of radiation-induced compressive stress and increased lattice strain. Nanoindentation analysis has revealed an increase in the material stiffness and a clear improvement in modulus (85 – 114 GPa). To induce higher damage in the material in limited time, they are subjected to 150 keV Ar^{2+} ion irradiation at different fluences between $1x10^{14}$ to $3x10^{16}$ ions/cm² followed by its testing. To understand ion beam energy loss mechanism in the material and induced damage in terms of DPA, SRIM/TRIM analysis was performed. Reduction in overall surface roughness for irradiated samples were obtained by AFM & SEM analysis. Grazing incidence XRD trend is in-line with our earlier reported study.

Experimental work is in progress for a defect evolution study and material response at higher neutron damage levels. This work lays foundation for predictive modelling of materials for fusion-relevant conditions.