Seminar

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Institute for Plasma Research

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Title: Radiation Damage and Defect Analysis of Feasible Plasma-Facing Components

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Date: 18th May 2026 (Monday)

Time: 11:15 AM

Venue: Seminar Hall, IPR

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Abstract

The long-term performance of plasma-facing components (PFCs) in fusion reactors critically depends on the radiation tolerance and defect stability of candidate materials under extreme irradiation environments. During the present six-month research progress, systematic investigations were carried out on neutron- and ion-irradiated silicon carbide (SiC) and on other fusion-relevant materials. Neutron irradiation studies were performed on SiC samples using fluence of 7.8×10^{12} n/cm^2 to simulate fusion neutron damage conditions, followed by defect characterization using positron annihilation spectroscopy (PAS), Raman spectroscopy, and other analysis. In parallel, oxygen and nitrogen ion irradiations were also conducted to understand the feasibility of PFCs displacement damage, defect accumulation, and ion- defect interactions.

In addition, low-energy Ar^+ irradiation (0.5 keV) was employed on Silicon samples with different ion dose rates to investigate near-surface nano-structuring and surface modification mechanisms. The evolution of irradiation-induced vacancy-type defects, disorder, and morphology changes were systematically correlated with irradiation conditions. Variable energy positron annihilation spectroscopy coupled with VEPFIT analysis was utilized to obtain depth-resolved defect information and qualitative defect profiling. Further, the PAS data analysis was done for ion- and neutron irradiated Cu-alloy systems. The overall work establishes a defect-centric experimental framework for understanding radiation damage, defect evolution, and surface modification and its feasibility of plasma facing materials.

References

1. F. Linez, I. Makkonen, F. Tuomisto, *Calculation of positron annihilation characteristics of six main defects in 6H-SiC and the possibility to distinguish them experimentally*, Physical Review B, 94 (2016) 014103.
2. T. Sizyuk, J.N. Brooks, T. Abrams and A. Hassanein, *Comprehensive new insights on the potential use of SiC as plasma-facing materials in future fusion reactors,* Nucl. Fusion (2024) 64 086036