Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **46** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

Synchrotron Grazing Incidence X-ray Analysis of PIII Implanted Helium and Deuterium Tungsten, Tungsten-Nickel-Copper, and Tungsten-Tantalum as Plasma-facing Components

Wednesday 11 June 2025 14:45 (15 minutes)

Tungsten (W) is considered the optimal choice for plasma-facing components (PFCs) in fusion devices due to its high melting point, excellent mechanical properties, and minimal erosion rate. However, studies have shown that W undergoes extreme morphological change when it is bombarded by a high fluence of low-energy ions from helium (He) and deuterium (D) plasmas. To maintain W properties, its alloys—tungsten heavy alloys (W-HA), (90%W-6%Ni-4%Cu), and tungsten-tantalum (W-10%Ta) were investigated as PFCs. The microstructural analysis of He and D ion implanted W and its alloys was conducted using synchrotron grazing incidence X-ray diffraction (GIXRD) and X-ray reflection (GIXRR) techniques at the Canadian Light Source (CLS). The analysis was performed at different grazing incidence angles, 0.5°, 1°, 3°, 5° and 7° to study near-surface defects. The implantation results unmistakably show that He^+ ions inflict significantly more near-surface strain, peak broadening, and distortion than D^+ ions, especially up to a depth of 120 nm. At a depth of 1000 nm, D^+ implanted pure-W exhibits a severely deformed (110) GIXRD diffraction peak. W-Ta and W-Ni-Cu alloys did not exhibit (110) peak distortion. The GIXRR revealed that X-ray reflection is lower from implanted samples than un-implanted, confirming the increased surface roughness in ion-implanted W and W-alloy target materials. The results indicate that the negative effects of He^+ and D^+ ions can be mitigated by alloying W with suitable components.

Keyword-1

Synchrotron GIXRD and GIXRR

Keyword-2

PFC's

Keyword-3

W and W-alloys

Author: YOUSAF, tahreem

Co-authors: Prof. SZPUNAR, Jerzy; Prof. BRADLEY, Michael

Presenter: YOUSAF, tahreem

Session Classification: (DPP) W2-9 Plasma Physics and Technology | Physique et technologie des plasmas (DPP)

Track Classification: Symposia Day (Wed June 11) / Journée de symposiums (Mercredi 11 juin): Symposia Day (DPP - DPP) - Plasma Physics and Technology | Physique et technologie des plasmas