SEMINAR NOTICE

Department of Physics and Engineering Physics
University of Saskatchewan

SPEAKER: Tahreem Yousaf, PhD Candidate
Department of Physics & Engineering Physics

TOPIC*:* ***High Fluence Plasma Immersion Ion Implantation for Fusion PFC material Testing***

DATE: Tuesday February 14th, 2023

TIME: 3:30-4:30 p.m.

PLACE: ***Physics 103***

Abstract:

Plasma fusion devices will require plasma-facing components (PFCs) which can withstand the extreme environment at the edge of a hot fusion plasma. Despite the excellent properties of tungsten as a hard refractory metal, adverse effects such as embrittlement, melting, and morphological evolution have been observed in W when it is bombarded by a high-fluence of low-energy ions from helium and deuterium plasmas (i.e., primarily low-energy He^+ ions, and deuterons) [1-2]. In our work, we consider other tungsten-based PFC candidate materials such as NAECOMET 1000 (formerly known as CMW 1000 AMS-T-21014 AMS-7725 ASTM B777 High-Density Machinable Tungsten). W-Ni-Cu alloys such as NAECOMET 1000 are machinable grades that may find application where precise machinability is required; they provide other advantages due to their high fracture toughness and tensile strength compared to pure tungsten. High fluence ion implantation for this work will be conducted in a custom Plasma Immersion Ion Implantation (PIII) system developed by the Bradley group at the University of Saskatchewan, consisting of an Inductively Coupled Plasma and a custom high-voltage modulator [3-5]. The ITER-grade tungsten and NAECOMET 1000 tungsten alloys were implanted with Helium plasma with variable pulse lengths (10us -20us) with a range of NPHV pulse amplitudes (1 -3 kV). We discuss the results of these experiments and the various mechanisms involved.

References

[1] M. J. Baldwin and R. P. Doerner, "Formation of helium induced nanostructure 'fuzz' on various tungsten grades," *J. Nucl. Mater.* **404**, no. 3, pp. 165–173 (2010).
[2] K. Tokunaga *et al.*, "Blister formation and deuterium retention on tungsten exposed to low energy and high flux deuterium plasma," *J. Nucl. Mater.*, **337–339**, pp. 887–891 (2005).
[3] M. Risch and M.P. Bradley, "Prospects for Band Gap Engineering by Plasma Ion Implantation", *physica status solidi* (c) **6**, S210-S213 (2009).
[4] C.J.T. Steenkamp and M.P. Bradley, "Active Charge/Discharge IGBT Modulator for Marx Generator and Plasma Applications", *IEEE Trans. Plasma Sci.* **35**, 473-478 (2007).
[5] J. Moreno, A. Khodaee, D. Okerstrom, M.P. Bradley, and L. Couëdel, "Time-resolved evolution of plasma parameters in a plasma immersion ion implantation source", *Physics of Plasmas* **28**, 123523 (2021).