Seminar

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Institute for Plasma Research

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Title: Development of a Multi-Anode High Flux X-ray Source for X-ray Crystal Spectrometer Calibration

Speaker: Dr. Gaurav Shukla
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Date: 7th March 2024 (Thursday)

Time: 10:30 AM

Venue: Online (Link to Join)

Abstract

Commercially available X-ray sources lack the necessary characteristics for calibrating X-ray crystal spectrometers (XCS) in the crucial soft X-ray range (1 – 100Å). This necessitates the development of large area, high flux, and uniform sources for XCS calibration, especially for ITER's XRCS diagnostics operating across a broad wavelength band. Our study addresses this challenge by creating a novel multi-anode high flux X-ray source specifically designed for XRCS calibration. Meticulous source design is with tungsten straight wire as the cathode material due to its superior flux and extended lifespan. Leveraging the Richardson-Dushman equation, we calculated the current density to determine the optimal filament dimensions. Additionally, for accurate calibration, specific anode materials are selected to emit X-ray lines closely matching those anticipated from ITER plasmas.

To capture and analyze the X-ray photons from the X-ray source, X-ray sensitive large area Si-PIN photodiode (100 mm^2) with precisely defined spectral response are procured. Furthermore, compatible visible light-blocking filters were identified to ensure seamless operation within the vacuum chamber. To characterize the X-rays generated and monitor the source performance, the different photodiode-based detector systems will be installed on the ports simultaneously. The photodiode detectors will measure characteristic line emission, and photon flux distribution both spatially and temporally.

Fabrication of the multi-anode chamber and detector mount is ongoing, with completion anticipated soon. Subsequent efforts will involve characterizing the existing fixed anode source using the newly developed photodiode readout unit and finalizing data analysis routines for crucial parameters. Assembly of the multi-anode chamber, leak testing, and final characterization using the large area photodiode system within the vacuum chamber will follow.

In this presentation, we will report on the design of the Multi-Anode X-ray source and the progress in in-house development of a photodiode-based X-ray detector system to characterize the X-ray source.