Seminar

==========

Institute for Plasma Research

==========

Title: Study of Friction Weld Joints for Fabrication of Ion Extractor Grid

Speaker: Dr. Hardik Vyas
Institute for Plasma Research, Gandhinagar

Date: 16th May 2024 (Thursday)

Time: 10:30 AM

Venue: Seminar Hall, IPR

Abstract

It is to be noted that the heart of the neutral beam injection system was the ion extractor grids which were subjected to high voltage, under a high vacuum. These grids were constructed using copper. During beam operation, the grids received a heat load of 1.75 MW/m2, which was efficiently dissipated by active water cooling channels embedded in the copper base plate. Inlet water at a pressure of (maximum) 12 bars was supplied to these cooling channels through SS304L stub pipes (length 30 mm, OD 12 mm, and inner diameter 9 mm) that were FWed to the copper base plate. The development and examination of the properties of an asymmetrical dissimilar metal joint produced using friction welding. Friction welding involving dissimilar materials, specifically a 50 mm (length) × 45 mm (width) × 20-mm (thickness) electrolytic tough pitch copper (ETP-Cu) plate and a 12.5-mm-diameter SS304L rod, was carried out. The assessment of the asymmetrically welded components encompassed ultrasonic testing, high-pressure helium gas testing, leak testing, tensile testing, scanning electron microscopy, optical microscopy, energy-dispersive X-ray spectroscopy, X-ray diffraction analysis, hardness measurements, and elemental mapping via X-ray. Significantly, there was an observed increase in tensile strength, resulting in a joint efficiency of 86.50% compared to the ETP-Cu base material, following FW between an asymmetric ETP-Cu plate and SS304L rod. The study unveiled notable variations in the microstructure near the joint interface on the ETP-Cu material side. Intermetallic compounds, such as $FeCu_4$ and Cu_9Si phases, were detected within the reaction layer at the interface between ETP-Cu and SS304L, exhibiting a variable thickness ranging from 30 to 50 μm.