Seminar

==

Institute for Plasma Research

==

Title: Numerical modelling of an arc plasma and its interaction with the anode

Speaker: Dr. Abin Rejeesh AD
Institute for Plasma Research, Gandhinagar

Date: 24th April 2024 (Wednesday)

Time: 11:00 AM

Venue: Seminar Hall, IPR

Abstract

The thermal plasma process has evolved as an important technique for the synthesis of various nanomaterials due to advantages over other methods. Researchers have shown keen interest in modeling the process using magnetohydrodynamic equations with the aim of obtaining plasma characteristics, which are then applied to replicate similar conditions in experiments for synthesizing nanomaterials.

In a free-burning transferred arc plasma, an electric arc is struck between electrodes, forming the plasma. The high temperature of the plasma is enough to melt and evaporate materials. The plasma plume heats the anode workpiece to its melting point, which eventually leads to its evaporation. Nano particles are formed via vapour phase nucleation and growth of evaporated species.

In order to simulate the nucleation and growth, details of vapour flux is essential, this in turn is dependent on the arc plasma properties. To achieve this objective a numerical simulation is carried out to estimate the profiles of temperature, velocity, potential and current density. The results are obtained for a free burning argon arc using an opensource package OpenFoam and modified the solver to include the Maxwell's equations for the arc phenomena called *arcFoam*. The model integrates necessary plasma electrode coupling to investigate anode coupling dynamics. It successfully incorporates energy balance considerations at the plasma anode interface, factoring in total electrical flux, thermal conduction flux, enthalpy heat flux, and radiation flux. Additionally, conservation of current is sustained at the interface. To enhance accuracy, the model updates mixtures of viscosity, density, thermal conductivity, specific heat capacity, and electrical conductivity variation with temperature in the plasma region. This allows for precise calculations of redistributed velocity and energy distribution inside the plasma, particularly influenced by evaporation. The details and results of the above simulation will be presented.
