Seminar

Institute for Plasma Research

Title : Theoretical modeling and simulation of DC thermal plasma torches for nanoparticle synthesis

Speaker: Dr. Gayatri Dhamale
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Date : 21st December 2020 (Monday)

Time : 11.00 AM

Venue : Online - Join the talk: https://meet.ipr.res.in/PDFtalk-GayatriDhamale

Abstract :

During the thermal plasma synthesis of nanoparticles, the knowledge of temperature gradient and velocity fields of the plasma is necessary as it depicts the final size distribution of particles. Numerical modeling and simulation of the process is one of the viable ways for picturizing the plasma flow. The present study is bifurcated to fluid dynamics simulation of thermal plasma and numerical modeling of particle growth during thermal plasma synthesis.

In the tenure of my post-doctoral study, the first part of the above task was carried out, viz. CFD simulation of thermal plasma for DC arc plasma torches operated in transferred and non-transferred arc mode. Using FLUENT (ANSYS Inc.) software tool, a CFD simulation of the process has been done by additionally incorporating a UDF code developed by me to account for the temperature dependent (300-30,000K) plasma gas properties in equilibrium, boundary conditions at electrode surface, and associated energy and momentum source terms to the solver. The developed code was benchmarked with the existing model. Obtained results closely matches with the reported one.

A 2-dimensional, axisymmetric geometry has been constructed for a non-transferred as well as transferred arc mode DC torch with the help of ANSYS Design Modeler application. The computational domain was constructed and meshed with structured grid arrangement. The plasma profiles were simulated for different cathode-anode distance and input DC currents. After successful application of the UDF code in FLUENT solver, a plasma profile for DC thermal plasma torch is simulated. The code was tested for oxygen and argon as a plasma forming gas.

The obtained temperature contour plot and velocity profiles helps in getting the heat flux delivered at the work-piece. It will also help in predicting the heat losses to the wall of plasma chamber for which the given study has been proposed. The results will be presented and discussed in the talk.