Seminar

Institute for Plasma Research

Title : Experimental study on force balance in thermal plasma torch

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Date : 12th April 2018 (Thursday)

Time : 11.00 AM

Venue : Seminar Hall, IPR

Abstract :

The dynamical behaviour of the plasma in a plasma torch is the result of complex interactions between various forces [1] acting on the plasma arc column. In this work, experimental studies on plasma dynamics have been conducted by investigating the force balance mechanism using a combination of fast imaging [2], electrical, magnetic [3] and OES diagnostics. The studies were carried out on a low power (~25 kW), non-transferred, nitrogen plasma torch at atmospheric pressure over a wide range of gas flow rates, discharge currents and external magnetic fields. The work constituted (i) development of diagnostics and implementation on the experimental system (ii) investigation of different types and nature of arc root attachment, diffuse or constricted (iii) studies on the influence of experimental parameters on the fluctuations. Using fast imaging, it was observed that nature of arc root attachment varies with variation in experimental parameters such as current, magnetic field and flow; arguments are invoked to explain the observed phenomena. Using electrical and magnetic diagnostics, it is observed that volume return currents give way to constricted line currents in the anode return path under certain conditions. This is attributed to eddy currents arising out of space varying return currents components in the anode. Using spectroscopy, the influence of various operating parameters on the plasma temperature was also investigated. This helps us not only to estimate plasma parameters but also correlate the evolution of various species with several of the observed physical processes. In order to explain all the observed phenomena, a three dimensional model of the force balance in a magnetically stabilized plasma torch, such as ours, is presented and discussed.

References:

[1] Collares, M. P., & Pfender, E. (1997). Effect of current connection to the anode nozzle on plasma torch efficiency. IEEE transactions on plasma science, 25(5), 864-871.

[2] Goyal, V., Ravi, G., Bandyopadhyay, P., Banerjee, S., Yugesh, V., & Mukherjee, S. (2017). Study of dynamical behaviour of the plasma in a dc non-transferred plasma torch using fast imaging. Physics of Plasmas, 24(3), 033506.

[3] Goyal, V., Ravi, G & Mukherjee, S. (2018). Role of return currents in the dynamics of amagnetically rastered plasma torch. Physics of Plasmas (in communication)