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P4.3014 Schlieren imaging and flow simulation results of an axial injection torch

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METU Plasma Research Laboratory microwave plasma torch is a high power (up to 2kW) microwave source operating at 2.45 GHz via a surfaguide waveguide. Argon gas is fed from one end, the plasma column generated inside a 20 mm diameter quartz tube comes out as a high-speed continuous jet from the other end. Due to its geometry, this type of microwave torches is referred to as TIA "Torche a Injection Axiale" in the literature [1]. In general, TIAs can be used for numerous plasma applications including surface treatments of materials, nanopowder synthesis and for the production of carbon nanotubes. Some of these applications may require a certain understanding of the plasma flow and target interactions. In our studies, we mainly focus on the flow analysis of the plasma jet coming out of the torch nozzle. The plasma is surrounded by colder, ambient nonionized gas. It is observed that the interaction of these multiphase fluids in a narrow tubing leads to large eddies, which are separated into smaller ones, developing turbulent flows. Based on the gas flow rates Reynolds number can be evaluated. Using a "Z- type" Schlieren imaging technique, we confirm that turbulence takes place at various microwave power settings. The plasma plume length and width are also measured at various microwave power settings. Thermal effects are investigated via numerical simulations using COMSOL Multiphysic CFD Module [2]. These simulations provide a better understanding about the flow dynamics observed in the captured images. This work is supported by METU Research Grants YOP-105-2018-2840.

[1] E A H Timmermans et al 2000 Plasma Sources Sci. Technol 9 625.
[2] COMSOL Multiphysic v. 5.4. www.comsol.com. COMSOL AB, Stockholm, Sweden.

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