The Schlieren Imaging to Investigate the Flow of a High-Power Axial Injection Plasma Torch

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Schileren imaging is utilized to assess dynamical properties of a high-power injection torch (AIT). The AIT system operates at atmospheric pressure using a power modulated 2.45 GHz microwave source through a surfaguide waveguide. Argon gas is feed to the system and plasma is generated inside a quartz tube of 20 mm in diameter. In AIT systems, the plasma is often surrounded by ambient nonionized gas, which is colder than the plasma. In small diameter tubing, it is observed that the interaction of these multiphase fluids leads to large eddies, which are separated into smaller ones by interactions, developing turbulent flows.[1] It is vital for us to investigate the transition from laminar to turbulent flow in a relatively large diameter plasma which will be used for the purpose of plasma surface treatments in our studies.

Reynolds Number is one of the important dynamical parameters to describe transition from laminar flow to turbulent flow. To investigate its effect, various amounts of Argon mass flow rates are studied. Thermal effects are also important for turbulence development; therefore, the effect of the input microwave power on the flow is investigated by repeating the same measurements at different power settings up to 2 kV. A "Z-type" Schileren imaging is used for the investigation of turbulence under the influence of various Reynolds Numbers, and Microwave (MW) powers before and after the plasma ignition. In addition to the results on various neutral flow and plasma flow rates, dynamical instabilities initiated by the plasma ignition are also identified using a time resolved analysis.

1. M. Shigeta, J. Phys. D. Appl. Phys. **49**, (2016).