Optical emission and mass spectrometric characterization of an atmospheric microwave plasma jet

J. Lo[1], L. Chauvet[1], C. Muja[1], L. Latrasse[2], Ph. Guillot[1]

[1] *Laboratoire Diagnostics des Plasmas Hors Equilibre (DPHE), Université de Toulouse, INU Champollion, Albi, France*
[2] *SAIREM SA,Neyron, France*

In this work, characterization of a surface wave discharge (SWD) in argon at atmospheric pressure generated by a surfatron device was performed by optical emission spectroscopy (OES), iCCD imaging and Time-Of-Flight Mass Spectrometer (TOF MS). The objective is to determine the spatial distributions of different species and evaluate different ions (TOF MS) generated by the source for different operating conditions.

Increasing interest in cold atmospheric pressure plasma jets (APPJ) has been observed during the last decade. Their applications are largely investigated in various fields such as nanomaterial synthesis [1], decontamination and sterilization [2], cancer treatment [3] or analytical chemistry [4]. Their ability to propagate in open air and to allow the formation of a rich chemical environment populated by ions, radicals and excited species make them promising versatile tool.

In this work, the surfatron plasma source (S-wave) is a compact source designed for industrial and laboratory applications which operates at atmospheric pressure. The plasma is generated in a dielectric tube (4 mm internal diameter and 6 mm external diameter placed within the source) by a solid-state microwave generator (200 W, 2.45 GHz). The microwave electric field propagates longitudinally at the dielectric/plasma interface. Hence, a plasma column is created and sustained with lengths varying as a function of the operating gas flow, microwave power and gas nature. In our case, the discharge gas is Argon maintained at 1 sl/min. The S-Wave plasma source is inductively coupled, thus only two tuning adjustments are provided to match the impedance. During operation, 0 W of reflected power is achieved using the integrated tuners. The source can be efficiently applied to the production of reactive/excited species.

Resolved spatial optical emission distribution measurements were performed with an optical spectrometer (HR2000+, Ocean Optics) and with an iCCD camera (PIMAX-2K-RB, Pearson Instruments). The optical measurements were performed with an iCCD camera coupled with filters to observe the spatial distributions of the main species emissions (argon, oxygen, nitrogen). The influence of the power will be presented and discussed. The presence of the ions created by the jet will be investigated with a Time-Of-Flight Mass Spectrometer (TOF MS).

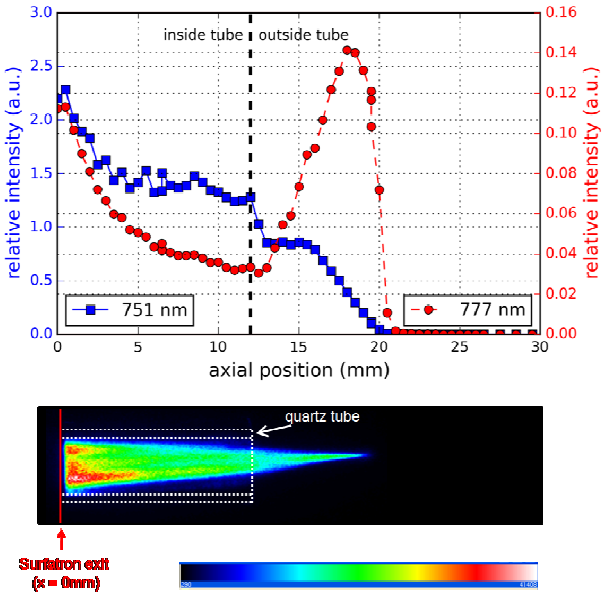

Figure 1: Intensities of argon (751 nm) and oxygen (777 nm) optical emissions as a function of axial position associated with iCCD camera imaging at 100 W power input, 1 sl/min argon.

References

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