Study of filamentation phenomenon in an atmospheric pressure microwave plasma jet.

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The TIA (Torche à Injection Axiale) is a microwave plasma torch that generates microwave plasmas at atmospheric pressure in ambient air over a wide input power range (220 W to 1000 W). It is suitable for various applications including atmospheric pressure plasma enhanced chemical vapour deposition (AP-PECVD) processes [1]. In the present study, the TIA is employed for the deposition of titanium oxide thin films (TiO2) from titanium tetraisopropoxide (TTIP) vapor and argon as plasma gas for photovoltaic and photocatalytic applications [2-3]. It has been shown that the microstructure of the thin films depends not only on operating conditions, but also on the nature of the substrate and on its position along the discharge axis.

The plasma jet is described as being cone-like [4]. The lateral and radial profiles of the plasma parameters obtained by optical emission spectroscopy (OES) present off-axis maxima close to the nozzle and becomes Gaussian-like as we move away from the nozzle. This can be attributed to a filamentation phenomenon which occurs in the plasma as a result of the skin effect of the microwave field in the plasma [5].

The study of the plasma by fast camera imaging (at a record rate of 10 000 fps and exposure time of 100 µs) reveals that the filamentation phenomenon depends not only on the operating conditions but also on the presence and nature of a substrate. The number of filaments observed increases as the substrate is moved closer to the nozzle. It also modifies the diameter and light intensity of the plasma.

References

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