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Simulation and measurements of ozone production in a multi pins to plane corona discharge reactor

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Key words: corona discharges, ozone, electro-hydrodynamics, atmospheric-pressure plasma, absorption measurements

This work presents a simulation of ozone production in a multi pins to plane atmospheric pressure corona reactor. When a positive DC voltage is applied to the pins, mono-filamentary discharges are generated between each pin and the common grounded plane electrode, with a mean natural repetition frequency of 10 kHz in ambient air.

The simulation of this reactor is particularly tricky, due to large differences:

- in the temporal scales, as each discharge phase lasts typically 150 ns and is followed by a long post discharge phase of about 0.1 ms during which convection and diffusion processes begin to operate, coupled with chemistry;
- in the spatial scales, the discharge diameter being typically of 50 μm while the reactor length is 8 cm.

A 2D model taking into account the spatio-temporal generation of primary radicals (N and O atoms) and the heat deposition in each discharge channel is presented and the behavior of the whole reactor described. In previous publications [1-2], the results corresponding to the first 0.1 s of simulation were presented. Parallelization of the code allowed us to here extend the simulation up to 30 s of activation of the pins, corresponding to $3 \cdot 10^5$ discharge / post discharge successive cycles. Calculated ozone densities are also compared with measured concentrations obtained by UV-C absorption, showing only a qualitative agreement.

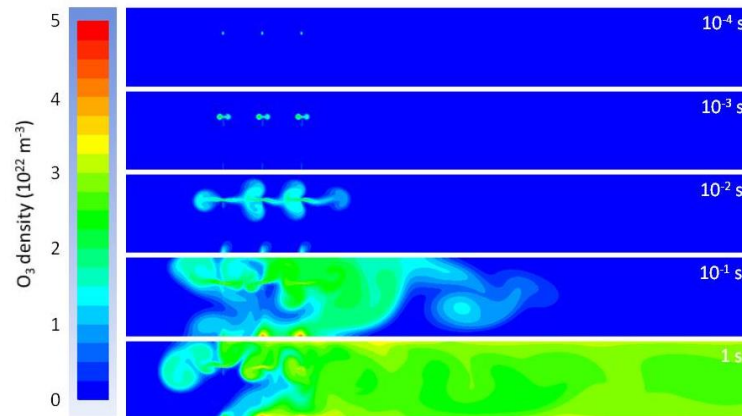


Figure 1 : Spatio-temporal distribution of ozone concentration in the corona reactor (3 pins activated).

Air flows in the reactor from left to right at 15 cm/s.

References

- [1] Meziane M., Eichwald O., Sarrette J.P., Ducasse O., Yousfi M., Marchal F, J. Appl. Phys. (2013), **113**, 153302.
- [2] Sarrette J.P., Eichwald O., Marchal F., Ducasse O., Yousfi M., Plasma Sci. Technol. (2016), **18**, 469.

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