

INFLUENCE OF ADSORBENT MATERIALS ON STREAMERS PROPAGATION IN AIR AND INDUCED CHEMICAL EFFICIENCY

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Abstract. Atmospheric pressure plasmas are now used in many different applications from odor treatment to biomedicine as well as surface functionalization or molecules synthesis. Dielectric barrier discharge (DBD) is a widely used source for this application because of safety reasons, low energetic cost, and randomly distributed treatment over the whole reactor volume (Kogelschatz 2003, Kim 2004, Roth et al. 1998, Guaitella et al. 2008).

DBD used for air treatment of volatile organic compounds (VOC) produce filamentary plasmas which have to be combined with porous catalytic surfaces. Filaments have then to ramp in contact with a complex dielectric surface, or even go through small diameter holes which could constraint the filaments. As a consequence, the breakdown, and the development of the filaments could be strongly modified by the surface, and the species adsorbed on it. The aim of this work is to discriminate in the plasma/catalyst coupling performed for VOC abatement in DBD, what is a consequence of surface chemistry on the adsorbent material from what is due to modifications of filaments behavior. The same dielectric surfaces (pyrex, quartz, TiO₂ and Al₂O₃) are then used in different experimental setups. A classical study on VOC removal is first performed downstream a DBD with or without catalyst. These results are compared to surface chemistry directly measured onto the surfaces by DRIFT method. Then, the physical properties of filaments generated on the same surfaces are analyzed with three different experiments. A double electrode surface DBD discharge allows studying the influence of photo-desorption of charges stored onto the surface on the filament breakdown. Then the dynamic of charge deposition is obtained by electrical measurement on a devoted multiple ground electrodes reactor. Finally, the velocity and electric field are measured for air streamers forced to propagate inside capillary tube.

All these experiments performed with the same dielectric materials, give a new insight on the main role played by the dielectric in the development and the chemical efficiency of streamers ignited in DBD for air treatment.

References

- Guaitella, O., Thevenet, F., Puzenat, E., Guillard, C., Rousseau, A.: 2008, *Applied Catalysis B: Environmental*, **80**, 296–305.
- Kim, H.-H.: 2004, *Plasma Processes Polym.*, **1**(2): p. 91-110.
- Kogelschatz, U.: 2003, *Plasma Chemistry and Plasma Processing*, **23**(1), p. 1-46.
- Roth, J. R., Sherman, D. M. and Wilkinson, S. P.: 1998, in *36th AIAA Aerospace Sciences Meeting & Exhibit.*, AIAA 98-0328: Reno, Nevada. p. 0328.