From streamers to long lived species: dynamics of a surface barrier discharge

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In recent years, applications based on Surface Barrier Discharges (SBDs) have increased significantly. SBDs in such applications serve as a simple and low cost source of reactive chemical species under ambient conditions (atmospheric pressure and room temperature). Examples of applications where this type of discharges is being used include CO_2 conversion, pollution abatement in water, and microbial decontamination [1]. Critically, in the SBD configuration, reactive species are not only generated, but transported beyond the discharge region through an induced flow of the background gas caused by Electrohydrodynamic (EHD) forces generated by the plasma [2]. For any given application it is necessary to understand the spatial distribution of the generated reactive species, which is a challenging task as the chemistry of the discharge is influenced by its induced flow [2]. In this work, a 2D multiscale experimentally-validated numerical model is used to identify the distribution of reactive species in space and time. The physics described by the model is verified through comparison with flow pattern measured using Particle Image Velocimetry (PIV). While the chemistry described in the model is verified by comparison of calculated densities of species to measured densities using Laser Induced Fluoresce (LIF) and Fourier Transform Infrared spectroscopy (FTIR). The comparison shows close agreement over a range of conditions and that the distribution of NO produced by the discharge is confined to the induced flow region above SBD. While this is not the case for several other species.

References

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