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MODELING OF A DIELECTRIC BARRIER DISCHARGE USED AS A FLOWING CHEMICAL REACTOR

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Abstract. The non-thermal character of atmospheric pressure dielectric barrier discharges (DBDs) is one of their main advantages. The fact that they can operate at room temperature while the electrons are still highly energetic enables chemical reactions that thermodynamically would not occur at such low gas temperatures and it makes DBDs efficient plasma-chemical reactors.

Our aim is to develop and optimize a model for a dielectric barrier discharge used as a chemical reactor for gas treatment. In order to determine the optimum operating conditions, we have studied the influence of the gas flow rate, reactor geometry and applied voltage parameters on the discharge characteristics.

For this purpose, a two-dimensional time-dependent fluid model for an atmospheric pressure DBD, as a part of the PLASIMO code (see http://plasimo.phys.tue.nl), has been applied. It is based on the continuity and flux equations for each type of particles treated, the electron energy equation and the Poisson equation. The gas flow is incorporated in the conservation equations as a source term. The set of coupled partial differential equations is solved by the so-called modified strongly implicit method. The background gas flow is numerically treated separately, assuming in the model that there is no influence of the plasma on the flow. Indeed, the gas convection velocity is calculated using the commercial code FLUENT (see http://www.fluent.com) and it is used as input into the 2D fluid model. Details of the model can be found in e.g. Brok et al. 2003, Broks at al. 2005.

The numerical model has been applied to the atmospheric pressure DBD in helium with nitrogen impurities, in a cylindrical geometry. The plasma characteristics have been studied in terms of gas flow rate, applied voltage amplitude and frequency, and geometrical effects. The electric currents and the gap voltage as a function of time for a given applied potential have been obtained, as well as the number densities of plasma species.

References

Brok, W. J. M., van Dijk, J., Bowden, M. D., van der Mullen, J. J. A. M. and Kroesen G. M. W.: 2003, *J. Phys. D: Appl. Phys.*, **36**, 1967.

Broks, B. H. P., Brok, W. J. M., Remy, J., van der Mullen, J. J. A. M., Benidar, A., Biennier, L. and Salama F.: 2005, *Phys. Rev. E*, **71**, (3), 036409.