Time-resolved electric field study of an impulse dielectric barrier discharge, in pure ammonia gas by means of induced second harmonic generation

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The aim of this study is to characterize the axial electric field strength that develops in an **impulse dielectric-barrier discharge (iDBD) in pure ammonia**, using the electric-field induced second harmonic generation (E-FISH) diagnostic. A fine management of a conventional Nd:YAG nanosecond laser allows a spatial resolution of **70 µm**, a time resolution of **2 ns** and a sensitivity of about **100 V.cm^{-1}**, matching the **millimetric and nanosecond scales** of the discharge. Indeed, the latter is driven by a 250 µs-periodic symmetrical applied voltage, inducing a discharge only during the transient regime (< 1µs) thanks to planar and symmetrical dielectrics. The time-evolution of the axial electric field in discharge has been studied over three sets of experimental parameters: the applied voltage, the gas pressure, and the gap where occurs the plasma discharges. On the one hand, compared to the E-FISH measurements in a non-breakdown condition (*i.e.* without discharge), those with plasma unveil a **counter-field (E_{cf})** whose variations oppose the electric field resulting from the applied voltage to the electrodes, **regardless of the experimental condition studied**. This counter-field results from **surface charged species accumulation** on the dielectric plate arising after the previous discharge. On the other hand, the axial electric-field measured in the gap midway depicts several trend according to the studied conditions. Finally, the next step would be to study the time-evolution of the axial electric field across the gap, since the issue of residual bulk charges remain [1]. Overall, these results are a first step of understanding the physics of such an iDBD, particularly in pure ammonia, throughout the E-FISH diagnostic.

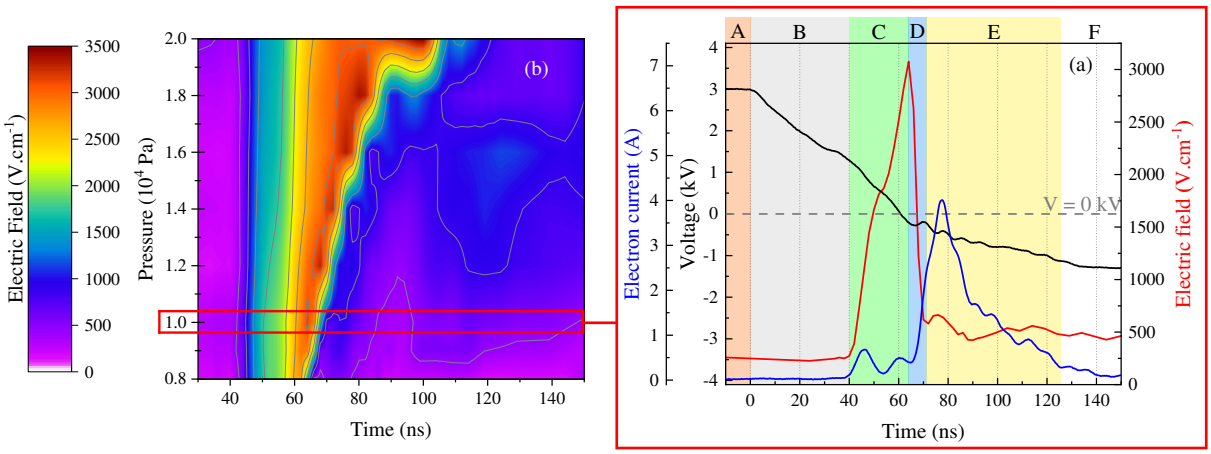

Figure 1. (a) Cartography over time and gas pressure, from 0.8 to 2.0 × 10^4 Pa, during the positive to the negative transient polarisation of upper electrode. (b) Focus of the electric field (red curve) and electrical (black and blue curves indicating respectively applied voltage and current variations) measurements for the 10^4 Pa gas pressure condition. Pure ammonia, applied voltage 6 kV_{pp} and gap 3 mm.

[1] F. Massines, *et al.*, EPJ Appl. Phys. **47** (2009) 2

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