Dielectric barrier discharges

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DIELECTIC BARRIER DISCHARGES: FROM SPATIALLY RESOLVED ELECTRICAL MEASUREMENTS TO A RECONFIGURABLE ELECTRODE

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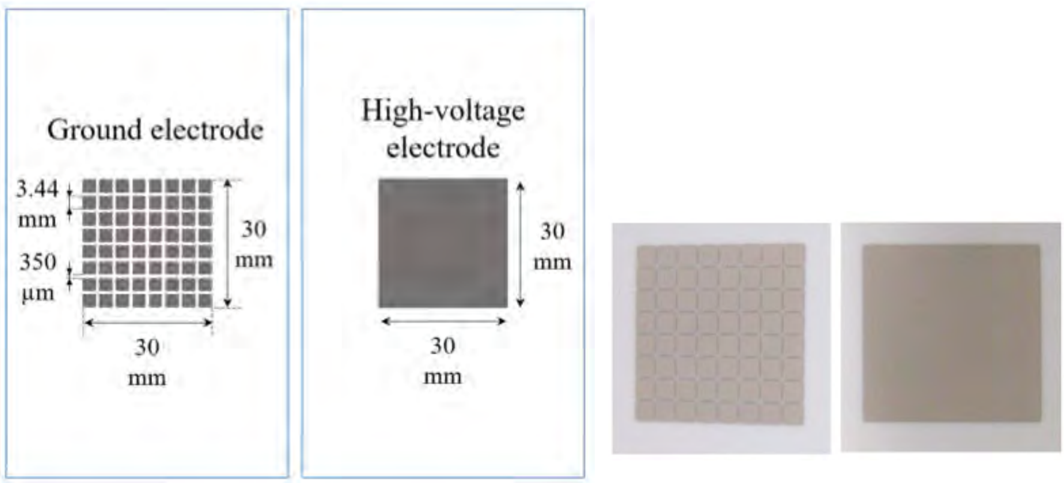
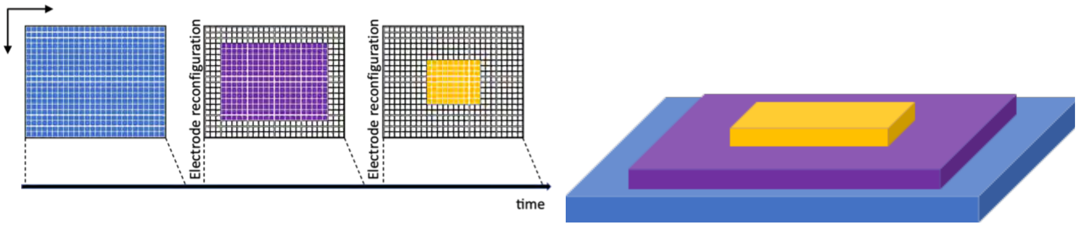
Dielectric Barrier Discharges (DBDs) can be used in many processes such as thin-film coating, sterilisation, treatment of gases, aerodynamic flow control, and lighting devices [1]. Depending on the gas, electrical operation parameters and discharge geometry, the plasma operates in the classical filamentary mode or a homogeneous regime [2]. Therefore, electrical measurements are more convenient than optical measurements to characterise the discharge regime and study the discharge behaviour. However, because of the dielectric presence, it is not possible to directly measure the electrical parameters of the discharge. Usually, the electrical parameters of the discharge (discharge current and gap voltage) are calculated from the measured quantities with the usage of an electrical equivalent circuit [4]. The key parameter for this approach is the discharge area, which is usually considered equal to the electrode surface as long as the discharge is homogeneous. However, even if the plasma seems to cover the electrodes uniformly, its electrical properties (current density, breakdown voltage, duration of discharge, …) are not precisely the same at any time and any point on the surface. To characterise the discharge behaviour more accurately, we developed an innovative electrical measurement allowing us to obtain a 2D mapping of the local current density [5]. The ground electrode is prepared as a segmented electrode with 64 equally spaced square segments. The high voltage electrode still remained full (figure 1). This system has been successfully used to study the memory effect responsible for the Townsend breakdown in the presence of oxidising species (N_2+O_2, N_2+N_2O, N_2+NO) [6]. This electrode arrangement coupled with the measuring system allow a 2D mapping of the discharge electrical parameters (discharge current, power dissipated, gap voltage, etc.) of Townsend but also for Glow discharges, hybrid or patterned regimes.



(a) (b)

Fig. 1: Diagram (a) and photograph (b) of the segmented electrode and the high-voltage electrode

For now, this system has been used only to study discharge physics. However, it could also be used for plasma processes. Indeed, for a surface coating process, this system can be used to monitor the evolution of the local discharge power, which defines the local deposition rate. Using this segmented electrode as the high voltage electrode with a dedicated power supply, we could reconfigure the electrode and the power transfer to the discharge. Then this system could be used to realise patterns. This opens up new directions, which will be discussed during the presentation.



(a) (b)

Fig. 2: (a) Illustration of the reconfigurable electrode concept, (b) Illustration of a pattern coating

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