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Time–space behaviour of barrier discharge ionization front in presence of 3D textured dielectric layer

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Atmospheric-pressure plasma represents particularly suitable technology for treating textiles. Nonetheless, fiber-based materials raise specific issues related to their surface processing, especially for woven materials, due to their particular 3D nature. In this respect, we are exploring the relation between the 3D structural characteristics of woven samples, the plasma parameters during sample exposure and the time–space evolution of the discharge, aiming to establish the role of the heterogeneous nature of the permeable samples, working as supplementary dielectric layer, in controlling the discharge, and thus the plasma processing efficiency. It results that such structures shift the behavior of the discharge and the plasma parameters, depending on the 3D characteristics.

1. Introduction

Woven materials are heterogeneous structures, from mechanical, electrical and chemical point of view, and may shift the behavior of the discharge and the plasma parameters during processing, depending on their 3D characteristics. Taking this into account, we are exploring the relation between the woven structural characteristics, the plasma electrical parameters during sample exposure and the time–space evolution of the discharge.

2. Experimental

The plasma is produced using DBD, in asymmetrical electrode arrangement [1]. The discharge is generated using positive voltage pulses with 5 kV amplitude, 5 kHz frequency, 100 μs width. The DBD parameters are established by electrical measurement. Then, a fast imaging technique using an ICCD was employed to complete the information on the plasma parameters and the time–space behavior of the ionization front.

3. Results and discussion

The voltage and current waveforms show two temporally distinct discharges, so-called primary and secondary discharge, respectively, associated to the HV rising and falling slope.

The current profile for the primary discharge, which ignites due to the externally applied electric field, is different in presence of different samples (Fig. 1), whereas the current profile for the secondary discharge, igniting by the so-called "memory effect", due to the charge deposited on the dielectric surface during the primary discharge, is similar for all samples.

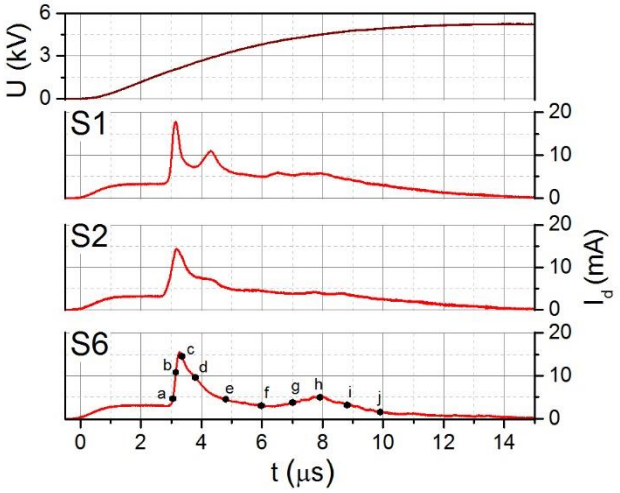

Fig. 1. Current waveforms in presence various fabrics during the HV rising slope.

The amplitude of the current pulse and the discharge energy vary for different samples, resulting that the aspects related to the permeability of the structure, due to its weaving characteristics, play the major role in the behavior of the discharge.

The total light intensity shows different distribution of the discharge regions, for the primary and the secondary discharge.

4. Acknowledgement

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5. References

[1] G.B. Rusu, I. Topala, C. Borcia, N. Dumitrascu, G. Borcia, Plasma Chem. Plasma Process. **36** (2016) 341-354.