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ADVANCES IN OPTICAL DIAGNOSTICS OF ATMOSPHERIC PRESSURE DIELECTRIC BARRIER DISCHARGES

G. DILECCE, P. F. AMBRICO and S. DE BENEDICTIS
Istituto di Metodologie Inorganiche e dei Plasmi CNR, sede di Bari - Via Orabona 4, 70125 Bari, Italy
E–mail: giorgio.dilecce@ba.imip.cnr.it

Abstract. Dielectric barrier discharges at atmospheric pressure have recently received a growing interest because of their potentially advantageous use in a number of applicative fields, in both their main classes of "volume" and "surface" geometric arrangements. The possibility of obtaining a uniform, or glow, regime, in contrast to the usual filamentary one, has further enlarged their perspectives for surface treatments applications. From a diagnostic point of view, the high pressure regime adds problems relevant to an enhanced role of collision quenching, vibrational and rotational relaxation, while maintaining most of the demands of a highly non-equilibrium system for a detailed characterization of its degrees of freedom. In addition, filamentary DBDs are intrinsically pulsed systems, in which the electron impact excitation is confined in small space regions and very short time intervals, such that a prominent afterglow phase, both spatial and temporal, is present in the discharge volume, and kinetic processes involving long-lived species, chemi- luminescent reactions, recombinations (aided by the large pressure) can competitively come into play in the excitation of electronic states. We have applied our ensemble of diagnostic methods, based on time resolved emission and laser spectroscopy, to the investigation of elementary kinetics in DBDs. Here we present our last two years results that include: Optical-Optical Double Resonance (OODR)-LIF measurements of $N_2(A^3\Sigma_u^+)$ density, in a volume DBD that is of relevance in the debate upon the mechanisms for establishing the glow regime (Dilecce 2007); OODR-LIF and emission study on a Masuda type surface discharge (Ambrico 2008); measurement of $N_2(C^3\Pi_u, v)$ quenching and vibrational relaxation rate constants and its relevance to nitrogen Second Positive System emission diagnostics at atmospheric pressure (Dilecce 2006, 2007); kinetics of $CN(B^2\Sigma^+, v)$ formation and violet system emission in N_2-CH_4 discharges. The latter issue shows in addition a correlation between emissions and surface status (i.e. the presence of a deposit) that is a clear monitor of a gas surface interplay.

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