

Laser Diagnostics of Electrical Discharges in Nitrogen and Air-Nitrogen Mixtures: Advances and Challenges

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Recent advancements in laser-based diagnostics have significantly enhanced our understanding of the physicochemical processes governing non-thermal plasma discharges in nitrogen and air-nitrogen mixtures. This invited talk will present key results obtained using Laser-Induced Fluorescence (LIF) and Optical-Optical Double Resonance (OODR-LIF), with a focus on the characterization of metastable species such as $N_2(A^3\Sigma^+_u)$ and NO, and on the spatiotemporal evolution of the electric field during discharge development through EFISH. Particular emphasis will be placed on recent investigations of nanosecond pulsed dielectric barrier discharges (ns-DBDs) in humid air, where time-resolved electric field measurements and emission imaging have revealed the dynamics of breakdown formation in plane-to-plane geometries. These studies highlight the influence of humidity, pre-ionization, and field distribution on streamer initiation and propagation, offering new insights into the early stages of discharge formation. Beyond advancing diagnostic capabilities, these results provide a robust experimental foundation for validating kinetic models and optimizing plasma-based technologies in real-world applications.