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Electric Pulse Parameter and Electrode Geometry Impact on Plasma Formation

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Mutliple theoretical and experimental studies have investigated the species generation„ ignition, flame stability, and combustion enhancement due to nanosecond electric pulses (NSEPs) for potential applications in plasma assisted combustion (PAC) and ignition (PAI) [1,2] . While many experiments use standard pulse generators with fixed pulse duration, rise- and fall-times, and peak voltage, parameter modification may enhance flexibility by facilitating control of species or discharge characteristics (e.g. glow vs. arc). Here, we explore the impact of NSEPs on species generation and discharge evolution with various electric fields and pulse durations from 10ns to 50ns. We present optical emission spectroscopy (OES) results of species generation and images demonstrating discharge formation and evolution under various NSEP conditions. Furthermore, novel electrode geometries may induce nonuniform electric fields to possibly facilitate the generation of cold plasmas at high pressures and create other species useful for PAC and PAI. Mathematical models of the electric fields for various geometries will enable comparison to the more homogeneous electric fields of conventional geometries and provide inputs for future modeling of species generation as a function of pulse parameters and electrode geometries for future PAC and PAI experiments. We will present OES and imaging of the discharges with various electrode geometries and compare these results to electric field models to assess the impact of nonuniform electric fields on performance. The potential implications for PAC and PAI and future work for system development and design will be discussed.

1. A. Starikovskiy and N. Aleksandrov, "Plasma-assisted ignition and combustion,"Prog. Energy Combsut. Sci., vol. 39, pp. 61-110, 2013.

2. Y. Lu and W. Sun, "Plasma assisted combustion: Dynamics and chemistry,"Prog. Energy Combust. Sci., vol. 48, pp. 21-83, 2015.

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