DBD plasma assisted combustion for 1D flat flame

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The potential use of non-equilibrium plasma for ignition and combustion control has garnered increasing interest due to the possibility of plasma-assisted approaches for ignition and flame stabilization. During the past decade, significant progress has been made toward understanding the mechanisms of plasma–chemistry interactions, energy redistribution and the non-equilibrium initiation of combustion. The main ideas are the possibility to apply electric fields for stabilization of the flames, reducing soot formation, increasing flame velocity, extending flammability limits.

Two burner head designs will be examined to study the effect of the plasma location on the flame characteristics at the same operating conditions.

1- Micro-hollow plasma discharge, figure (2).
2- Surface plasma discharge, figure (3).

Experimental setup

1D flat flame experimental setup is considered in this study for better understanding of the flame behavior under plasma condition as well as validation of the plasma/flame simulation results. The schematic of the experimental setup is shown in figure (1), consisting of two parts; the plenum chamber(bottom) and burner head (top). The goal of this setup is to create a uniform flow toward the burner head to ensure 1D flat flame configuration.

Numerical study

One dimensional Plasma-flame interaction with reduced chemistry using COMSOL software for single hole (0.5mm diameter) to study the effect of the non-equilibrium plasma on the emission, temperature and flame stabilization.

Fig.1. Schematic of the experimental setup
Fig.2. Micro-holes plasma discharge
Fig.3. Surface plasma discharge