



THE USE OF GAS DISCHARGE PLASMAS TO CONTROL COMBUSTION AND AERODYNAMIC FLOWS

Prof. Mark A. Cappelli, Stanford University

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Abstract

There is emerging interest in plasma sources to ignite, stabilize, and enhance combustion under adverse conditions. In this seminar, recent studies will be described, where repetitive, short-pulse discharges are used to control lift-off in strongly ventilated partially-premixed flames. When located where the local mixture is on the lean side of the stoichiometric value, flame anchoring is achieved for flow velocities that exceed twenty times the stoichiometric laminar flame speed. Also described are experiments in fully premixed flows, where combustion is sustained well below the lean flammability limit. The mechanism for flame stability is the indirect coupling of the flame chemistry with the plasma through the formation of relatively stable intermediates such as CO and H₂. Detailed simulations are carried out of the discharge kinetics. These Discharges are also being used to control aerodynamic flows and dielectric barrier discharges are a favored flow actuator. DBDs generate wall jets (forcing) of velocities as high as 30 m/s which can be used to control/delay separation for drag reduction and lift enhancement. These relatively low velocities make control of high speed flow difficult. However, with appropriate actuator configurations, forcing can generate strong suction that sweeps high speed flow into the low speed boundary layers.

About the Speaker: Mark Cappelli is a Professor in the Mechanical Engineering Dept. at Stanford Univ. He received his B.Sc. in Physics at McGill University, and M.A.Sc. and Ph.D. in Aerospace Science at the Univ. of Toronto where he studied formation of dense plasma channels using laser resonance saturation. His research spans a wide range of plasma science, including plasmas in materials synthesis and processing, propulsion, acceleration of ions, microplasma physics, plasma assisted combustion, and plasma assisted flow control. Many of his studies deal with advancing non-intrusive laser and optical diagnostics.