Michigan Institute for Plasma Science and Engineering

NANOSECOND PULSE NONEQUILIBRIUM DISCHARGES FOR HIGH-SPEED FLOW CONTROL AND PLASMA ASSISTED COMBUSTION

Prof. Igor Adamovich

Ohio State University

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Abstract

Recent experiments with repetitive nanosecond pulse discharges (RNSPD) show their potential for engineering applications such as plasma assisted combustion, high-speed flow control, and sustaining nonequlibrium hypersonic flows. The main advantage of using RNSPD for ignition is efficient generation of electronically excited and radical species, such as O, H and OH. Time-resolved temperature, radical densities, and ignition delay time are measured in premixed ethylene-air and H_2-air flows excited by RNSPD and compared with kinetic modeling. The results show that ignition in a uniform plasma occurs in a large volume, due to generation of radical species in the discharge. The main advantage of using RNSPD for high-speed flow control is rapid localized flow heating which produces repetitive compression waves, generating coherent structures (spanwise vortices) in the flow. Shlieren and PIV measurements show that this effect is purely thermal and entirely different from flow entrainment by ions in conventional DBD plasma actuators. The coherent structures transfer momentum from the freestream to the boundary layer and prevent its separation at Mach numbers up to at least M=0.3 and Reynolds numbers of $Re{\sim}10^6$.

About the Speaker: **Dr. Adamovich is a Professor in the Dept. of Mechanical and Aerospace Engineering at the Ohio State Univ. He received an M.S. in Mechanical and Aerospace Engineering from Moscow Institute of Physics and Technology and a Ph.D. in Chemical Physics from OSU. His research interests include kinetics of gases and plasmas at extreme nonequilibrium, molecular energy transfer, high-speed nonequilibrium flows, plasma-assisted combustion, plasma flow control, and gas lasers. He has coauthored over 300 publications and is an Associate Fellow of the AIAA.**