Abstract Submitted
for the GEC06 Meeting of
The American Physical Society

Simulations of nitrogen glow discharge phenomena for high-speed flow control THOMAS DECONINCK, SHANKAR MAHADEVAN, LAXMINARAYAN RAJA, University of Texas at Austin — Plasma actuators offer a promising opportunity for high-speed flow control applications. The forcing of the flow occurs through three primary mechanisms: electrohydrodynamic forcing or ion drag, dilatation effects related to gas heating, and magnetohydrodynamic forcing in the presence of magnetic fields. In order to gain a physical understanding of these factors, we developped a detailed computational model for the plasma and bulk flow. The model is based on a two-dimensional, self-consistent, multi-species continuum description of the plasma. We use a two-temperature chemical kinetics model that includes the following species: e^-, N_2^+, N^+, N, and N_2. In this work, a surface plasma actuator with two bare-electrodes on a single plane is considered. The imposed background flow-field simulates a boundary layer with an external velocity of 700 m/s. Results include maps of charge density, temperature and electric potential profiles. For a pressure of 5 Torr and an applied voltage of 2500 V, the sheath region in front of the cathode is about 5 mm thick. The peak electron number density reaches ∼1e16 mˆ(-3) in the bulk plasma. The number density of N_2^+ is found to be dominant in the discharge, about two orders of magnitude higher than that of N^+. Relative contributions of the body forces will be explored for different operating conditions.

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Date submitted: 19 Jun 2006 Electronic form version 1.4