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Electrode Polarity Effects in Direct Current Glow Discharges for Supersonic Flow Control SHANKAR MAHADEVAN, LAXMINARAYAN RAJA, The University of Texas at Austin — Computational simulations of air glow discharge plasma in the presence of supersonic flow are presented. The glow discharge model is based on a self-consistent, multi-species, continuum description of the plasma. A finite-rate air chemistry model with 11 species is validated against experiments from the literature at p=600 mTorr. The validated air plasma model is then used to study the effect of the surface plasma on M=3 supersonic flow at freestream pressure 18 Torr and the corresponding effects of the flow on the discharge structure. The Navier-Stokes equations are solved on the entire computational domain, and the plasma equations are solved on a smaller subdomain consistent with the typical length-scale of the glow discharge. Results indicate that O^- can have comparable concentrations to electrons in the pressure range 1-20 Torr. The peak gas temperature from the computations is found to be 1420 K with the surface plasma alone, and 1180 K in the presence of supersonic flow with the cathode located upstream with respect to the flow direction. The effect of placing the cathode downstream with respect to the flow direction is investigated. For the case studied in this work the primary effect of the plasma on the supersonic flow is volumetric heating.

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