Abstract Submitted
for the GEC09 Meeting of
The American Physical Society

Numerical and Experimental Investigations of Plasma Actuators Based on Magnetogasdynamics CHIRANJEEV KALRA, SOHAIL ZAIDI, MIKHAIL SHNEIDER, RICHARD MILES, Princeton University — Numerical and experimental studies were conducted of magnetically driven DC surface plasma discharges. Their application to supersonic boundary layer control is investigated, specifically the shockwave-turbulent boundary layer interaction problem and the induced separation control is shown. This interaction causes incoming boundary layer thickening and localized pressure loads and high heating rates. In the case of scramjet engine inlet this results in reduced effective cross-section and loss of thrust and efficiency. Magnetogasdynamic flow control is achieved by generating a plasma column close to the wall in boundary layer and dragging the gas close to the wall using Lorentz force due to perpendicular (to flow direction as well as current) magnetic field. The surface plasma column appears as a transverse "arc" between two slightly diverging electrodes which is driven by j x B forces so that it sweeps the gas near the surface in the separated region or the recirculation zone, either in the downstream direction or in the upstream direction. Depending on the direction of Lorentz force, separation bubble is either induced in the boundary layer or the shockwave induced bubble is reduced in intensity and probably eliminated. It is shown that these interactions between the plasma and the recirculation zone are non-thermal in nature.

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Date submitted: 12 Jun 2009 Electronic form version 1.4