

Boundary layer control using surface discharges

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Effective power source for local boundary layer control is problem of plasma aerodynamics, treated in recent years. Different types of electric discharges were proposed as efficient sources of energy supply in local boundary layer area - compression wave area, duct inlets and others. In present work two types of surface discharges are tested for boundary layer control purposes. Investigations of local energy deposition were conducted. Nanosecond pulse surface discharge ("plasma sheet") efficiency and flow control mechanism are compared to those of HF barrier discharge. Plasma sheet can be used for creation of nonequilibrium energy deposition area in thin layer near wall. Pulse-periodic energy supply in boundary layer including shock wave interference area using plasma sheet is one of the effective ways to correct the flow [Aulchenko et al. 2009]. Due to discharge self-localization effect, it is possible to vary the energy deposition zone. Basing on this effect it was possible to achieve high surface energy deposition rate per surface unit and to control flow through changing shock wave location in transonic and supersonic flow. In the HF barrier discharge a directed gas flow appears, which forms a turbulent boundary layer (Fig.1). As the experiments show [Penyazkov O.G. et al. 2008] the use of high frequency surface barrier discharge allows achieving profile drag coefficient decrease on 3 – 7 % in velocity range of incident flow up to 10 m/sec. The discharge is bound inflexibly to the electrodes and is not blown out by incident flow with velocity up to 60 m/sec.

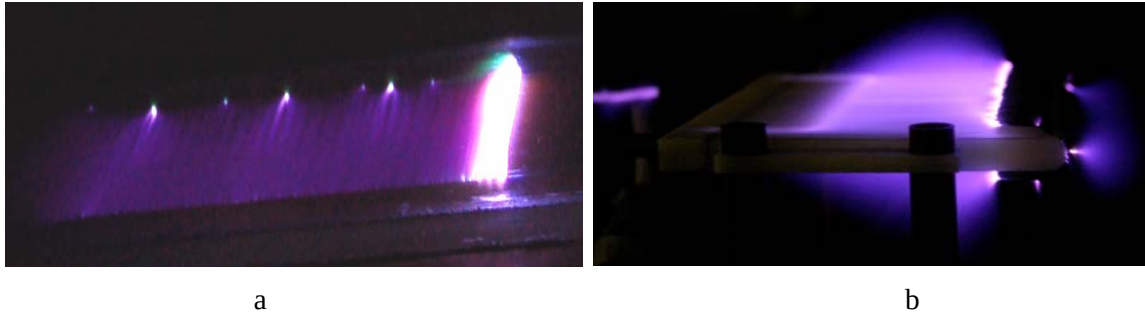


Figure1. a. Near wall shock interaction with surface pulse discharge. b. Plasma luminescence on a surface of a dielectric plate close multi-edged electrode.

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References

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