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Parametric Investigation of Nanosecond Pulse Driven Dielectric Barrier Discharge Plasma Actuators for Aerodynamic Flow Control
ROBERT DAWSON, JESSE LITTLE, University of Arizona — Nanosecond pulse driven dielectric barrier discharge plasma actuators are studied experimentally in quiescent atmosphere. Per unit length peak energy and instantaneous peak power are calculated using simultaneous voltage and current measurements. Electrical characteristics are evaluated as a function of peak voltage, pulse frequency, discharge length and dielectric thickness. Schlieren imaging of compression waves is used to provide a relative measure of discharge energy that is coupled to the near surface gas as heat for the same parameters. Characteristics of the DBD load have a substantial effect on voltage and current traces which are reflected in the peak energy and peak power. Both peak energy and compression wave strength depend primarily on dielectric thickness and secondarily on actuator length although this is not universal in the case of energy necessitating examination of alternative calculation strategies. Peak power is mainly dependent on actuator length which is inconsistent with schlieren data as expected. Higher pulse frequency produces higher pulse energy, but is primarily attributed to heating of the actuator and power supply components. This effect is mainly observed for short actuators. Pulse energy increases as peak voltage to the power 3.5. This behavior is similar to observations of energy and thrust for ac-DBD plasma actuators suggesting that aspects of lumped-element circuit models may be applicable for optimizing ns-DBD performance.

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