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Research of Airflow Control Using Surface Dielectric Barrier Discharge Plasma at Atmosphere Pressure

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This paper presents experiments carried out on atmospheric pressure surface dielectric barrier discharge plasma actuators. Two parts concerning these actuators are addressed in this work: First, the effect of a DC bias on the electrohydrodynamics force induced by the AC discharge actuator for airflow control is investigated. A special designed corona like discharge potential probe is used to measure the surface potential due to charge deposition at different DC biases. From the surface potential data, the plasma electromotive force is shown not affected much by the DC biases except for some reduction with negative DC bias near the exposed electrode edge for the sheath-like configuration. Meanwhile, the temporally averaged electric wind velocity, the mean thrust production and the schlieren visualization are measured. The results show the airflow and thrust force induced by the actuator can be influenced by DC bias. The direct thrust force is almost a linear relationship to the potential voltage at the exposed electrode edge; the velocity profiles with different DC biases are gradually diversified in the further downstream area as well as the upper space away from the discharge plasma area. In the second part of the paper, a new electrode configuration, i.e., a row of needle is taken as an exposed electrode for the plasma actuator, and the electrode height is adjustable. The different effects of the electrode height on the airflow acceleration behavior are experimentally investigated by measuring the same electrical and mechanical characteristics. It is demonstrated that the airflow velocity and thrust increase with the electrode height and the best actuator performance can be obtained when the exposed electrode is adjusted to an appropriate height. The difference, as analyzed, is mainly due to the distinct plasma spatial distributions.

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