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An Out-of-Plane Velocity Component in Dielectric Barrier Discharge Actuator Flow[1] JILLIAN R. KISER, KENNETH S. BREUER, Brown University — The performance of an array of two, two-dimensional dielectric barrier discharge actuators was studied, including both power dissipation measurements and flow visualization using stereo particle image velocimetry. The power dissipation over a range of operating conditions was characterized, showing a relationship between power dissipation, frequency, and voltage such that $P_{diss} \propto fV^{3.5}$. Additionally, the flow induced by plasma generation was measured in quiescent air using PIV, with the driving voltage and frequency being varied. Kinetic energy within a control volume was calculated to quantify the effect of each driving condition, both during the transient start-up flow (lasting up to 600 ms) and at steady state. The induced flow was found to have a non-negligible velocity component in the out-of-plane direction. This component of the kinetic energy, as compared with in-plane kinetic energy, is studied as a function of voltage, frequency, PIV particle size, and actuator design. Potential causes of this velocity component are discussed, considering both electrophoretic forces on the PIV particles, as well as the possibility that it is inherent to the plasma induced flow.

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