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High Mach Number Leading-edge Flow Separation Control using AC DBD Plasma Actuators[1] CHRISTOPHER KELLEY, PATRICK BOWLES, JOHN COONEY, CHUAN HE, THOMAS CORKE, University of Notre Dame, BRADLEY OSBORNE, JOSEPH SILKEY, JOSEPH ZEHNLE, The Boeing Company — Wind tunnel experiments were conducted to quantify the effectiveness of alternating current dielectric barrier discharge flow control actuators to suppress leading-edge stall on a NASA energy efficient transport airfoil at compressible freestream speeds. The objective of this research was to increase lift, reduce drag, and improve the stall characteristics of the supercritical airfoil near stall by flow reattachment at relatively high Mach and Reynolds numbers. In addition, the effect of unsteady (or duty cycle) operation on these aerodynamic quantities was also investigated. The experiments were conducted for a range of Mach numbers between 0.1 and 0.4. corresponding to a Reynolds number range of 560,000 through 2,260,000. Lift, drag, quarter chord moment, and suction side pressures were measured near stall for baseline, steady actuation, and a scan of nondimensional duty cycle frequencies. The results show that the plasma actuators were effective at reattaching the leading-edge separated flow as evidenced by the increase in maximum lift coefficient and stall angle (as much as 2.5 degrees). The experiment also showed that lift was increased the most when the plasma actuator was operated unsteady with a nondimensional frequency of unity.

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