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Plasma Roughness for Transition Control in a 3-D Supersonic Boundary Layer[1] CHAN-YONG SCHUELE, ERIC MATLIS, THOMAS CORKE, University of Notre Dame, STEPHEN WILKINSON, NASA Langley Research Center — The design and use of patterned "plasma roughness" for control of transition to turbulence of the boundary layer with a supersonic free-stream is presented. The plasma roughness consisted of an azimuthal array of 20 nm thick electrodes that were equally spaced around the cone tip, just upstream of Branch I for cross-flow instability growth. The electrodes were part of a DBD arrangement that produced an azimuthally periodic stationary body force that acted on the flow. The azimuthal spacing of the electrodes was designed to either enhance the most amplified stationary mode growth ($m = 45$ in this case), or to excite a sub-critical mode number ($m = 68$) that was designed to suppress the most amplified mode. The experiment was performed on a 14° right-circular cone placed at a 4.3° angle of attack in the NASA LaRC SLDT. Measurements consisted of azimuthal profiles of the total pressure just above the cone surface. These documented the mean flow distortion produced by the growing stationary cross-flow modes. Comparisons were made with and without the plasma roughness, as well as against passive patterned roughness with the same azimuthal mode numbers. The results indicated that the stationary cross-flow modes were receptive to the patterned plasma roughness, and that Re_{trans} was increased.

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