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Transition within a hypervelocity boundary layer on a 5-degree half-angle cone in freestream air/CO_2 mixtures JOSEPH JEWELL, California Institute of Technology, ROSS WAGNILD, Sandia National Laboratories, IVETT LEYVA, Air Force Research Laboratory, GRAHAM CANDLER, University of Minnesota, JOSEPH SHEPHERD, California Institute of Technology — The effect of freestream CO_2 content on transition in hypervelocity flow over a slender cone was investigated in experiments and computations. Experimental data were obtained in Caltech's T5 reflected shock tunnel. The model was a 5 degree half-angle sharp cone instrumented with thermocouples, providing heat transfer measurements from which transition locations were determined by comparison with laminar and turbulent heat flux correlations. Four carbon dioxide/air gas mixtures were tested at reservoir enthalpies from 7–10 MJ/kg and reservoir pressures from 55–60 MPa to attempt to reproduce the largest shift in transition location implied by computations using the semi-empirical e^N approach. By mass fraction of carbon dioxide these mixtures were 0.0 (e.g. all air), 0.5, 0.75, and 1.0. For tests at an enthalpy of ~9.2 MJ/kg, transition delays of up to 30% in terms of x-location, 38% in terms of edge Reynolds number, and 140% in terms of the Reynolds number evaluated at reference conditions were documented for increasing CO_2 mass fractions compared with similar experiments in air.

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