Abstract Submitted
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Development of a nanoscale hot-wire probe for supersonic flow applications[1] KATHERINE KOKMANIAN, Princeton University, SVEN SCHARNOWSKI, MATTHEW BROSS, CHRISTIAN J. KAEHLER, Bundeswehr University Munich, MARCUS HULTMARK, Princeton University — A new sensor based on the nanoscale thermal anemometry probe (NSTAP) was designed and fabricated in Princeton University's clean room to obtain well-resolved mass flux measurements in supersonic flows. In order to withstand high forces, the sensing element was redesigned to be 400 nm thick, 2 μm wide and 30 μm long. The sensor was tested in the Trisonic Wind Tunnel Munich (TWM) at Bundeswehr University. The TWM is a two-throat blowdown tunnel with a unique capability of altering both the Mach number and the Reynolds number independently and in real-time. Freestream measurements were taken at M=2 to investigate the convective heat transfer characteristics of the sensor. A linear calibration between the Nusselt number and the Reynolds number appeared to best fit the data. This linear Nu-Re dependence has previously been observed when operating hot-wires in free-molecule flows. Given the relatively large Knudsen numbers experienced by the sensing element (Kn>0.01 based on both width and thickness of sensing element), the sensor is believed to operate in slip flow conditions, exhibiting unique heat transfer characteristics. The importance of both the thickness and the width of the sensing element was also investigated theoretically for various Mach numbers.

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