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HEAT TRANSFER RATE OF GAS FLOW THROUGH A STAINLESS STEEL MICRO-TUBE WITH CONSTANT WALL TEMPERATURE

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Abstract

Total temperature of the nitrogen gas jet from the outlet of a micro-tube with constant wall temperature was measured to obtain the heat transfer rate of the micro-tube. The experiments were carried out with a stainless steel micro-tubes of 332 μm in diameter. The temperature difference between the inlet and the wall was maintained at 5K and 10 K by circulating water around the inlet tube and the micro-tube, respectively (Fig. 1). The stagnation pressure was selected in such a way that the flow ranges up to *Re*=12900 with the outlet flow discharged into the atmosphere. In order to measure the total temperature at the micro-tube outlet, a polystyrene tube with a thermally insulated exterior, containing six interior baffles, which reduces the gas velocity, and converts the kinetic energy into thermal energy, was attached to the micro-tube outlet. Heat transfer rates were obtained from the differences in gas enthalpies, determined by total temperatures and pressures measured at the inlet and outlet of the micro-tube. Heat transfer rates were also compared with those obtained from ideal gas enthalpies determined by only total temperatures (Fig. 2).

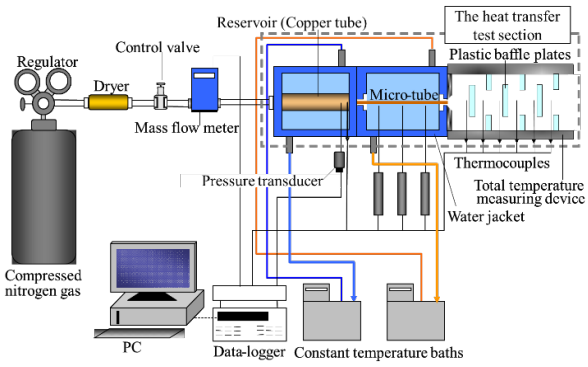

Fig. 1 Schematic of experimental setup

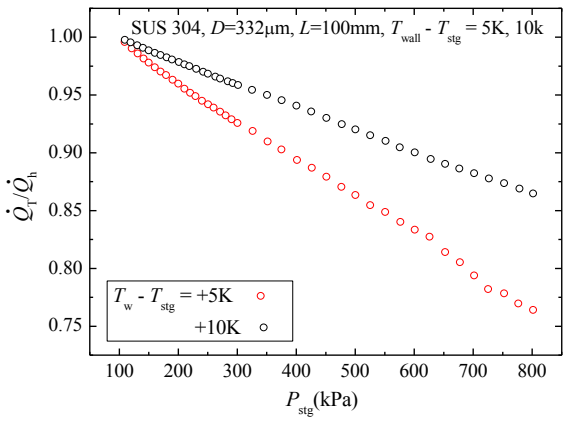

Fig. 2 Heat transfer rates as a function of p_{stg}