A FLOW CHARACTERISTICS OF TRANSITION REGION BETWEEN LAMINAR AND TURBULENT GAS FLOWS THROUGH MICRO-TUBES

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Abstract

Flow characteristics in the transition region between laminar and turbulent gas flows through micro-tubes were experimentally investigated. The experiments were performed for nitrogen gas flowing through two stainless steel micro-tubes of D = 124 and 162 μm and two fused silica micro-tubes of D = 100 and 151 μm (Fig. 1). The Mach numbers and gas bulk temperatures at the inlet and locations near the exit were also obtained by measuring stagnation temperatures, stagnation pressures, pressures at locations near exit and mass flow rates. The average Fanning friction factors also were obtained. The mass flow rate levels off in the transition flow region for micro-tubes as the stagnation pressure increases. The Mach number increases with an increasing Reynolds number in the laminar flow region. However Mach number decreases when Reynolds number goes higher in the transition flow region since the mass flow rate stays nearly constant with an increase of the stagnation pressure in the transition flow region. On the other hand, the bulk temperature increases in the transition flow region. This was validated by measuring wall temperature of micro-tubes whose outer walls are thermally insulated. The decrease in Mach number and the increase in the bulk temperatures in the transition flow region are the dominant scaling effect for the smallest diameter micro-tubes (Fig. 2).

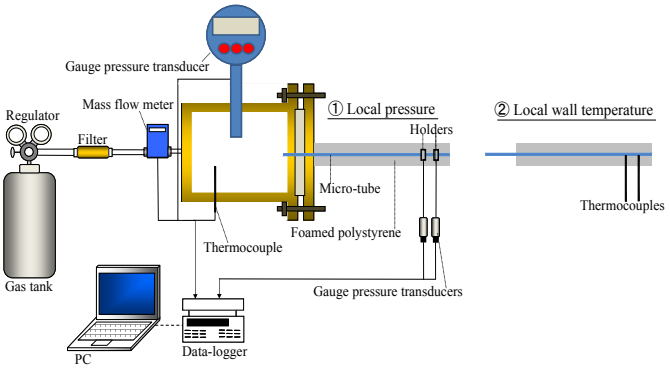

Fig. 1 Schematic of experimental setup

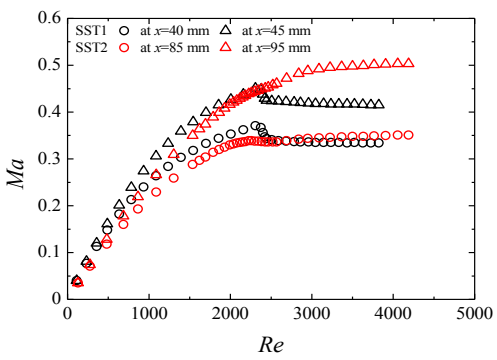

Fig. 2 Mach numbers vs *Re*

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