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GAS FLOW AND HEAT TRANSFER IN MICROCHANNELS

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ABSTRACT

In this paper experimental results of friction factor for gas flow through rectangular cross-section microchannels are presented. (100) and (110) silicon wafers were used to fabricate microchannels with smooth and rough surfaces, respectively. The instrumentation includes local pressure measurement along the microchannel length to determine the axial pressure profile. Sensors to directly measure the microchannel surface temperature are currently under development to enable calculation of the Nusselt number. The microchannels were etched into silicon wafers, capped with smooth glass, and have a range of hydraulic diameters, $4 < Dh < 100$ μm. All measurements were made in the laminar flow regime with Reynolds numbers in the range $0.1 < Re < 1000$. The results show close agreement between the measured friction factor and the theoretical friction factor for continuum flow. The effect of compressibility is observed as a mild (8%) increase in the friction factor as the Mach number approaches 0.35. A 50% decrease in the friction factor was seen as the Knudsen number was increased to 0.27. Finally, surface roughness was shown to have an insignificant influence on the friction factor in both the continuum flow and slip flow regimes.

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