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Two Dimensional Unsteady Convection in Pressure-Driven Nitrogen Flow in Long Microchannels with Uniform Heat Flux Input
ZHANYU SUN, YOGESH JALURIA, Rutgers University — The transient features of pressure-driven Nitrogen flows in long microchannels under uniform heat flux input conditions are numerically studied. The two-dimensional momentum and energy equations are solved, where variable properties, rarefaction effects, including velocity slip, thermal creep, and temperature jump, as well as compressibility and viscous dissipation effects, are all taken into account. This paper focuses on two conditions: a sudden heat flux change at the channel wall and a sudden inlet pressure change. The thermal and fluid dynamics after these two changes are described and discussed in detail. The approach to steady-state conditions and the overall transient response are investigated. It is found that the overall transient response for the case with a sudden increase in the heat flux input is slower than that for the case with a sudden decrease in the heat flux input. The transient response for the case with a sudden increase in the inlet pressure is much faster than that for the case with sudden decrease in the inlet pressure. Based on the results obtained earlier, the difference in overall transient response is mainly caused by the energy taken up by the pressure work. Other physical results are obtained and discussed.

Yogesh Jaluria
Rutgers University

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