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Second-Order Slip Flow and Heat Transfer in a Long Isothermal Microchannel

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Abstract : This paper presents a study on the effect of second-order slip and jump on forced convection through a long isothermally heated or cooled planar microchannel. The fully developed solutions of thermal flow fields are analytically obtained on the basis of the second-order Maxwell-Burnett slip and Smoluchowski jump boundary conditions. Results reveal that the second-order term in the Karniadakis slip boundary condition is found to contribute a negative velocity slip and then to lead to a higher pressure drop as well as a higher fluid temperature for the heated-wall case or to a lower fluid temperature for the cooled-wall case. These findings are contrary to predictions made by the Deissler model. In addition, the role of second-order slip becomes more significant when the Knudsen number increases.

Keywords : microfluidics, forced convection, gas rarefaction, second-order boundary conditions
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