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

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Abstract : This paper presents a study on the effect of second-order slip on forced convection through a long isoflux heated or cooled planar microchannel. The fully developed solutions of flow and thermal fields are analytically obtained on the basis of the second-order Maxwell-Burnett slip and local heat flux boundary conditions. Results reveal that when the average flow velocity increases or the wall heat flux amount decreases, the role of thermal creep becomes more insignificant, while the effect of second-order slip becomes larger. The second-order term in the Deissler slip boundary condition is found to contribute a positive velocity slip and then to lead to a lower pressure drop as well as a lower temperature rise for the heated-wall case or to a higher temperature rise for the cooled-wall case. These findings are contrary to predictions made by the Karniadakis slip model.

Keywords : microfluidics, forced convection, thermal creep, second-order boundary conditions
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