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Effect of Axial Fluid Conduction on Thermal Transport in Superhydrophobic Microchannels[1] ADAM COWLEY, DANIEL MAYNES, JULIE CROCKETT, Brigham Young Univ - Provo, FLUIDS AND THERMAL TRANSPORT LAB - BYU TEAM — Convective heat transfer in a rib/cavity structured superhydrophobic microchannel is explored numerically. The cavities are assumed to be in the Cassie state (not wet) and the liquid meniscus is modeled as flat. The ribs are oriented perpendicular to the flow direction and are smaller than the channel hydraulic diameter. A constant heat flux condition is prescribed at the top of the ribs while the gas/liquid interface is approximated as adiabatic. The varied parameters include Peclet number, relative cavity size, and relative channel-wall spacing. The influence of fluid axial conduction is explored and it is found that axial conduction plays a significant role in superhydrophobic microchannels. Aggregate results are presented in the form of an average Nusselt number and the ratio of the temperature jump length to the hydrodynamic slip length. These results are compared to two previous studies: one where axial conduction was neglected and another where diffusion is assumed to be dominant. Overall, the results show that heat transfer is decreased for a superhydrophobic channel when compared to a classical smooth channel and that axial conduction exerts influence over a much larger range of parameters than prevails for classical no-slip channels.

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