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Inertial effects on heat transfer in superhydrophobic microchannels[1] ADAM COWLEY, DANIEL MAYNES, JULIE CROCKETT, BRIAN IVERSON, Brigham Young University, BYU FLUIDS TEAM — This work numerically studies the effects of inertia on thermal transport in superhydrophbic microchannels. An infinite parallel plate channel comprised of structured superhydrophbic walls is considered. The structure of the superhydrophobic surfaces consists of square pillars organized in a square array aligned with the flow direction. Laminar, fully developed flow is explored. The flow is assumed to be non-wetting and have an idealized flat meniscus. A shear-free, adiabatic boundary condition is used at the liquid/gas interface, while a no-slip, constant heat flux condition is used at the liquid/solid interface. A wide range of Peclet numbers, relative channel spacing distances, and relative pillar sizes are considered. Results are presented in terms of Poiseuille number, Nusselt number, hydrodynamic slip length, and temperature jump length. Interestingly, the thermal transport is varied only slightly by inertial effects for a wide range of parameters explored and compares well with other analytical and numerical work that assumed Stokes flow. It is only for very small relative channel spacing and large Peclet number that inertial effects exert significant influence. Overall, the heat transfer is reduced for the superhydrophbic channels in comparison to classic smooth walled channels.

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Adam Cowley
Brigham Young University

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