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Influence of the Vapor Cavity Depth on Liquid Flow through a Microchannel Exhibiting Superhydrophobic Walls DANIEL MAYNES, KEVIN JEFFS, BRADY WOOLFORD, BRENT WEBB, Brigham Young University — We report results of an analytical and experimental investigation of laminar flow in a parallel-plate microchannel with superhydrophobic walls. The walls are fabricated with hydrophobically coated micro-ribs and cavities that are oriented parallel to the flow direction and are modeled in an idealized fashion, with the shape of the liquid-vapor meniscus approximated as flat. An analytical model of the flow in the vapor cavity is employed and coupled with a numerical model of the liquid flow. The numerical predictions show that the effective slip length and the reduction in the classical friction factor-Reynolds number product increase with increasing relative cavity width and depth, and decreasing relative micro-rib/cavity module length. Comparisons are also made between the zero shear interface model and the liquid-vapor cavity coupled model. The results illustrate that the zero shear interface model under-predicts the overall flow resistance. Further, the deviation between the two models was found to be significantly larger for increasing values of both the relative rib/cavity module width and the cavity fraction. The trends in the frictional pressure drop predictions are in good agreement with experimental measurements made at similar conditions and a generalized expression for predicting the friction factor is proposed.

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