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Laminar and Turbulent Flow of a Liquid through Microchannels with Walls Exhibiting Wetting and Non-Wetting Cavity Regions BRADY WOOLFORD, DANIEL MAYNES, BRENT WEBB, BRIAN JENSEN, Brigham Young University — Recent developments in micro-scale systems have enabled significant reduction in the frictional drag for liquid flow through microchannels. To accomplish this the channel walls are created by patterning microribs and cavities onto a substrate and then treated with a hydrophobic coating. There is an apparent risk when using such surfaces, however, that the Laplace pressure may be exceeded and that the liquid will wet the cavities. Results that compare the flow dynamics through channels that exhibit wetted and non-wetted cavities, oriented both parallel and transverse to the direction of flow will be presented and discussed. The results show the reduction in the total frictional resistance is much greater in channels when the liquid phase does not enter the cavities, both when the ribs/cavities are oriented parallel to the flow direction and when they are oriented transverse to the flow direction. Measurements of the frictional resistance for transitional and turbulent flows in such microchannels where the liquid has wet the cavity walls will also be presented and discussed. Results are presented for Reynolds numbers ranging from 2 to 10,000, microchannel hydraulic diameters ranging from 180 – 500 μm, microrib widths ranging from 3 – 20 μm, and microcavity widths ranging from 20 – 60 μm.

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