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Transient two-phase flow in microfluidics and nanofluidics ANGEL VELASCO, ANDREW SONG, SERAH FRIEDMAN, MATTHEW PEVARNIK, ZUZANNA SIWY, PETER TABOREK, University of California, Irvine — We have studied the flow of a high pressure liquid (nitrogen and water) into vacuum through large aspect ratio pipes with diameters ranging from 25 microns to 50 nanometers. The decreasing pressure in the pipe induces boiling when the saturated vapor pressure is reached, creating a two-phase liquid/vapor flow. A novel method of measuring extremely small flow rates based on mass spectrometry will be presented. The validity of the method was verified using measurements of the flow of helium and argon through standard micron scale capillary tubes; subsequent measurements used single ion track pores which were 12 microns long with diameters in the range of 800-50 nm. A systematic study with nitrogen at 77 K was done with inlet pressures above and below the saturated vapor pressure. When the applied pressure is below the saturated vapor pressure the single phase flow was observed to obey the compressible Navier-Stokes equation. At pressures greater than the saturated vapor pressure, a stable flow was observed in pipes with diameters greater than 5 microns. For diameters below 2 microns significant fluctuations in the flow rate are observed at applied pressures up to 35 Atm, suggesting the onset of two-phase flow.

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