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Pressure driven flows of superfluid helium-4 through a single nanopipe ANGEL VELASCO, CRYSTAL YANG, ZUZANNA SIWY, PETER TABOREK, University of California, Irvine — We have measured flow rates of helium-4 through single etched nanopores of 72 nm and sub-20 nm diameter in PET and mica respectively with a mass spectrometer. Flow rates were measured as a function of pressure at constant temperature and at saturated vapor pressures along the coexistence curve between 0.5 K and 3.0 K. Due to the constraint of the mass spectrometer the low pressure side was maintained at P=0 creating an intrinsic superfluid/vapor interface which forms inside the pipe or at its exit. We observed flow velocities in the range of 2-4 m/s in the low temperature region which is consistent with Feynman's critical velocity. Near the lambda point our temperature dependent critical velocity did not agree with the thermal vortex nucleation theory. The superfluid transition temperature was measured to be suppressed by 2-3 mK in the 72 nm nanopore. We have also measured flow rates in the normal state and found rates in exact agreement with conventional viscous theory with zero slip length. The results were also consistent with previous nanofluidic studies. Supported by NSF DMR-0907495.

Angel Velasco
Univ of California - Irvine

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