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Third Sound Measurements of Superfluid ^{4}He Films on Multiwall Carbon Nanotubes Below 1 K[1] EMIN MENACHEKANIAN, VITO IAIA, ANDREW LI, BOB CHEN, GARY WILLIAMS, UCLA — Third sound is studied for superfluid films of ^{4}He adsorbed on multiwall carbon nanotubes of average diameter 12 Angstroms packed into an annular resonator. The third sound is generated with mechanical oscillation of the cell, and detected with carbon bolometers. A filling curve at temperatures near 250 mK shows oscillations in the third sound velocity, with maxima at the completion of the third and fourth atomic layers. The "dead" layer appears to be close to two atomic layers, about one layer thinner than previously found for flat graphite surfaces. We attribute this weaker binding to the effect of the cylindrical geometry on the van der Waals potential, the repulsive surface tension forces from the high curvature, and the lower density of the tubes compared to graphite. At the completion of the third layer there is a sudden reduction of the superfluid onset temperature, and then a recovery back to the Kosterlitz-Thouless linear dependence, forming re-entrant superfluidity. In a small region around 2.5 layers there is very anomalous behavior in the low-temperature variation of the third sound velocity, which is found to increase linearly with temperature. This could be related to changes in the gas-liquid coexistence at this intermediate fill.

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