Low-Temperature Transport Measurements of Multilayer WSe$_2$ FETs

L. J. STANLEY, DRAGANA POPOVIĆ, National High Magnetic Field Lab., Florida State University, HSUN-JEN CHUANG, ZHIXIAN ZHOU, Wayne State University, MICHAEL KOEHLER, The University of Tennessee, JIAQIANG YAN, DAVID MANDRUS, The University of Tennessee and Oak Ridge National Lab — Transition metal dichalcogenides (TMDs) offer an exciting new opportunity to study transport in 2D and the universality of the 2D metal-insulator-transition (MIT), but high-resistance, non-ohmic contacts have been a major impediment. Recently, however, 2D/2D low-resistance ohmic contacts have been produced on ultrathin TMD samples [1] allowing for low-temperature characterization. We report studies of WSe$_2$ FET samples with $\sim$ 10 layers each, patterned into Hall bars, and with a favorably high mobility of up to $\sim$ 0.2 m$^2$/Vs at $\sim$ 5 K. Two-terminal and four-terminal conductivity ($\sigma$) measurements were performed at temperatures $0.25 \leq T(\text{K}) < 200$. Our results show that contacts remain ohmic down to 0.25 K over the entire useful range of back-gate voltages $V_{bg}$. Furthermore, the measurements reveal a change in the sign of $d\sigma/dT$ and the form of $\sigma(T)$ with $V_{bg}$, strongly suggesting the existence of a 2D MIT in this system. [1] Hsun-Jen Chuang et al., Nano Lett. 16, 1896 (2016).

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