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Phonon-Limited Electron Transport in Back-Gated Few-layer $MoSe_2$ Field- Effect Transistors BHIM CHAMLAGAIN, Wayne State University, QING LI, Oak Ridge National Lab, HSUEN-JEN CHUANG, MEEGHAGE MADUSANKA PERERA, MING-WEI LIN, Wayne State University, MINGHU PAN, Oak Ridge National Lab, DI XIAO, Carnegie Mellon University, JIAQIANG YAN, NIRMAL JEEVI GHIMIRE, DAVID MANDRUS, The University of Tennessee & Oak Ridge National Lab, ZHIXIAN ZHOU, Wayne State University — The ultrathin body of monolayer (and few-layer) semiconducting transition-metal-dichalcogenides (TMDs) in conjunction with their highly desirable surface properties makes them excellent candidates for the ultimate downscaling of digital electronics. We have fabricated field effect transistors (FETs) of mechanically exfoliated few-atomic- layer-thick $MoSe_2$, a member of the semiconducting TMD family; and measured their device characteristics as a function of temperature. We find that the field-effect mobility of the devices increases with the applied back-gate voltage, which can be attributed to the Schottky barrier reduction via band bending at the contacts. In the limit of high back-gate voltages, the mobility increases from $\sim$ 135 cm^2/V.s at room temperature to over 300 cm^2/V.s at 200 K following the power law of $\mu \sim T^{-2.1}$, indicating that the mobility is chiefly limited by phonon scattering rather than charged impurity scattering. We attribute the high mobility and its temperature dependence to the extremely low density of defects and/or impurities in the starting $MoSe_2$ crystals as verified by low temperature scanning tunneling microscopy/spectroscopy (STM/STS) measurements.

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