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Semiconducting Behavior, Schottky Barriers and Field Effect Transistors in Ultrathin Rhenium DiSulfide[1] CHRIS CORBET, CONNOR MCCLELLAN, AMRITESH RAI, SUSHANT SONDE, EMANUEL TUTUC, SANJAY K. BANERJEE, The University of Texas at Austin — We report the fabrication, characterization, and device characteristics of exfoliated dual-gated ReS_2 Field Effect Transistors (FETs). All devices were created on few-layer crystals isolated using micromechanical exfoliation of source material grown by molecular beam epitaxy. X-ray photoelectron spectroscopy and energy dispersive X-ray spectroscopy found the composition of the source material to be 34% Re and 66% S. A combination of atomic force microscopy, optical microscopy, and photoluminescence (PL) measurements were used to estimate the number of ReS_2 layers (2-7) in all fabricated devices. Source and drain contacts were created using a combination of electron beam lithography and e-beam evaporation of 10 nm Cr / 40 nm Au. The ReS_2 FETs showed n-type behavior with an on-off ratio of 10^5 and a maximum field-effect mobility of 16 $cm^2 \bullet V^{-1} \bullet s^{-1}$ at room temperature. The contact resistance was determined using the transfer length method and was found to be gate bias dependent ranging from 175 $k\Omega \bullet \mu m$ to 5 $k\Omega \bullet \mu m$. Additionally, the contact resistance showed an exponential dependence on back-gate voltage, indicating Schottky barriers at the source and drain contacts. Dual-gated FETs were fabricated with an e-beam-evaporated alumina gate dielectric and a Cr/Au top-gate. The dual-gated FETs demonstrated current saturation and voltage gain with a subthreshold swing of 148 mV/decade.

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