High-Performance WSe₂, MoS₂, and MoSe₂ Transistors Enabled by a New Contact Strategy

HSUN JEN CHUANG, BHIM CHAMLAGAIN, Wayne State University, MICHAEL KOEHLER, The University of Tennessee, MEEGHAGE MADUSANKA PERERA, Wayne State University, JIAQIANG YAN, Oak Ridge National Laboratory, DAVID MANDRUS, The University of Tennessee, DAVID TOMNEK, Michigan State University, ZHIXIAN ZHOU, Wayne State University — Fabrication of high-performance transistors of transition metal dichalcogenides (TMDs) including WSe₂, MoS₂, and MoSe₂ has been a major challenge in 2D electronics. The performance of current metal-contacted TMDs is limited by the presence of a significant Schottky barrier in most cases. Here we introduce a new strategy for fabricating low-resistance ohmic contacts to a variety of TMDs. We demonstrate low contact resistance ≈ 0.3 kΩμm, high on/off ratios up to >10⁹, and high drive currents exceeding 320 μA/μm in few-layer WSe₂ field-effect transistors (FETs). These favorable characteristics are combined with a two-terminal field-effect hole mobility μFE ≈ 2x10² cm²V⁻¹s⁻¹ at room temperature, which increases to >2x 10³ cm²V⁻¹s⁻¹ at cryogenic temperatures. We observe a similar performance also in MoS₂ and MoSe₂ FETs. *We acknowledge the partial support by NSF grant number DMR-1308436 and the WSU Presidential Research Enhancement Award.