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High Performance WSe2 Field-Effect Transistors via Controlled Formation of In-Plane Heterojunctions. BILU LIU, YUQIANG MA, CHONGWU ZHOU, University of Southern California, UNIVERSITY OF SOUTHERN CALIFORNIA COLLABORATION, TSINGHUA-BERKELEY SHENZHEN INSTITUTE COLLABORATION — Monolayer WSe2 is a 2D semiconductor with a direct bandgap, and is promising for electronics and optoelectronics. Low field effect mobility is the main constraint preventing WSe2 from becoming a competing channel material for field-effect transistors (FETs). Here, we report that controlled heating in air significantly improves device performance of WSe2 FETs. After heating at optimized conditions, chemical vapor deposition grown monolayer WSe2 FETs showed average FET mobility of 31 cm2•V−1•s−1 and on/off current ratios up to 5108. For few-layer WSe2 FETs, after the same treatment, we achieved a high mobility up to 92 cm2•V−1•s−1. The underlying chemical processes involved during air heating and the formation of in-plane heterojunctions of WSe2 and WO3-x, which is believed to be the reason for the improved FET performance, were studied in detail. We further demonstrated that by combining air heating method developed here with supporting 2D materials on BN substrate, we achieved a noteworthy field effect mobility of 83 cm2•V−1•s−1 for monolayer WSe2 FETs. This work is a step towards controlled modification of the properties of WSe2 and potentially other TMDCs, and may greatly improve device performance for future applications of 2D materials in electronics..

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