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Reversible Semiconducting-to-Metallic Phase Transition in Chemical Vapor Deposition Grown Monolayer WSe_2 and Applications for Devices YUQIANG MA, BILU LIU, ANYI ZHANG, LIANG CHEN, MOHAMMAD FATHI, CHENFEI SHEN, AHMAD ABBAS, MINGYUAN GE, MATTHEW MECKLENBURG, CHONGWU ZHOU, Univ of Southern California, USC NANOLAB TEAM[1] — Two-dimensional (2D) semiconducting monolayer transition metal dichalcogenides (TMDCs) have stimulated lots of interest because they are direct bandgap materials that have reasonably good mobility values. However, contact between most metals and semiconducting TMDCs like 2H phase WSe_2 is highly resistive, thus degrading the performance of field effect transistors (FETs) fabricated with WSe_2 as active channel materials. We applied a phase engineering method to chemical vapor deposition (CVD) grown monolayer 2H-WSe_2 and demonstrated semiconducting-to-metallic phase transition in atomically thin WSe_2. We have also shown that metallic phase WSe_2 can be converted back to semiconducting phase, demonstrating the reversibility of this phase transition. In addition, we fabricated FETs based on these CVD-grown WSe_2 flakes with phase-engineered metallic 1T-WSe_2 as contact regions and intact semiconducting 2H-WSe_2 as active channel materials. The device performance is substantially improved with metallic phase source/drain electrodes, showing on/off current ratios of 10^7 and mobilities up to 66 $cm^2/V{\bullet}s$ for monolayer WSe_2.

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