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Electronic transport and device properties of monolayer CVD MoS_2 WENJUAN ZHU, TONY LOW, IBM T.J. Watson Research Center, YI-HSIEN LEE, National Tsing Hua University, Hsinchu, Taiwan, HAN WANG, DAMON B. FARMER, IBM T.J. Watson Research Center, JING KONG, Massachusetts Institute of Technology, Boston, MA, USA, FENGNIAN XIA, Yale University, PHAEDON AVOURIS, IBM T.J. Watson Research Center — The electronic transport and device properties of monolayer molybdenum disulphide (MoS_2) grown by chemical vapor deposition (CVD) are studied in this work. We show that these devices have the potential to suppress short channel effects, be aggressively downscaled and have high critical breakdown electric field. These properties make them a compelling alternative to organic and other thin film materials. However, our study reveals that the electronic properties of these devices are at present, severely limited by the presence of a significant amount of band tail trapping states. Through capacitance and ac conductance measurements, we systematically quantify the density-of-states and response time of these states. Due to the large amount of trapped charges, the measured effective mobility also leads to a large underestimation of the true band mobility and the potential of the material. These exponentially distributed states further limit the device's subthreshold slope to 200meV/dec, regardless of the temperature. Continual engineering efforts on improving the sample quality are needed for its potential applications in flexible electronics, high resolution displays, photo-detection and energy harvesting.

Wenjuan Zhu
IBM T.J. Watson Research Center

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