Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Ionic-Liquid Gated Few-layer MoS_2 Field-Effect Transistors[1]

MEEGHAGE PERERA, MING-WEI LIN, HSUN-JEN CHUANG, BHIM CHAMLAGAIN, CHONGYU WANG, XUEBIN TAN, MARK MING-CHENG CHENG, ZHIXIAN ZHOU, Wayne State University — We report the electrical characterization of ionic-liquid-gated bilayer and few-layer MoS_2 field-effect transistors. The extrinsic mobility of our ionic-liquid-gated devices exceeds 70 $cm^2V^{-1}S^{-1}$ at 250 K, which is 1-2 orders of magnitude higher than that measured in the Si back-gate configuration (without ionic liquid). These devices also show ambipolar behavior with a high ON-OFF current ratio of $> 10^7$ for electrons and $> 10^6$ for holes, and a near ideal subthreshold swing (SS) of ~ 50 mV/decade at 250 K for the electron channel. More significantly, we show that the mobility increases from ~ 100 $cm^2V^{-1}S^{-1}$ at 180 K to ~ 220 $cm^2V^{-1}S^{-1}$ at 77K as the temperature decreases following a $\mu \sim T^{-\gamma}$ dependence with $\gamma \approx 1$, indicating that the intrinsic phonon-limited mobility can be achieved in few-layer MoS_2 FETs. We attribute the enhanced device performance to the drastic reduction of the Schottky barrier width (thus higher tunneling efficiency) via highly efficient band bending at the MoS_2/metal interface afforded by the extremely large electrical double layer capacitance of the ionic liquid.

[1]This work was supported by NSF (No. ECCS-1128297).

Zhixian Zhou
Wayne State University

Date submitted: 14 Nov 2012 Electronic form version 1.4