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# $MoS_2$ MOSFETs: Dielectrics, Metal Contacts and Scaling

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The discovery of graphene has unveiled another material family with layered structures, which includes boron nitride, topological insulators such as $Bi_2Te_3$ and $Bi_2Se_3$, and transition metal dichalcogenides like $MoS_2$, $WS_2$, and $NbSe_2$. Though graphene, a fascinating two-dimensional (2D) crystal, has shown a superior carrier mobility of up to 200,000 $cm^2/V\cdot s$, its zero bandgap property limits its application to logic devices as graphene transistors cannot have high on/off ratios. As opposed to the semi-metal graphene, transition metal dichalcogenides (such as $MoS_2$), as another type of layered structure material, have shown great potential in device applications due to their satisfied bandgaps, thermal stability, carrier mobility, and compatibility to silicon CMOS process. In order to realize high performance $MoS_2$ MOSFETs [1], three major issues must be solved: 1) how to deposit a high-quality dielectric on 2D crystal, 2) the fabrication of low-resistivity metal-semiconductor junction to be used as device contacts, and 3) the elimination of short channel effects. [2,3] In this talk, I will review the recent progress in this field about these three device aspects and discuss the fundamental physics, chemistry, and posible solutions on these challenges.

[1] Radisavljevic, B.; Radenovic, A.; Brivio, J.; Giacometti, V.; Kis, A. Single-Layer $MoS_2$ Transistors, *Nat. Nanotechnol.* **2011**, 6, 147– 150.
[2] Liu, H.; Neal, A.T.; Ye, P.D. Channel Length Scaling of $MoS_2$ MOSFETs, *ACS Nano* **2012**, 6, 8563-8569.
[3] Liu, H.; Ye, P.D. $MoS_2$ Dual-Gate MOSFET with Atomic-Layer-Deposited $Al_2O_3$ as Top-Gate Dielectric, *IEEE Electron Device Lett.* **2012**, 33, 546-548.