Improved electrical characteristic of MoS_2 on two-dimensional $TMPS_3$

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Molybdenum disulfide (MoS_2) has been studied for complementary of graphene because of its intrinsic bandgap and high mobility. While atomic thickness and dangling- bond-free surface can make us to consider MoS_2 as a promising candidate for short channel devices, these properties make the deposition of high-k dielectrics on MoS_2 challenges, which results in the threshold voltage instability induced by high-density traps and make hard to deposit on transistors [1,2].

Given that graphene on high-k $SrTiO_3$ epitaxial thin film get influence and protect from the charges nearby layer [3], we deposited MoS_2 on $TMPS_3$, which is another 2D material and shows various high-k dielectrics dependent on constructed transition metal. Also, controlling thickness of $TMPS_3$ through mechanical exfoliation can facilitate the improvement of electrical characteristics of MoS_2. These results can be explained by not only mitigating adverse effect from SiO_2 substrate but also enhancement of electrical properties of MoS_2 when integrated with high-k materials.

We fabricate metal/$TMPS_3$/MoS_2 structure using mechanical exfoliation and dry transfer method. As gate voltage is applied from -100V to 100V progressively, improved current flow is shown in results. Also, enhanced mobility about 48cm^2/Vs is represented in our study.

References

[1] Jingli Wang *et al*., Advanced Materials, 37 (2016) 8302-8308
[2] Qingkai Qian *et al*., Scientific Reports, 6:27676 (2016) 1-9
[3] Jeongmin Park *et al*., Nano Letters, 16 (2016) 1754-1759

Figures

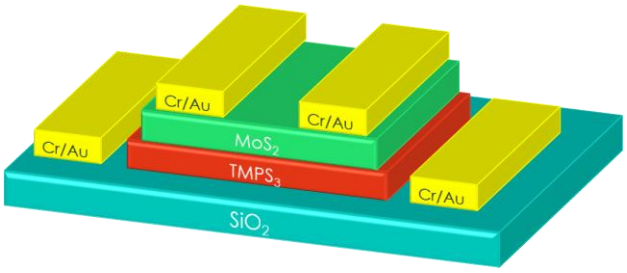

Figure 1: The schematic of $TMPS_3$/MoS_2 on SiO_2 substrate

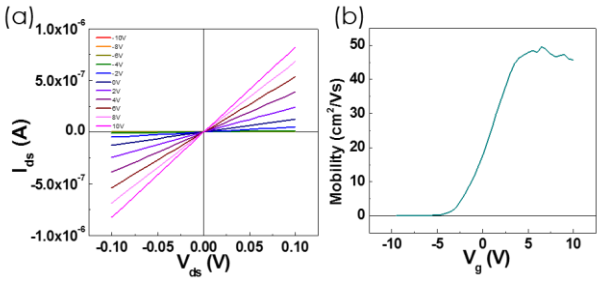

Figure 2: (a) I_{ds}-V_{ds} curve of MoS_2 as applied gate voltage from -100V to 100V and (b) mobility of MoS_2 on $FePS_3$