Contact Resistance Engineering in MoS_2 using Hexagonal Boron Nitride

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Abstract

Molybdenum disulphide (MoS_2), one of the most widely applicable transition metal dichalcogenide (TMD) is known to have high electron mobility at room temperature as well as optical property for monolayer. The band gap of single layer MoS_2 shows direct transition which values ~1.8 eV [1] is believed to be the source of its rectifying behaviour. MoS_2 shows Schottky behaviour when it is electrically contacted to metal by forming Schottky barrier (SB) at metal/MoS_2 interface. The potential barrier at the interface is directly related to contact resistance which should be minimized to achieve lower power consumption for high device performance. Many efforts were reported to engineer contact resistance for MoS_2 by adopting low work function metal for contact [2], doping the channel material with molecular dopant [3], transferring conductive layer at the contact/channel interface [4] and introducing thin insulating material on top of the channel [5]. In this study, we used centimetre-scale synthesized hexagonal boron nitride (hBN) on top of the MoS_2 channel layer in order to take advantage of absence of fermi level pinning which is considered to be a main reason of forming high Schottky barrier at the interface.

References

[1] R. Kappera et al, Nature Mater. 13, (2014) 1128 - 1134
[2] S. Das et al, Nano Lett, 13(1) (2013)pp 100 - 105
[3] Y. Du et al, IEEE ELECTRON DEVICE LETTERS, 34(10) (2013) 1328 - 1330
[4] X. Cui et al, Nature Nanotechnol 10, (2015) 534 – 540
[5] S. Lee et al, Nano Lett, 16(1), (2016) pp 276 – 281

Figures

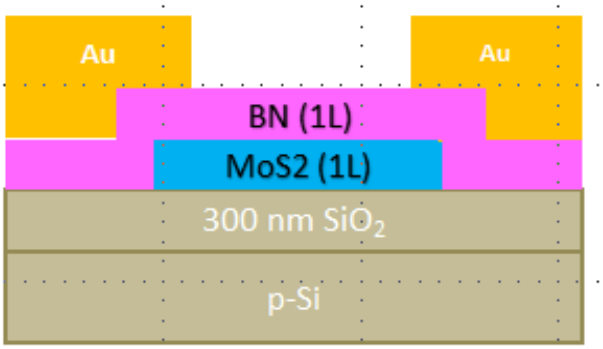

Figure 1: Atomically thin insulator is inserted between MoS_2 channel and contact metal.

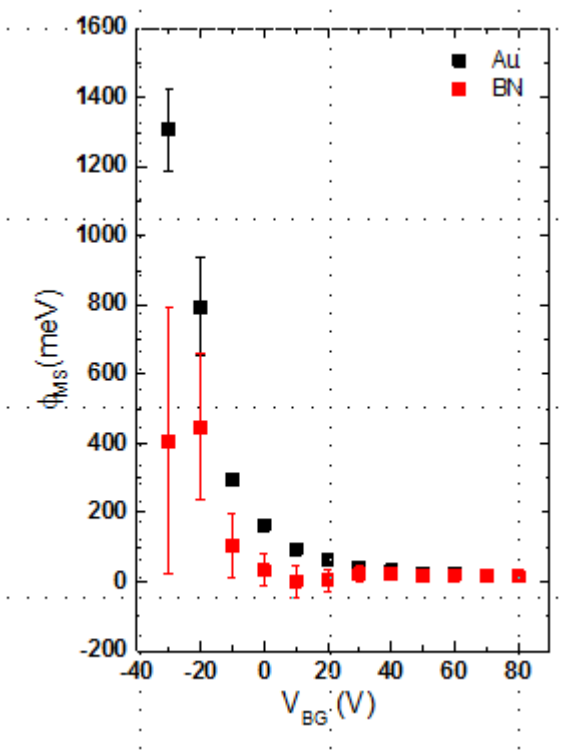

Figure 2: Comparison of Schottky barrier height (SBH) between metal/MoS_2 contact and metal/hBN/MoS_2 contact.