Ambipolar transport in encapsulated $MoTe_2$ using graphene contacts

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Probing the intrinsic electronic properties of transition metal dichalcogenides (TMDs) and other novel 2D materials has for long been hindered by environmental degradation and poor contacts. Recently these issues were partially overcome by protection from the environment using hexagonal boron nitride (hBN) encapsulation, along with using graphene as a tuneable contact material [1, 2].

Here we show how the tuneability of single-layer patterned [3] graphene contacts allow for clear ambipolar transport in bilayer $MoTe_2$, while hBN allows for degradation-free operations in ambient conditions. Similar to encapsulated MoS_2 devices, the $MoTe_2$ device exhibits linear and Ohmic contacts over a wide range of voltages and temperatures in the two on-states. This is particularly interesting in the case of ambipolar transport in $MoTe_2$, as the classical picture of Schottky barriers fails to account for a single metal providing an Ohmic contact in both the n- and p-regime. Contact resistance for both p- and n-type transport in $MoTe_2$ is similar to that achieved in high-quality encapsulated MoS_2 with graphene contacts, hinting at non-conventional momentum-mismatch as limiting the contact performance.

References

[1] X. Cui *et al.*, Nat. Nano., 10 (2015), 534
[2] D. A. Banduri *et al.*, Nat. Nano, Issue (2016) 1748
[3] F. Pizzocchero *et al.*, Nat. Comm., 7 (2016) 11894

Figures

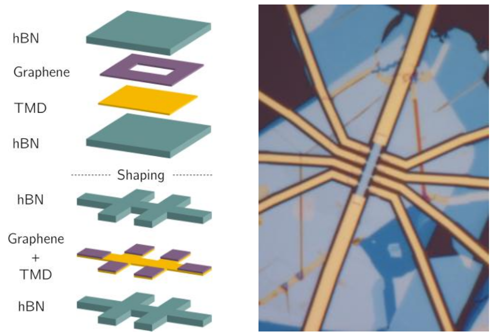

Figure 1: Schematic and optical image of the MoTe2, encapsulated with hBN and with contacts from pre-shaped graphene.

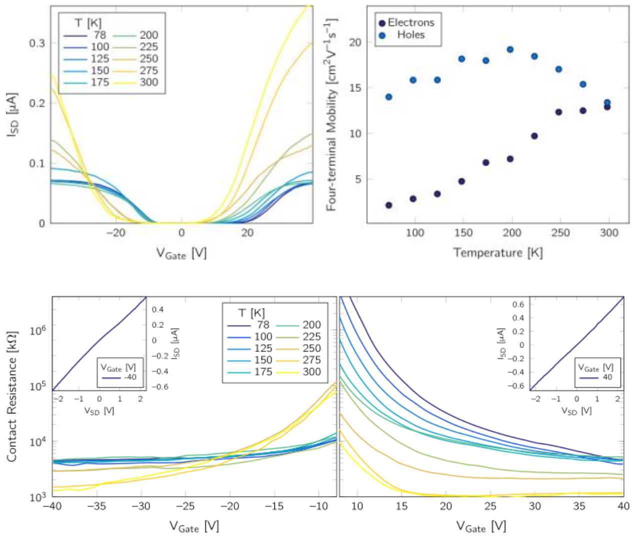

Figure 2: Ambipolar transport of bilayer MoTe2. Top panels shows current vs gate and four-terminal mobility vs temperature, while the bottom panels shows p- and n-type contact-resistance