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Fermi-level de-pinning at the intrinsic WSe_2-metal junction via van der Waals bottom contacts

Fermi-level pinning has been a critical challenge in the integration of 2D materials into semiconductor devices. In metal-semiconductor contact formed by physical vapor deposition, the Fermi level is pinned inside the band gap due to interface states or crystal disorder. Herein, we report a pinning-free tungsten diselenide (WSe_2) field-effect transisors (FETs) by utilizing the van der Waals bottom electrical contact. Our device structure is free of chemical disorder and crystal defects arising from metal deposition, which enables a near ideal Fermi-level de-pinning. The pinning factor of our device structure equals to 0.93, which proves our pinning free MS contact, allows us to effectively control the device polarity. With the ability to control the device polarity through metal work function variation, we prepared a complementary metal-oxide-semiconductor (CMOS) inverter with an ultrahigh gain of 198 at a bias voltage of 4.5V. Our study addresses an effective method to overcome the roadblock of further application of 2D materials to modern electronics.

Acknowledgement

This work was supported by the Global Research Laboratory (GRL) Program (2016K1A1A2912707) and the Global Frontier R&D Program (2013M3A6B1078873), both funded by the National Research Foundation of Korea (NRF).

Reference

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Figures

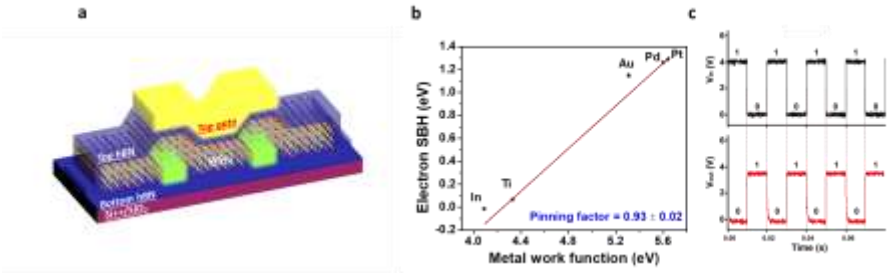

Figure 1: a) Schematic of the WSe_2 van der Waals bottom contact field-effect transistors. **b)** Pinning factor of our van der Waals bottom contact device. **c)** Dynamic output voltage response of our doping-free bottom contact CMOS inverter.