Van der Waals Contacts on 2D Semiconductors

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Abstract

Ultra-clean van der Waals interfaces can be achieved between soft indium metal and monolayer 2D transition metal dichalcogenide semiconductors. Such interfaces lead to low contact resistance and n-type field effect transistors with high mobilities – in excess of 100 cm^2-V^{-1}-s^{-1}. It has been, however, challenging to make similarly clean interfaces between refractory metals with high work functions to achieve efficient hole injection. Here, I will present our efforts on realizing p-type contacts using high work function metals and alloys. We show that it is possible to deposit a thin layer of indium and then a high work function metal on top of it to form an alloy by annealing at 200°C. This method preserves the ultra-clean interface between the monolayer semiconductor and alloy while increasing the work function so that p-type devices can be realized. We also demonstrate clean interfaces using metals such as Au and Pt via direct deposition. These interfaces reveal low contact resistance and also high mobility p-type devices.

Figures

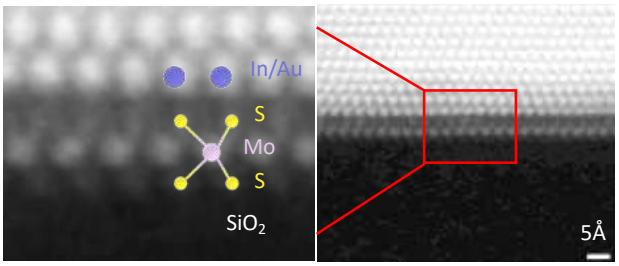

Figure 1: High resolution cross-sectional TEM image of the interface between 3D metal and 2D MoS_2 semiconductor.

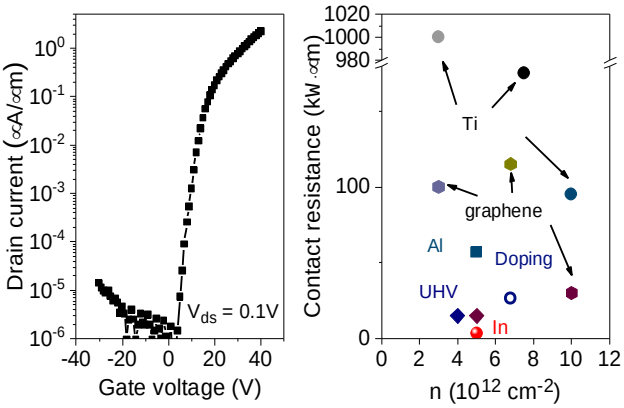

Figure 2: Left: Transfer characteristics of single layer MoS2 FET with van der Waals contacts showing a mobility of ~ 170 cm^2-$V^{-1}s^{-1}$. Right: Comparison of contact resistance of different electrode materials and Indium.

References

[1] Y Wang, J C Kim, R J Wu, J Martinez, X Song, J Yang, F Zhao, A Mkhoyan, H Y Jeong, M Chhowalla, Nature (2019) 568, 70 – 74.