Role of Asymmetric Metal Contacts in Monolayer TMD Phototransistors with van der Waals Contacts

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Transistors based on two-dimensional Transition Metal Dichalcogenide (TMD) materials have excellent electrical properties, and also superior optical properties due to their direct band gap transition in a monolayer. Especially, since the effect of the metal contacts on the performance of the monolayer TMD transistors is very important, several studies have been conducted to understand the role of metal contacts. However, there is a lack of the understanding the properties of the metal contact on the high-performance photodetector which current flows at zero bias. In this work, we fabricated a phototransistor with an asymmetric metal contact structure using electrodes with different work function values. Molybdenum Carbide (Mo2C), which have metallic behavior and TMD materials form van der Waals contact, a structure in which the Fermi level pinning effect is minimized, and the metals with different work function values are used to contact at Metal-Semiconductor junction. The work function difference between various metals and Mo2C, which has a work function value of 4.8eV[1] makes an asymmetric photodiode under built-in electric field in a P-N junction structure. These allows light detection without voltage bias. These results provide a better understanding of the 2-D TMD monolayer phototransistor and easy processing for future applications.

Keywords : asymmetric metal structure, van der Waals contact, Mo2C, phototransistor, transition metal dichalcogenides

References

[1] X. Zhang et al, “Surface-engineered Mo2C: an ideal electrode for 2D semiconductor-based complementary circuit with Schottky-barrier-free contacts”, Materials Today Chemistry 24 (**2022**) 100790