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Enhanced Transport Characteristics of Few-layer Indium Selenide Transistors with Extended Stability Using an Indium Oxide Encapsulated Layer

Two-dimensional (2D) semiconductors, e.g. black phosphorus and transition metal dichalgenides (TMDs), have attracted considerable interests recently. We investigate the electronic transport properties of Indium Selenide (InSe) by exploring the nature of the semiconductor-metallic contact interface. For 2D-material-based field-effect transistors (FETs), issues regarding substrates and the contact are extremely important. We employed hexagonal boron nitride (h-BN) as the substrate of InSe FET to reduce surface roughness and suppress charged-impurity density at the interface.[1] To avoid resist contamination in our FETs, we utilized resist-free method to fabricate the InSe FET devices.[2] A thin layer of Indium oxide is grown to improve the contact characteristics. The Schottky barrier height (SBH) with the Indium oxide layer is reduced to 48.7 meV, compared with the control samples without the capping layer.[3] High drain current up to 300 μA/μm in the saturation regime at room temperature is achieved because of the low contact resistance. Electronic transport measurements show linear current voltage characteristics at high gate voltages at T=2 K, indicating ohmic contact. The field-effect mobility reaches 1400 $cm^2V^{-1}s^{-1}$ and the on/off ratios is 10^7-10^8 at T=2 K. Though InSe is very sensitive to the ambient environment, the thin encapsulated layer can effectively improve the chemical stability.

References

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