

The Effect of Various Passivation Layers to the Stability of the MoS₂ Field-Effect Transistor

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Recently, 2-dimensional (2-D) semiconductors have been researched a lot as an active layer of next-generation nanoelectronics, due to their peculiar electrical and optical characteristics.¹ Graphene, which is a representative of 2-D material, has been reported to have extremely high mobility. However, the pristine graphene does not have a band gap, resulting in a high off-current of graphene transistor. Due to the limitation of the graphene, transition metal dichalcogenides (TMDs), another kind of 2-D material, has appeared as an alternative material for graphene. MoS₂ is one of TMDs with a direct band gap of ~1.9eV in the monolayer form.²

MoS₂ has attracted great attention and there are many reports on MoS₂ transistors which show high carrier mobility.³ Also, its potential to be utilized in optoelectronics and other various applications was proved.^{4,5,6} However MoS₂ has a critical weakness in that the stability under ambient condition is very poor. The resistance of MoS₂ transistor increases under ambient atmosphere, which results in the decrease of field-effect mobility.³

Preventing the degradation of device performance is very important in order to avoid circuit failure or to reduce the power consumption. In this research, we have focused on the stability enhancement of a MoS₂ field-effect transistor (FET). Various passivation layers were deposited on top of the bottom-gate MoS₂ FET. Then, the evolution of electrical properties for both transistors with and without passivation layer was measured. In addition, the change of device properties under high percentage of humidity condition was measured in order to compare the performance of diverse passivation layers. From this research, the effect of various passivation layers to the environmental stability of MoS₂ transistor will be reported.

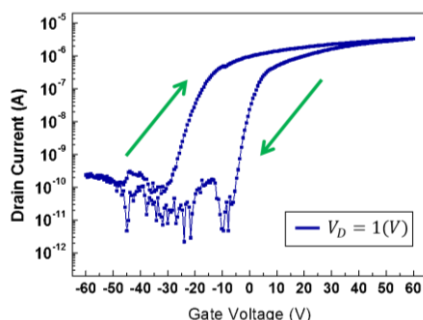


Figure 1. Transfer curve of a MoS₂ FET

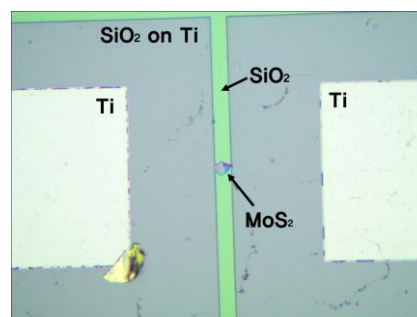


Figure 2. Microscopic image of a MoS₂ FET with passivation layer

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