High Temperature Electrical Behavior of 2D Multilayered MoS2

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We demonstrate the high temperature-dependent electrical behavior at 2D multilayer MoS2 transistor. Our previous reports explain that the extracted field-effect mobility of good device was inversely proportional to the increase of temperature. Because scattering mechanism is dominated by phonon scattering at a well-designed MoS2 transistor, having, low Schottky barrier. However, mobility at an immature our MoS2 transistor (μm < 10 cm²V⁻¹s⁻¹) is proportional to the increase temperature. The existence of a big Schottky barrier at MoS2-Ti junction can reduce carrier transport and lead to lower transistor conductance. At high temperature (380K), the field-effect mobility of multilayer MoS2 transistor increases from 8.93 to 16.9 cm²V⁻¹sec⁻¹, which is 2 times higher than the value at room temperature. These results demonstrate that carrier transport at an immature MoS2 with a high Schottky barrier is mainly affected by thermionic emission over the energy barrier at high temperature.

Keywords: 2D layered semiconductor, MoS2, High temperature, Thermionic emission

Fig. 1. (a) Cross-sectional view of multilayer MoS2 TFTs with SiO2 gate insulator. (b) The I-V, characteristics of a representative device. (inset) temperature dependent field-effect mobility from 300 K to 380 K as a step of 10 K. (c) Imaging of Schottky barrier of MoS2-Ti junction.