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Electrical Properties of Local Bottom-Gated MoS_2 Thin-Film Transistor

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Layered semiconductor materials can be a promising candidate for large-area thin film transistors (TFTs) due to their relatively high mobility, low-power switching, mechanically flexibility, optically transparency, and amenability to a low-cost, large-area growth technique like thermal chemical vapor deposition (CVD). Unlike 2D graphene, series of transition metal dichalcogenides (TMDCs), MX_2 (M=Ta, Mo, W, X=S, Se, Te), have a finite bandgap (1～2 eV), which makes them highly attractive for electronics switching devices. Recently, 2D MoS_2 materials can be expected as next generation high-mobility thin-film transistors for OLED and LCD backplane. In this paper, we investigate in detail the electrical characteristics of 2D layered MoS_2 local bottom-gated transistor with the same device structure of the conventional thin film transistor, and expect the feasibility of display application.

Keywords: MoS2, TMDCs, local bottom-gated transistor, high mobility, TFT

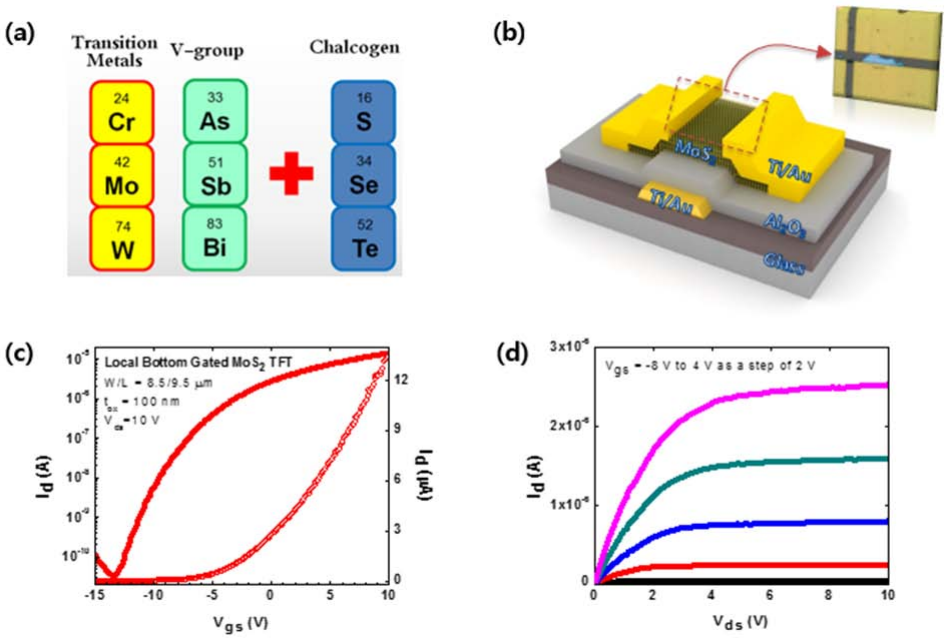

Fig. 1. (a) Some examples of elements constituting 2-dimensional transition metal dichalcogenides (TMDCs). They are made by formation of MX_2 where M=transition metal and X=chalcogen and form a 2D layered structure. (b) Schematic view of a multilayer MoS_2 transistor including ALD Al_2O_3 dielectric (100 nm), Ti / Au (15 nm / 300 nm) source/drain electrodes with local back-gated structure. Inset shows its optical image. (c) Transfer characteristics of MoS_2 transistor. Device mobility is extracted as 21 $cm^2/V \cdot sec$. (d) Output characteristics of the MoS_2 transistor. The curves recorded for various back-gated voltages with a step of 2 V.