Stable Al_2O_3 encapsulation of MoS_2-FETs Enabled by CVD grown h-BN

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Two-dimensional materials have attracted massive attention especially for their potential as an alternative in ultra-scaled FET and for flexible electronic applications. Molybdenum disulfide (MoS_2) is the most widely studied transition metal dichalcogenides because of its high carrier mobility compared to ultra-thin silicon FETs and its specific optoelectronic properties, but the electrical performance is strongly affected by the environment and dielectric interfaces, often leading to large hysteresis in MoS_2-based devices [1]. Encapsulation layer like aluminium oxide (Al_2O_3) is widely used in (opto)-electronics. At the same time, it leads to detrimental charge transfer n-doping to MoS_2 [2]. Here, we report a scalable encapsulation approach for MoS_2 FETs where hexagonal boron nitride (h-BN) monolayers are employed as a barrier layer in-between each of the Al_2O_3 and MoS_2 interfaces (Fig. 1a and b). These devices exhibit a significant reduction of charge transfer when compared to structures without h-BN (Fig. 1c and d). This has been confirmed by ab-initio Density Functional Theory calculations. In addition, the devices with h-BN layers show very low hysteresis even under ambient operating conditions [3].

References

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Figures

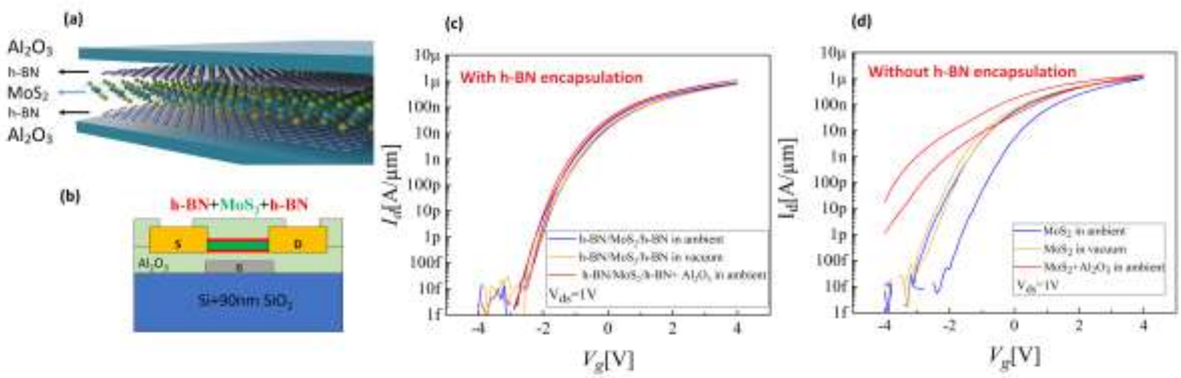

Figure 1: (a) Schematic of the channel material stack and (b) cross sections of the used FET structure. Electrical characterisation of a FET (c) with h-BN encapsulation and (d) without h-BN encapsulation in different conditions.

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