Photolithography fabrication of CVD 2H-$MoTe_2$ field effect transistors

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Transition metal dichalcogenides (TMD) materials are generating significant interest for "post silicon" electronic applications. Among the various TMDs investigated to date, two-dimensional (2D) transition metal ditellurides are promising materials owing to their narrow bandgap energy (1.1–1.2 eV). They are also compatible with bulk silicon and have inherent superior electrical transport [1].

Interestingly, when attempting to fabricate FET devices from 2D-$MoTe_2$, the fragility of thin films poses a significant fabrication challenge [2]. In numerous studies, the general approach for producing 2D-FETs uses top-down thin-film exfoliation techniques and situates them on patterned substrates. Although it achieves auspicious device performance, the random positioning of the $MoTe_2$ film with uncontrollable thickness renders it unsuitable for manufacturing [3]. More suitable and manageable manufacturing methods are required.

In our research, FET devices are fabricated and characterised directly on CVD-grown $MoTe_2$ films [2] using photolithography. This permits the precise design of FET device geometries with controlled thickness and other characterisation structures such as TLMs, Figure 1 depicts TLMs and FET structures fabricated from CVD $MoTe_2$. The characterisation process involves using scanning electron microscopy (SEM), atomic force microscopy (AFM), and Raman spectroscopy to detect any alterations in the properties of the film. Concurrently, electrical measurements were conducted on the produced TLM and FET structures. Before and after each step of the fabrication process, no change in the physical and chemical properties of $MoTe_2$ thin films was observed.

References

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Figures

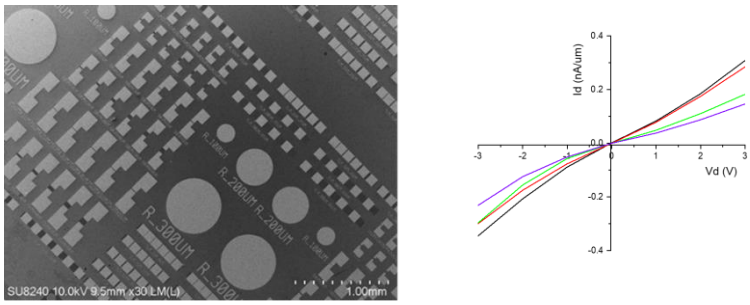

Figure 1: 5nm CVD $MoTe_2$ -FET SEM image and electrical measurement result