Vertical and Lateral Electrodeposition of 2D Material Heterostructures

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Abstract

Developing scalable techniques for growing 2D materials and their heterostructures is a major challenge that needs to be overcome before these materials can make an impact in industries. Electroplating (electrodeposition) is an industrially acceptable deposition technique that offers unique advantages. This work is divided into two main parts. First, we demonstrate controlled electrodeposition of uniform and continuous MoS_2 and WS_2 layers over a large-area and micropatterned graphene electrodes. Second, we present a novel electrode design that enables MoS_2 to be grown laterally over insulating substrates, demonstrating lateral photodetector devices based on TiN/MoS_2/TiN structure. Our goal is to show that electrodeposition can produce competitive quality of 2D materials which can potentially be scaled to wafer sizes in fabrication industries for device applications.

References

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[3] N. Abdelazim, Y. J. Noori, S. Thomas, et al., Wiley Adv. Electron. Mater., (2021) 2100419.
[4] S. Thomas, DE Smith, V. Greenacre, et al., J. Electrochem. Soc., 167 (2020) 106511.

Figures

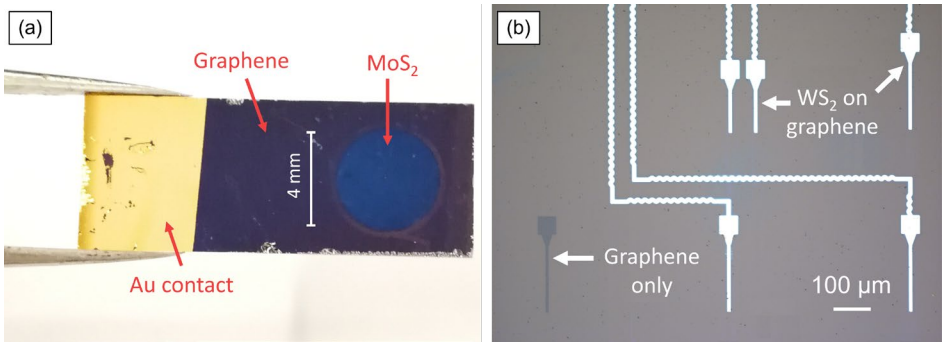

Figure 1: (a) Image of a large area MoS_2 that is electrodeposited over graphene (b) Optical microscope image of micropatterned WS_2/graphene heterostructures and a graphene only film.

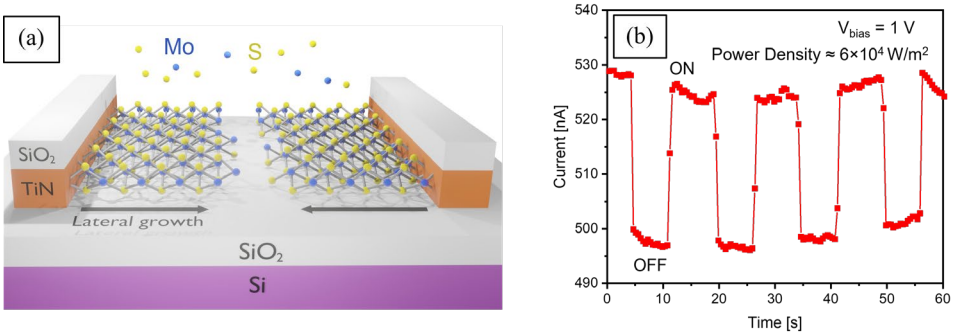

Figure 2: (a) Schematic of MoS_2 that is laterally electrodeposited over an insulator from TiN electrodes. (b) Illumination response of a photodetector device based on laterally grown MoS_2.