Highly Transparent Ohmic Interfaces in Tungsten Disulphide – Graphene Heterostructures

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Abstract

Vertical heterostructures of tungsten disulphide on graphene (WS_2/graphene) are relevant for optoelectronic, spintronic, and valleytronic devices, all requiring detailed knowledge of the electronic interface properties.
We investigated the electrical nature of such interfaces without conventional device integration and associated fabrication that is often detrimental to the structural integrity of monolayer materials, by using a four-probe scanning tunnelling microscope (STM). The measurements provided important insights into the electrical transport properties of monolayer WS_2 synthesized by chemical vapour transport on epitaxial graphene, featuring a Schottky-type contact between the metallic probe and WS_2, but Ohmic transport in the WS_2/graphene heterostructure, and a highly transparent interface evidenced by the measured four-probe resistances.
The electrical transparency of the WS_2/graphene interface is of considerable significance to a range of applications related to ultrathin electronics and optoelectronics seeking to overcome challenges associated with achieving optimized and reliable contacts to atomically thin materials.

Figures

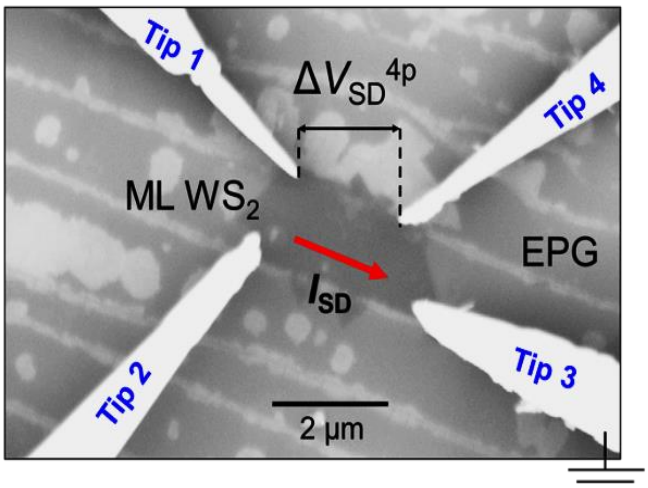

Figure 1: Scanning electron microscope image depicting the four STM tips arrangement for transport measurements of monolayer WS_2/ epitaxial graphene heterostructure