Dielectric screening in van der Waals materials probed through Raman spectroscopy

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Raman spectroscopy is a powerful characterization tool for low-dimensional materials. In particular, it is widely used to probe strain fields, doping or dielectric screening in graphene layers [1]. These characteristics can be finely engineered using van der Waals (vdW) heterostructures [2]. Here, using a large variety of vdW heterostructures, we show that the well-known Raman 2D mode of graphene is uniquely sensitive to dielectric screening and undergoes a sizeable upshift in excess of 15 cm^{-1} when comparing a bare suspended graphene monolayer with a graphene/transition metal dichalcogenide (TMD) heterostructure (Fig. 1). This upshift stems from the smearing of the Kohn anomaly that affects transverse optical phonons at the K point of the Brillouin zone [3]. Our results show that a single TMD monolayer smears the Kohn anomaly more efficiently than bulk Boron Nitride.

References

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Figure

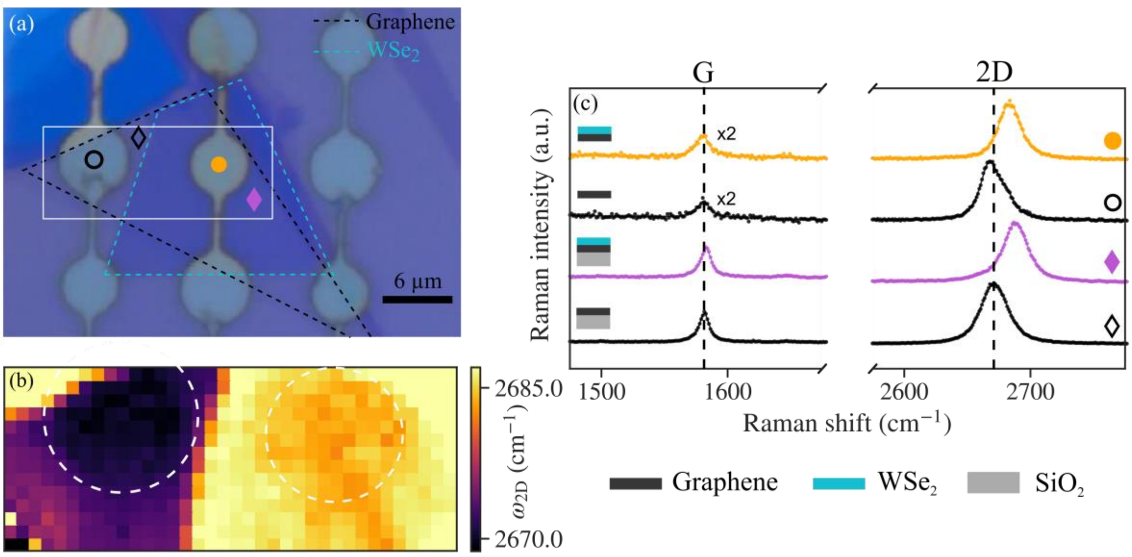

Figure 1: (a) Optical image of a graphene/WSe_2 heterostructure deposited on an Si/SiO_2 substrate with pre-patterned holes. (b) Hyperspectral Raman map of the graphene 2D-mode frequency. The mapping area corresponds to the white rectangle in (a). (c) Typical Raman spectra of SiO_2-supported graphene (black diamond) and graphene/WSe_2 (purple diamond), and suspended graphene (black circle) and graphene/WSe_2 (orange circle).