Studies on Interlayer Interaction in WS_2/WSe_2 Heterostructures depending on twist angle by using Raman Spectroscopy

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Transition metal dichalcogenide (TMD) heterostructures (HSs) exhibit novel phenomena driven by interlayer interactions. While the twist angle dependence of WS_2/WSe_2 heterostructures has been previously investigated through photoluminescence (PL) and high-frequency Raman spectroscopy, studies focusing on the interlayer vibrational modes remain limited [1, 2]. In this work, we explored these interlayer modes by employing low-frequency Raman spectroscopy. Monolayer WS_2 and WSe_2 flakes were prepared via mechanical exfoliation, and WS_2/WSe_2 heterostructures were subsequently assembled using the dry transfer method. The twist angles were determined by polarized second harmonic generation (SHG) measurements, and stacking configurations (3R and 2H) were identified through comparisons with low-frequency Raman spectra of chemical vapor deposition (CVD)-grown heterostructures. Distinct interlayer vibration modes were observed, notably in samples with twist angles near 0°, which exhibited unique Raman peaks. Furthermore, interlayer exciton emissions were characterized using PL spectroscopy at both room temperature and 5 K. The interlayer excitons of WS_2/WSe_2 HSs were found in the energy range of 1.35 to 1.5 eV.

References

[1] Ke Wu et al., National Science Review, 9(2022), 6
[2] Jiajun Chen et al., RSC Advanced, 13(2023), 18099-18107

Figures

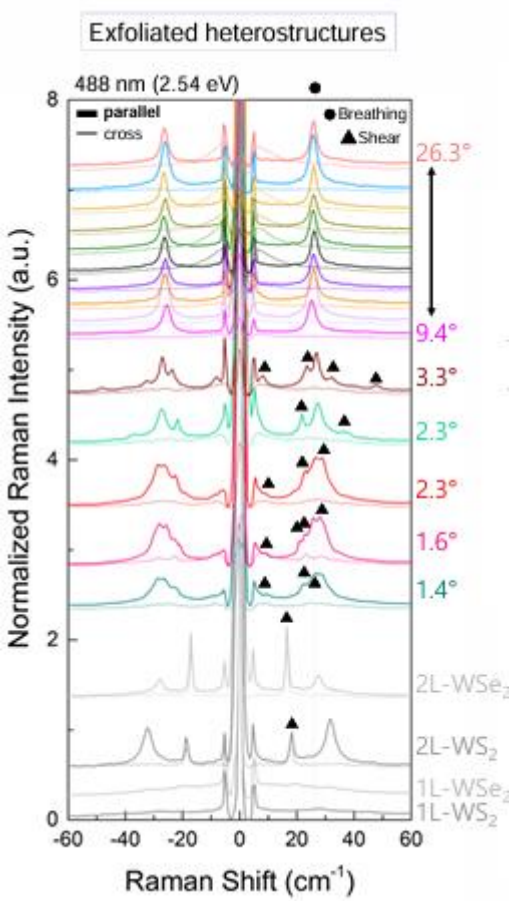

Figure 1: Low frequency region of Raman measurement in heterostructures depending on twist angle