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Resonant Raman Profile of few-layers to bulk PtSe₂

Two-dimensional (2D) Transition Metal Dichalcogenides (TMDs) are great candidates for opto-electronic applications due to their high electronic mobility, and also due to the strong light-matter interaction. Platinum diselenide (PtSe₂) is a noble TMD which thin films stand out for their remarkable bandgap tunability, ranging from 1.3 eV for a single-layer semi-conducting sheet, down to zero, semi-metallic behaviour as the thickness increases [1].

Our previous measurements on different stacking-PtSe₂ under 532 nm illumination allowed us to characterize each sample thickness by its Raman signature from 1L up to bulk regime. While this analysis provides us a powerful tool to identify stacking, it brings almost no information on the vibrational properties of the crystal. We also would like to address the multiple stacking for bilayer PtSe₂ that arises from exfoliated samples that present different absorption and Raman curves from one to another [2].

We performed resonant Raman experiments from 457 nm (2.71 eV) up to 785 nm (1.57 eV) using ten different laser lines to probe the vibrational behaviour of 1L, 2L, 3L and bulk samples. Raman Excitation Profiles (REP) are built from these measurements to make it possible to recover the electron-phonon coupling times of the first order modes as well their electronic transitions couplings. This information will complete our comprehension on the light-matter interaction of thin PtSe₂ [3].

References

- [1] Marin Tharrault et al 2025 Phys. Rev. Lett **134** 066901.
- [2] Marin Tharrault et al 2024 2D Mater. **11** 025011.
- [3] Bruno R Carvalho and Marcos A Pimenta 2020 2D Mater. **7** 042001.

Figures

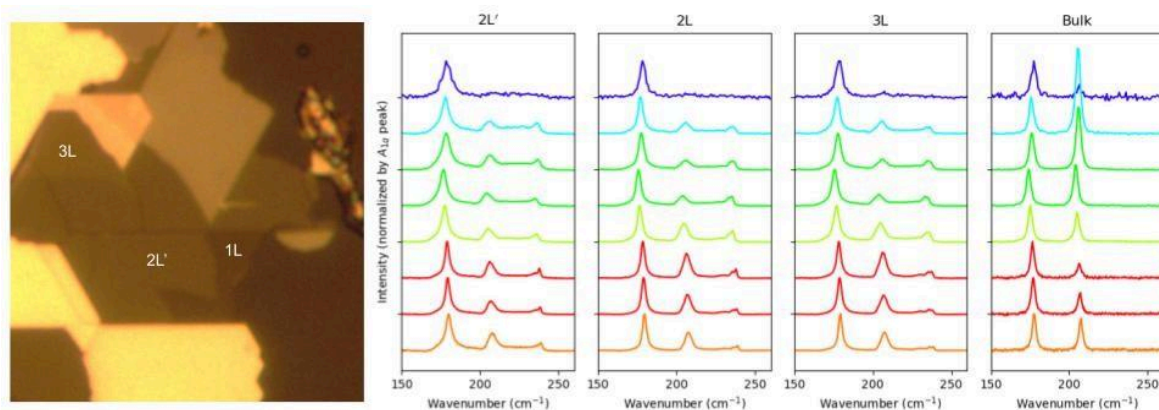


Figure 1: Optical image of gold-exfoliated PtSe₂ flakes under 50X magnification. Resonant Raman spectra of 2L, 2L', 3L, and bulk PtSe₂ flakes with eight different excitation energies, normalized with respect to the A_{1g} peak.