Thermally Induced Correlation Effects in metal/$PtSe_2$ heterostructures studied by Raman Spectroscopy

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We present a systematic study of interfacial physics in meta/$PtSe_2$ heterostructures (metal = Ti, Cr, Ni, Pd Pt) employing temperature-dependent Raman spectroscopy (RT–473 K) and SEM imaging. The deposition of metallic overlayers with thicknesses of 10 and 15 nm results in a pronounced narrowing of phonon linewidths (up to 50%) and a significant increase in the I_{A1g}/I_{Eg} intensity ratio compared to bulk $PtSe_2$[1]. These effects are attributed to dielectric screening and work-function-dependent charge redistribution[2]. An analysis of the relationship between the E_g and A_{1g} phonon modes indicates that the introduction of metallic layers leads to the onset of compressive strain and charge carrier doping. At the same time, the inherent anharmonic behaviour of the lattice captured by the temperature-dependent coefficients remains largely unaffected and closely matches that observed in bulk $PtSe_2$. Furthermore, although annealing triggers metal-dependent morphological modifications, the core vibrational properties of the $PtSe_2$ lattice remain essentially unchanged. These findings provide insight into the electronic and mechanical coupling at metal–2D interfaces and highlight $PtSe_2$ as a robust platform for stable two-dimensional electronic applications[3].

References

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