Switchable Electron-Phonon Scattering Strength in Monolayer Hexagonal Boron Nitride

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In the past decade, the layered compound hexagonal boron nitride (hBN) has drawn considerable attention due to its compatibility with various low-dimensional van der Waals (vdW) materials [1]. While hBN resembles graphene in lateral size, crystalline structure, and Debye frequency, its two distinct sub-lattices give rise to a significant energy band gap between the valence and conduction bands [2]. Recently, it was predicted that hBN should host strong electron-phonon coupling (EPC) in its electronic π- and σ-bands [3], reminiscent of the reported (and debated) interactions in the graphene σ-bands [4]. Since then, we have confirmed this EPC from observable energy renormalizations in the hBN band structure [5].

We will showcase the electron-phonon coupling (EPC) in hBN, highlighting how changing the substrate interaction, e.g., by adatom intercalation, can influence coupling strength (see Fig. 1). By combining angle-resolved photoemission and neutral helium atom scattering, we will demonstrate how these techniques together help demystify the scattering modes involved in electron-hole recombination. We will also mention the broader implications of EPC in materials with finite electronic band gaps.

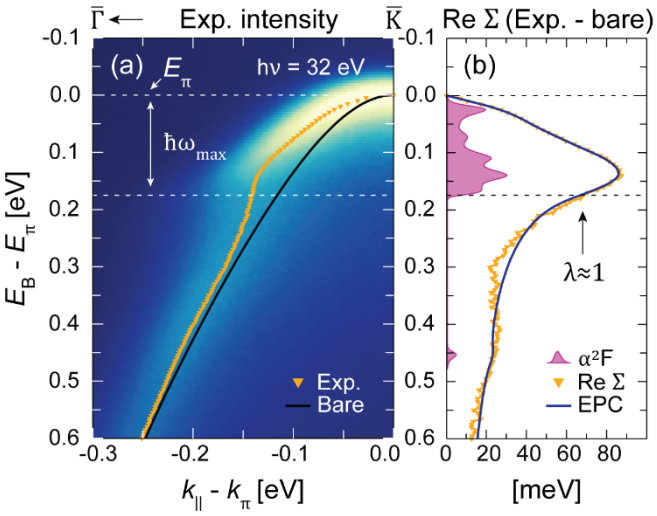

Fig. 1: EPC in intercalated hBN. **a:** Renormalized π-band of intercalated monolayer hBN near the high-symmetry K point. **b:** Experimental self-energy (Re Σ) of the π-band in panel **a**, showing significant electron mass enhancement ($\lambda \approx 1$) within $\hbar\omega_{max}$ = 175 meV of E_π. This range is similar to the energy bandwidth of hBN-derived phonons.

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