

Unusually strong electron-phonon kinks in graphene and hBN

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In 2013, we controversially reported strong electron-phonon coupling (EPC) in graphene's σ -bands [PRL 111:216806]. The result was controversial. Combining theoretical support with measurements in neighbouring Brillouin zones, we showed that the mass enhancement, $\lambda \approx 0.7$, was intrinsic [PRB 95:075430].

We subsequently predicted similarly strong EPC in the σ -bands of hBN [PRB 101:214513], whose electronic and phonon structures resemble those of graphene. Experimental confirmation further supported our understanding of EPC in graphene. Unlike graphene, hBN was predicted to exhibit strong EPC in its π -band, whose parabolic maximum leads to fundamentally different scattering phase space and much stronger coupling.

Most recently, we have developed improved our mathematical tools for analysing EPC. Established methods are implicitly based on the assumption of linear electronic bands, and are unsuitable near a parabolic maximum.

We reveal that π -band EPC depends strongly on doping, substrate choice and substrate interaction strength. In this talk, I will show our latest studies and analysis, as well as the open question which motivate ongoing ARPES, DFT and helium-scattering studies.

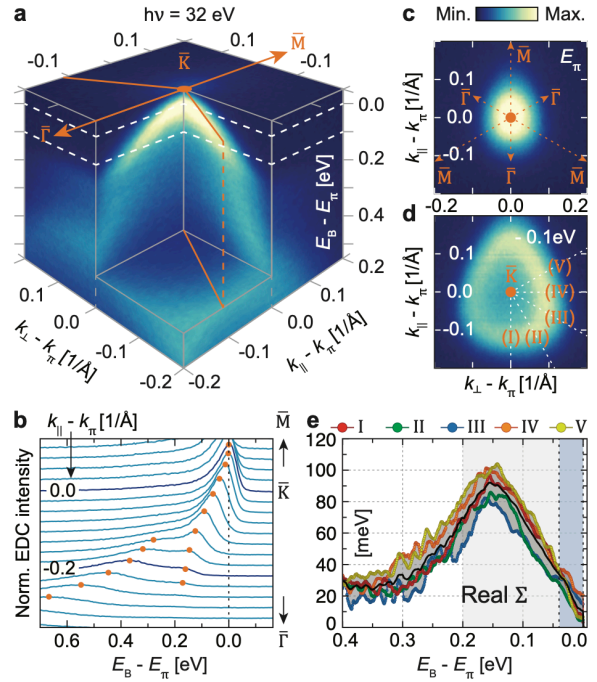


Figure: The electronic structure of Cl intercalated hBN near the K point. **a:** Volumetric rendering of the π -band maximum. Momentum and energies are referenced relative to the band maximum. **b:** Energy slices with 0.025 $\text{\AA}^{-1}$ separation along Γ KM. The peak positions (orange circles) have been indicated. **c-d:** Constant energy surfaces extracted at (c) E_π and (d) +100 meV binding energy (white dashed lines in a). **e:** Kramers-Kronig consistent, real self-energy $\text{Re } \Sigma$ of the π -band along the cuts I-V as marked in d. The average shape has been indicated (black solid line)