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Low energy electron transmission through layered materials and chiral organic films

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PROPOSITIONS

accompanying the dissertation

Low energy electron transmission through layered materials and chiral organic films

1. A mean free path in a quantum mechanical system is inherently ill defined as it can only be defined from a semi-classical viewpoint (Chapter 3).
2. There is an interlayer state between graphene and hexagonal boron nitride (hBN) monolayers when stacked on top of each other (Chapter 4).
3. Molybdenum disulfide (MoS_2), although consisting of relatively heavy atoms and having a large out-of-plane unit cell, is a suitable substrate for electron-Volt transmission electron microscopy (eV-TEM) in the 15-25 eV energy range (Chapter 5).
4. Imaging the polarization-dependent photoemissivity in a chirality-induced spin selectivity (CISS) experiment allows us to judge the uniformity of the optical illumination as well as the uniformity of the chiral molecular layer (Chapter 6).
5. The universal mean free path curve by Seah and Dench should only be applied to inelastic scattering in isotropic materials where band structure effects are expected to be of minor importance.
M.P. Seah, W.A. Dench, Surf. Interface Anal. 1, (1979)
6. The jellium model by Yang *et al.* cannot explain resonant states in graphene. Thus, the inelastic MFP they extract does not present evidence of a plasmon excitation.
L.H. Yang et al., Appl. Phys. Lett. 118 (2021)
7. Dai *et al.* show low-energy electron microscopy (LEEM) IV spectra of 30° -twisted and AB stacked bilayer graphene grown in-situ with outstanding quality. In their analysis, however, they severely overestimate the increase in layer distance for 30° -tBLG compared to AB stacking, claiming an unrealistic 6% increase. Analyzing the same data using a realistic interference toy model leads to a 2% increase.
Z. Dai et al., Phys. Rev. Lett. 127 (2021)
8. Photoemission studies of MoS_2 do not have the spectral and momentum space resolution to resolve the low energy interference states.
B. Da et al., Nat. Commun. 8, 15629 (2017)
9. Experiments and theory concerning the CISS effect should aim on consolidating the effects observed over a large energy range. So far it is unclear, whether the effects observed in transport measurements (i.e., at the Fermi level) and in photoemission experiments (i.e., above the vacuum level) stem from the same origin.
10. Bicycles should be engineered with a focus on servicing and reparability.
11. The Dutch government should abolish the 30 % ruling and replace it with a system, where integrating measures, e.g., Dutch courses (including previous years) and cultural community memberships, are tax-deductible.

Peter S. Neu
Leiden, June 12th, 2024