SFB1242

SFB 1242 Nichtgleichgewichtsdynamik kondensierter Materie in der Zeitdomäne

UNIVERSITÄT DUISBURG ESSEN

Open-Minded

26.05.2020 / 10 Uhr c.t.

Electronic structure control in 2D matter

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Two-dimensional (2D) materials allow for on-demand control of their physical properties by chemical functionalization and by stacking 2D layers into heterostructures. My group uses this approach to induce new quantum phases in epitaxially grown 2D layers and to control their physical properties. I will show how to induce large electron-phonon coupling, flat bands, energy band inversions and a Fermi gas in 2D matter. For investigation, we employ a unique combination of ultra-high vacuum (UHV) Raman/luminescence and angle-resolved photoemission (ARPES) spectroscopies. Chemical doping of graphene by alkali metals enables tuning of the charge carrier density into the superconducting regime. ARPES and UHV Raman reveal a strong renormalization of electrons and phonons because of electron-phonon coupling [1,2]. I will show how to realize a flat energy band at the Fermi level by encapsulating graphene by two layers of alkali metals [3]. For even larger alkali metal coverages, an alkali metal quantum well can be grown on intercalated bilayer graphene [4]. In this system massive and massless charge carriers coexist. The massive quantum well states have high electronic quality and are a realization of a 2D Fermi gas [4]. For phosphorene, chemical doping induces a staggered potential resulting in a band inversion that is driven by the Coulomb interaction between the layers [5]. Regarding transition metal dichalcogenides (TMDCs), I present the observation of a charge density wave in monolayer TaS_2/graphene [6] and show that MoS_2/graphene heterostructures have a record narrow photoluminescence amongst epitaxially grown samples [7]. These two observations highlight the importance of the environmental effect in 2D matter.

[1] Nano Letters **18**, 6045 (2018).
[2] Nature Comm. **5**, 3257 (2014).
[3] ACS Nano **14**, 1055 (2020).
[4] Nature Comm. **11**, 1340 (2020).
[5] Physical Review B **97**, 045143 (2018).
[6] ACS Nano **13**, 10210 (2019).
[7] 2D Materials **6**, 011006 (2018).

Für diese Zeit steht eine Kinderbetreuung nach vorheriger Anmeldung zur Verfügung.

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