Finite bias spectroscopy of insulating states in twisted bilayer graphene

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Twisted bilayer graphene shows correlated insulating states at fractional fillings of the superlattice unit cell as well as band insulating states at full filling of the moiré superlattice [1, 2]. Here, we present finite bias spectroscopy measurements of band gaps and correlated insulating states in a near-magic angle twisted bilayer graphene device with an estimated twist angle of 1.01° [Figure 1(a)-(c)]. The various insulating states show qualitatively similar behaviour, but quantitatively they differ significantly from each other. We observe a strong electron-hole asymmetry for the respective band insulating states regarding their energy scales as well as their stability against variations of the carrier density. In particular, the behaviour of the band insulating state at hole doping is reminiscent of the transport behaviour through etched graphene constrictions, which showed disorder dominated transport resulting in stochastic Coulomb blockade [3]. This similarity is also present in one of the correlated insulators at electron doping. Due to the size of our device in the micrometre range and the use of a graphite back gate we attribute this observation to moiré disorder instead of etch- or substrate induced charge-disorder. Our work thus shows that this type of bias spectroscopy measurements is promising to investigate and benchmark the strength and presence of disorder caused by the twist angle variations in such heterostructures.

References

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Figures

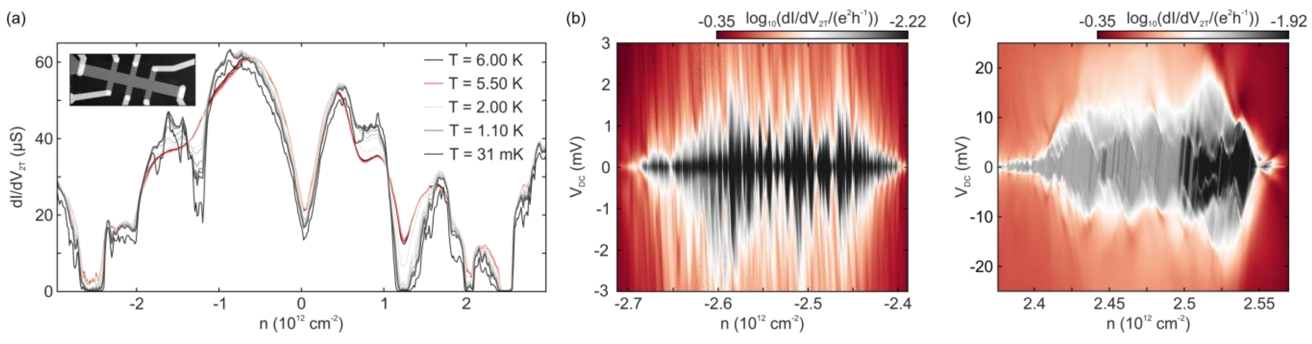

Figure 1: (a) Differential conductance as a function of carrier density for different temperatures of the twisted bilayer graphene device (twist angle 1.01°). The inset shows an atomic force micrograph of the device. (b) Finite bias spectroscopy of the band insulating state at hole doping showing indications of stochastic Coulomb blockade. (c) Analogous measurement as in (b) for the band insulating state at electron doping revealing the asymmetry of the gaps between the two doping regimes.