Magnetotransport in 2D periodically modulated graphene

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Embedding graphene into a hetero-structure with hexagonal boron nitride was shown to be an efficient way of achieving a high bulk mobility. The encapsulated graphene is protected in any further top-down fabrication procedure and pro-nounced commensurability features could be observed in 2D antidot lattices [1].
Here, we introduce a new method for periodical modulation of the carrier density, employing a few layer graphene patterned bottom gate. The bottom gate is defined by etching a 2D hole array into the few layer graphene and adapts perfectly to the commonly used stacking method for van der Waals heterostructures [2] (see Fig. 1).
By tuning the local bottom gate and the global back gate voltage, we can switch between the unipolar and bipolar transport regime.
We fabricated patterned bottom gates with lattice periods down to 150 nm and observe pronounced commensurability peaks that can be nicely compared to experiments with hard-wall antidot lattices [1,3]. The peaks can be examined up to T = 100 K, proving their classical origin from cyclotron orbits (see Fig. 2). We report on the difference between the unipolar and the bipolar regime, as well as the influence of the magnitude of the imposed super-lattice potential.

References

[1] A. Sandner et al., Nano Lett. **15** (2015)
[2] L. Wang et al., Science **342**, 614 (2013)
[3] D. Weiss et al., PRL **66**, 2790 (1991)

Figures

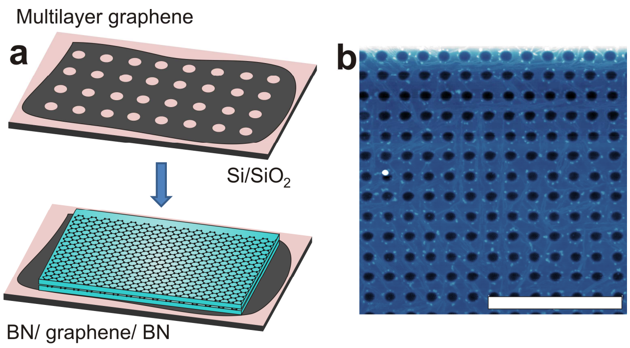

Figure 1: Schematic of sample geometry. **(a)** Patterned graphene gate on Si/SiO_2 and subsequent transfer of a hBN/MLG/hBN stack on top of it. **(b)** AFM image of a few layer graphene patterned bottom gate with a 2D periodic hole-lattice. Scale bar is 1 µm.

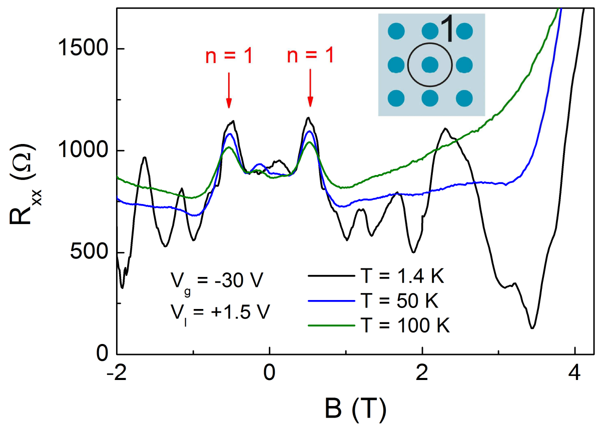

Figure 2: Magnetotransport experiment in the bipolar regime. The global back gate voltage is V_g = -30 V and the local bottom gate voltage is V_l = +1.5 V. The n = 1 commensurability peak is clearly visible at temperatures up to 100 K (red arrows). The inset is a sketch of the n =1 orbit around one antidot.