Magnetotransport in high-mobility graphene antidot arrays

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We report on the observation of antidot peaks in ρ_{xx} in monolayer-graphene (MLG), encapsulated between hexagonal boron nitride (hBN). The hBN-MLG-hBN heterostructures were fabricated with a dry transfer pick-up technique; subsequently mesas were etched in Hall bar geometry and contacted with 1-dimensional side contacts [1]. The periodic antidot lattice was defined in a following step by additional electron-beam lithography and reactive ion etching (see fig. 1).
We performed measurements on stacks with different antidot lattice periods down to 100 nm. Several peaks in magnetoresistance can be identified and assigned to orbits around one and several antidots (see fig. 2) [2]. This proves ballistic transport in our graphene heterostructures, in spite of the critical etching step for small lattice periods. We show measurements at different temperatures and can study antidot peaks down to very low carrier densities (n = 2 · 10^{11} cm^{-2}) and magnetic fields (B = 0.5 T). At higher magnetic fields, well defined quantum Hall plateaus with filling factors down to ν = 1 are observed, even at an antidot period of 100 nm.

[1] L. Wang *et al.*, Science **342**, 614 (2013)
[2] D. Weiss *et al.*, Phys. Rev. Lett. **66**, 2790 (1991)

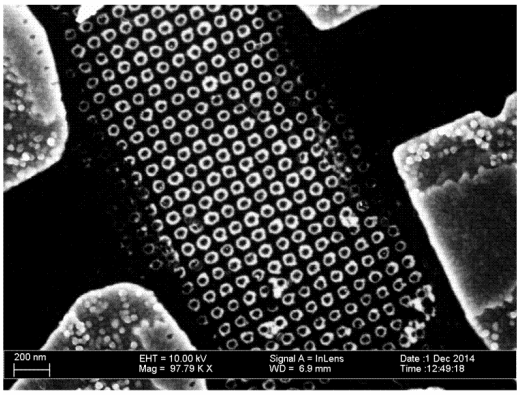

Fig. 1: SEM image of a hBN/MLG/hBN heterostructure with a patterned antidot array (lattice constant d = 100 nm). The stack is contacted by Cr/Au leads.

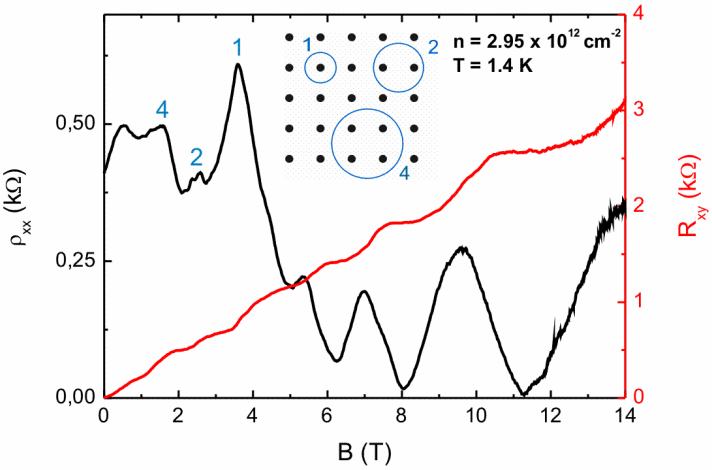

Fig. 2: Magnetoresistance (black) and Hall resistance (red) of a patterned sample (antidot lattice period d = 100 nm) as a function of magnetic field at 1.4 K. For small perpendicular magnetic fields, additional peaks rise in ρ_{xx}, which can be assigned to orbits around 1, 2 and 4 antidots. At higher fields (B ≥ 5 T), we can see pronounced plateaus from the QHE. The inset shows a sketch of electron orbits around a different number of antidots.