Magneto-transport through a side-gated graphene constriction

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The electronic band structure of graphene allows for continuous tuning between electron and hole transport, making it an interesting candidate for pnp-type devices. Using reactive ion etching we pattern graphene flakes into various geometries, including side-gated constrictions, quantum dots and ribbons. Side-gating of graphene devices has the advantage that the graphene etched side-gate can easily be very close to the device, 20 nm for our devices. Furthermore, no additional fabrication steps are needed to locally gate etched graphene devices, compared to etched top-gated devices.

In this work we study magneto-transport in the quantum Hall regime through a side-gated graphene constriction. The quantum Hall effect was already measured in both two- and multi-terminal top-gated pnp-junctions [1,2]. To study magneto-transport through a side-gated graphene constriction we etched a Hall bar shaped device with a 100 nm wide constriction in the central region. By back- and side-gating we tune both the global and local charge carrier densities in our device, creating a pnp-junction. This way we control the chirality and number of edge states separately in the constriction and the rest of the device. The Landauer-Büttiker formalism is used to calculate the expected quantized conductance through the junction [2,3]. In the pp'p regime we find good agreement with theory, but in the pnp regime the conductance is lower than expected. This can be explained by a reduction of equilibration along the pn interfaces.

References

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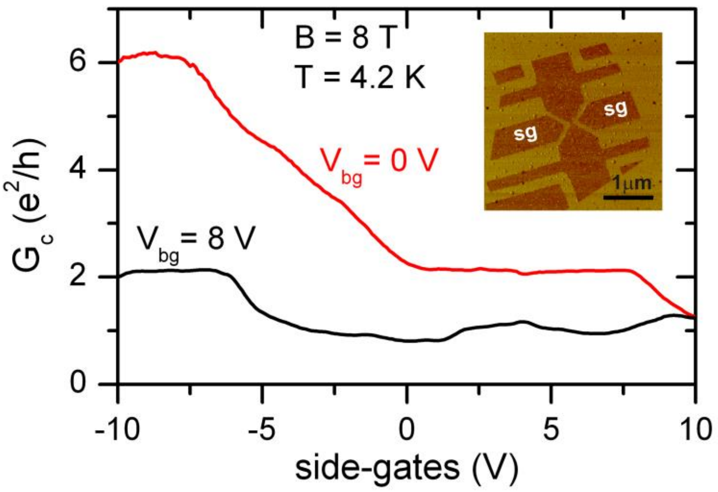
Figures



Quantized conductance through the constriction as function of side-gate voltage for two different back-gate voltages. In the pp'p regime we observe levels at $2e^2/h$ and $6e^2/h$. The inset shows an AFM phase image of the device. The dark areas are graphene, the light areas are SiO_2. The 100 nm wide constriction is in the center between two side-gates, labeled sg.