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Temperature dependence and bipolar interference in graphene monolayer quantum rings

D. Smirnov[1], H. Schmidt[1], and R. J. Haug[1]

[1]*Institut für Festkörperphysik, Leibniz Universität Hannover, Germany*

We analyze the electronic properties of a topgated monolayer graphene ring. Micromechanical cleavage was used to place a flake on a Si/SiO2 substrate. The structuring and contacting was done via plasma etching and electron beam lithography. An additional gate was placed on top of one arm of the ring which allows us to control the charge carrier concentration locally and additionally to create a pnp- (npn-) junction inside the ring. The sample was measured in a He3 cryostat and is identified as single layer graphene via magnetotransport measurements.

We observe Aharonov Bohm (AB) effect by sweeping the magnetic field around 0 T. The period of the oscillations is approx. 16 mT which fits the size of the ring well. We also observe the AB-oscillations when a pnp-junction is created inside the ring. The period is independent of the existence of a pnp-junction and stays constant in all situations. We analyse the amplitude in dependence of the charge carrier concentration. The absolute amplitude is constant in the bipolar and unipolar region[1].

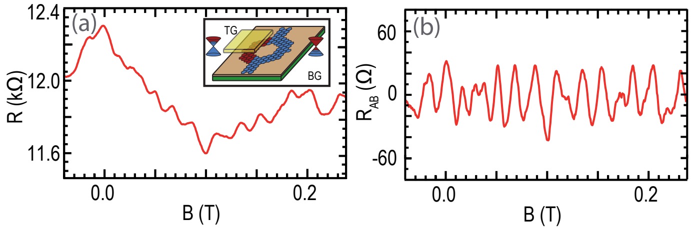

Figure 1: (a) shows the magnetotransport measurements in the range of 0 T with the weak localisation and AB oscillations. The Inset shows the schematic of the sample. (b) shows the oscillations with the background subtracted. A period of 16 mT can analysed and fits the geometry of the ring well.

We observe small AB amplitudes with visibilities of about $0.5 - 1\%$. This values are comparable to other ring experiments performed in graphene [2, 3, 4, 5]. To understand these small visibilities the temperature dependence of the AB oscillation was studied. The amplitude shows a fast decrease proportional to T^{-1} above 1 K and a slow decrease below 1 K. The origin of the slow decrease is not clear. Therefore the results are compared to the phase coherence length extracted from an analysis of the weak localization temperature dependence.

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