Microwave Measurements of Graphene in BN

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Introduction

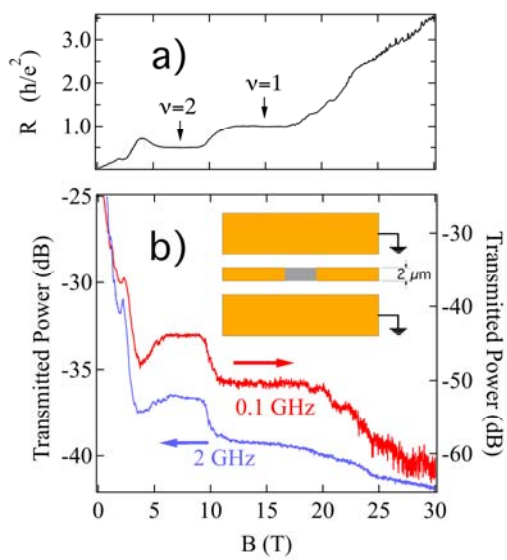
Microwave spectroscopy on two dimensional electron systems (2DES) in high magnetic fields (B), hosted in GaAs, has revealed pinning modes under conditions when the 2DES forms solid phases [1]. Graphene samples hosted in BN [2] approach the low level of disorder which is needed to observe such modes.

Experimental

As shown schematically in the inset to Fig. 1b, a piece of graphene, encapsulated in BN, is patterned to 4 µm long and 2 µm wide, and put into a break in the center conductor of a coplanar waveguide. The transmission of the coplanar waveguide is measured in a 50 ohm system. The sample backgate was lightly doped Si, , which at low temperature has sufficient conductivity to gate the sample without allowing excessive capacitively coupled current to bypass the graphene. The relative change in transmitted power in this experimental configuration is less at higher frequencies due to the parasitic capacitances around the graphene, though more power is transmitted at higher frequency.

Results and Discussion

The experimental set-up allows quasi-dc measurements as well as rf and microwave frequency ones. Two-terminal dc resistance vs B is shown in Fig 1a, for a fixed electron density of 3.6×10^{11} cm $^{-2}$. The integer quantum Hall effect (IQHE) plateaus centered around Landau fillings $\nu=1$ and 2 are clearly visible. Figure 1 b shows rf transmitted power (in dB) taken for the same backgate voltage and frequencies of 0.1 and 1 GHz. The $\nu=2$ IQHE plateau is clear at both frequencies. The high B part of the $\nu=1$ IΘHE plateau is less distinct at 1 GHz, and the low B corner of the plateau is slightly more rounded.



Conclusions

We have demonstrated that small graphene samples in BN can be measured at microwave frequencies. Measurements with greater sensitivity at high f, including the present geometry with different aspect ratio or a transmission line based set-up, will be of value in clarifying the features of rf magnetoconductance of high quality graphene in high B.

Acknowledgements

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References

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