Scanning gate microscopy on a ballistic graphene p-n junction

Hermann SELLIER[1]
Marco GUERRA[1], Kenji WATANABE[2], Takashi TANIGUCHI[2], Benjamin SACÉPÉ[1]
[1]*Univ. Grenoble Alpes, CNRS, Grenoble INP, Institut Néel, Grenoble, France*
[2]*National Institute for Materials Science, Tsukuba, Japan*
hermann.sellier@neel.cnrs.fr

We present a scanning gate microscopy (SGM) experiment on ballistic graphene [1,2] providing spatial insight on the electron flow across a p-n junction [3]. Similar to light rays in metamaterials, electron waves in graphene experience a negative refraction when passing rapidly from the conduction band to the valence band [4]. The device is made of a high-mobility BN/graphene/BN heterostructure and integrates a series of essential features to engineer electron optics devices, such as pinhole collimators for directional electron injection, reflection-less edges with electron absorbers, and the employment of a thin pristine graphite crystal as electrostatic gate for precise interface definition [5,6]. The electrically polarized tip of the microscope increases or decreases locally the carrier density depending on the junction side. This local perturbation scatters the electron flow and generates SGM maps of transmitted current with a high contrast across the p-n interface. The SGM maps of the reflected current show a series of oscillations localized at the junction which could result from interference in the injection region. In order to model the effect of the tip potential on the electron trajectories, we present ray-tracing simulations in a semi-classical context which are compared with the experimental data.

References

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