Imaging Ballistic Motion of Electrons from a Collimating Contact in Graphene

S. Bhandari[a], GH. Lee[a], T. Taniguchi[b], K. Watanabe[b], P. Kim[a], and R.M. Westervelt[a]

[a]School of Engineering and Applied Sciences and Department of Physics, Harvard University, Cambridge, MA 02138 , U.S.A
[b]National Institute for Materials Science 1-1, Namiki, Tsukuba, 305-0044, Japan

Ballistic motion of electrons in graphene paves the way for electron-optics experiments. A collimated beam of electrons would be ideal. Collimated contacts were created in a hBN/graphene/hBN hall bar by having absorbing zig-zag metal strips on both sides of each contact that can be grounded to collimate the flow. A cooled Scanning Probe Microscope (SPM) [1,2] directly images the ballistic motion of electrons emitted into the device. By displaying the change in transmission vs. tip position as the tip is raster scanned above the surface, images of electron flow are obtained. Collimation is tested by imaging the flow between two contacts on opposite sides of the channel as a perpendicular magnetic field is applied. Images with uncollimated contacts persist up to 0.19 T, while images with collimation disappear quickly at 0.05 T, because the orbits are bent away from the receiving contact, due to narrow entry angle distribution.
Supported by DOE grant DE-FG02-07ER46422 and AFOSR grant FA9550-14-1-0268.
References
1. M.A. Topinka et al., Nature 410, 183 (2001)
2. S. Bhandari et al., Nano letters, 21, 1-10 (2016)