Quantum Hall Effect in Bipolar Graphene Devices

Dong-Keun Ki[a], Hu-Jong Lee[a,b]
[a]*Department of physics, Pohang University of Science and Technology, Pohang 790-784, Korea*
[b]*National Center for Nanomaterials Technology, Pohang 790-784, Korea*

Half-integer quantum Hall (QH) effect in graphene, which is not expected to occur in a typical two dimensional electron gas system, is originated from its unique relativistic electrodynamic nature. Applied with a high magnetic field perpendicular to a graphene layer, metallic conduction states (or QH edge states) are available only along the one-dimensional edge line of the sample, permitting a circulating current along the edge, which is responsible for the observed QH plateaus in graphene. Bipolar characteristics of graphene allows us to investigate the equilibration between the QH edge states with different filling factor and/or current circulation direction, which can be tuned in a electrostatic way by local gates. We studied the edge-state equilibration process in a four-terminal configuration, revealing much richer information compared to previous two-terminal measurements. As a main result of this work, we suggest that all QH edge states are equally populated at the p-n interface and there exist undesired resistance plateaus whose quantized values are shown to be from the 5/2 transmission of the QH edge state. Experimental details and the theoretical calculations will be presented.

Keywords: graphene, quantum Hall effect, bipolar device