Quantum-Hall States in a Mono-/Bi-Layer Graphene Hybrid Junction

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Graphene attracts high attention due to its unique 'quasi-relativistic' carrier dynamics and high potentiality of device applications. Most experiments to date have been focused on the mono- and/or bi-layer graphene systems, with very limited reports[1,2] on the mono/bi-layer graphene hybrid systems. In quantum-Hall regime, mono- and bi-layer graphene, with distinctive physical nature from each other, possess much different Landau levels. To examine how quantum-Hall edge states in mono-layer graphene is connected to those in bi-layer graphene, four-terminal transport measurements were made on a mono-/bi-layer graphene hybrid system with a local gate above the mono-layer. By varying local-gate and back-gate voltages, the filling factor and the chiral direction of edge states of mono- and bi-layer graphene were tuned individually in our hybrid graphene system. Asymmetric longitudinal and diagonal resistances were observed, which are quite distinct from the previous two-terminal conductance studies [3,4] as well as from the four-terminal studies on the p-n-p junction of graphene [5]. Experimental observations are in good agreement, at least qualitatively, with the analysis based on the complete mode mixing picture, where all edge states are equally populated at the interface of mono- and bi-layer graphene. Possible reasons for the disagreement will be discussed.

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