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Electronic transport properties of graphene nanostructures

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The electronic states of graphene near the Fermi energy are well described by massless Dirac Fermion. The presence of edges, however, makes strong implications for the spectrum of the electrons. In graphene nanoribbons with zigzag edges, localized states appear at the edge with energies close to the Fermi level. In contrast, edge states are absent for ribbons with armchair edges. In my talk, we focus on edge and nanoscale effect on the electronic properties of graphene nanoribbons. We discuss the following aspects of graphene nanostructured systems. (1) In zigzag nanoribbons, for nonmagnetic long-ranged disorder, a single perfectly conducting channel emerges associated with a chiral mode due to the edge state, i.e., the absence of the localization in this class. (2) We show the electronic transport properties of graphene nanojunctions crucially depend on the peripheral lattice structures. The condition for electron confinement is discussed. (3) We will discuss the effect of edge chemical modification on magnetic properties of nanographene systems. Also, we discuss the hole doping effect on the spin-polarized states appearing along the graphene zigzag edges. Our studies reveal that the peculiar electronic, magnetic and transport properties of graphene nanostructured systems. In addition, we present our recent work on graphene double layer structure (GDLS), where two graphene layers are separated by a thin dielectric. We will discuss the dielectric environment effect on the charged-impurity-limited carrier mobility of the GDLS on the basis of the Boltzmann transport theory. It is found that carrier mobility strongly depends on the dielectric constant of the barrier layer if the interlayer distance becomes larger than the inverse of the Fermi wave vector. Our results suggest effective use of ultra-thin dielectric barriers and a practical design strategy to improve the charged-impurity-limited mobility of the GDLS.

[1] *K. Wakabayashi, Physics and Chemistry of Graphene: Graphene to Nanographene, Pan Stanford Publishing, 2012 ISBN-13: 978-9814241489, Chapter 4,* ***[2]*** *K. Wakabayashi and S. Dutta, Solid States Communications, vol. 152, 1420-1430 (2012).,* ***[3]*** *K. Hosono, K. Wakabayashi, Appl. Phys. Lett. vol. 103, 033102 (2013).*

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