Two Dimensional Anderson Mobility Edge in Antidot Graphene

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Abstract

Anderson localization [1] is one of the most important physical phenomena caused by the wave nature of quantum particles. It was originally proposed for the electronic system, but never clearly observed because the wave nature of electrons is usually only manifest at extremely small distances, denoted the dephasing length, and therefore making its observation very difficult. Through exponential sample size scaling of conductance, we have demonstrated Anderson localization in two-dimensional (2D) nanostructured antidot graphene samples at the charge neutrality point (CNP) [2]. The opening of the correlation quasigap, observable below 25 K through the temperature dependence of hopping conductance, makes possible the exponential suppression of inelastic scatterings and thereby leads to the observed large dephasing length. Large-scale mesoscopic transport may provide promising future to graphene nanoelectronic device applications.

In this work, we report the existence of the 2D Anderson mobility edge in antidot graphene. The earlier experimental results has revealed the existence of Anderson localization at the band boundaries near CNP while this phenomena was absent at higher energy, which indicates that there is a localization-to-delocalization transition at a certain critical energy, and hints the existence of a mobility edge in the two-dimensional antidot graphene [3]. The same approach is adopted to study the localization length of antidot graphene as a function of energy at low temperature. We observed that by tuning the energy (gate voltage) the localization length increased dramatically, displaying an approximately exponential behavior at a certain critical energy, around 35 meV above the CNP. The obtained critical energy in experiment is consistent with the value acquired from the maximally crossed diagram calculations.

References

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