Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Electronic Transport Properties of Semiconductor Nanostructures

By

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With reduced size and dimensions, semiconductor nanostructures have shown dramatic differences in electrical properties from their bulk counterparts. These differences have given rise to novel phenomena and contents, such as quantum Hall effects and bandgap engineering. By utilizing those properties, numerous electrical devices have been proposed and created to improve life quality and productivity.

Graphene, carbon atoms formed in only one atom-layer, was experimentally discovered in 2004 and raised a lot of attention. It has unique electronic band structure and promising applications. Many fundamental physics questions and practical limitations on device functions need to be addressed.

We have investigated the low frequency 1/f noise, which poses a limit on the signal-to-noise ratio in broad band electrical circuit, in both suspended and on-substrate graphene field-effect transistors. We have found that, compared to on-substrate devices, in general suspended graphene devices show lower 1/f noise, as a result of their higher mobility. We explain the observed noise dependence on gate voltage using the Hooge's empirical relation between noise amplitude and the number of charge carriers in the device's channel, with a variable proportionality parameter (or Hooge parameter). This parameter is correlated with the device's mobility and possibly the microscopic details of each device.

This dissertation also includes studies on quantum Hall effect, metal-insulator transition and spatially resolved photocurrent in graphene. Moreover, optical bandgap and electrical properties of $(GaN)_{1-x}(ZnO)_x$ solid solution nanowire have been studied to explore the possibility of using this material as a photovoltaic catalyst in water splitting for generating renewable energy.

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