N2-P019

Electrical transport characteristics of deoxyribonucleic acid conjugated graphene field-effect transistors

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Graphene is a good candidate for the future nano-electronic materials because it has excellent conductivity, mobility, transparency, flexibility and others. Until now, most graphene researches are focused on the nano electronic device applications, however, biological application of graphene has been relatively less reported. We have fabricated a deoxyribonucleic acid (DNA) conjugated graphene field-effect transistor (FET) and measured the electrical transport characteristics. We have used graphene sheets grown on Ni substrates by chemical vapour deposition. The Raman spectra of graphene sheets indicate high quality and only a few number of layers. The synthesized graphene is transferred on top of the substrate with pre-patterned electrodes by the floating-and-scooping method [1]. Then we applied adhesive tapes on the surface of the graphene to define graphene flakes of a few micron sizes near the electrodes. The current-voltage characteristic of the graphene layer before stripping shows linear zero gate bias conductance and no gate operation. After stripping, the zero gate bias conductance of the device is reduced and clear gate operation is observed. The change of FET characteristics before and after stripping is due to the formation of a micron size graphene flake. After combined with 30 base pairs single-stranded poly(dT) DNA molecules, the conductance and gate operation of the graphene flake FETs become slightly smaller than that of the pristine ones. It is considered that DNA is to be stably binding to the graphene layer due to the π - π stacking interaction between nucleic bases and the surface of graphene. And this binding can modulate the electrical transport properties of graphene FETs. We also calculate the field-effect mobility of pristine and DNA conjugated graphene FET devices.

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Keywords: Graphene, Field-effect Transistor, Deoxyribonucleic Acid