TW-P007

The Effects of Work Function of Metal in Graphene Field-effect Transistors

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Graphene field-effect transistors (GFET) is one of candidates for future high speed electronic devices since graphene has unique electronic properties such as high Fermi velocity (vf=10^6 m/s) and carrier mobility (15,000 $cm^2/V \cdot s$) [1]. Although the contact property between graphene and metals is a crucial element to design high performance electronic devices, it has not been clearly identified. Therefore, we need to understand characteristics of graphene/metal contact in the GFET. Recently, it is theoretically known that graphene on metal can be doped by presence of interface dipole layer induced by charge transfer [2]. It notes that doping type of graphene under metal is determined by difference of work function between graphene and metal. In this study, we present the GFET fabricated by contact metals having high work function (Pt, Ni) for p-doping and low work function (Ta, Cr) for n-doping. The results show that asymmetric conductance depends on work function of metal because the interfacial dipole is locally formed between metal electrodes and graphene. It induces p-n-p or n-p-n junction in the channel of the GFET when gate bias is applied. In addition, we confirm that charge transfer regions are differently affected by gate electric field along gate length.

References

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Keywords: Graphene, Graphene field effect transistors, Graphene-metal contact

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Transparent Conductive Films Composite with Copper Nanoparticle/Graphene Oxide Fabricated by dip Process and Electrospinning

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We explain a method to fabricate multi-layered transparent conductive films (TCF) using graphene oxide (GO), copper powder and polyurethane (PU) solution. The flexible graphene nanosheets (GNSs) serve as nanoscale connection between conductive copper nanoparticles (CuNps) and PU nanofibers, resulting in a highly flexible TCF. To fabricate conductive films with high transmittance, polyurethane (PU) nanofibers were used for a conductive network consisting of CuNps and GNSs (CuNps-GNSs). In this experiment, copper powder and graphene oxides were mixed in deionized water with the ultrasonication for 2 h. NaBH4 solution is used as a reduction agents of CuNps and GNSs (CuNps-GNSs) under a nitrogen atmosphere in the oil bath at 100% for 24 h to mixed. The purified and dispersed CuNp-GNS were obtained in deionized water, and diluted to a 10wt.% based on the contents of GNSs. Polyurethane (PU) nanofibers on a PET substrate were formed by electrospinning method. PET slides coated with the PU nanofibers were immersed into CuNp-GNS solution for several second, rinsed briefly in deionized water, and dried to obtain self-assembled CuNp-GNS/PU films. The morphology of the multi-layered films were characterized with a field emission scanning electron microscope (FE-SEM, Hitachi S-4700) and atomic force microscope (AFM, PSIA XE-100). The electrical property was analysed by the I-V measurement system and the optical property was measured by the UV/VIS spectroscopy.

Keywords: transparent conductive films (TCF), polyurethane (PU) nanofibers, graphene nanosheets (GNSs), copper nanoparticles (CuNps)