S-012

Control the Work Function and Plasmon Effect on Graphene Surface Using Metal Nanoparticles for High Performance Optoelectronics

Si Jin Park, Seong Jun Kang*

Department of Advanced Materials Engineering for Information and Electronics, Kyung Hee University, 1 Seocheon-dong, Giheung-gu, Yongin-si, Gyeonggi-do 446-701, Korea

We have controlled the graphene surface in two ways to improve the device performance of optoelectronics based on graphene transparent conductive films. We controlled multilayer graphene (MLG) work function and localized surface plasmon resonance wavelength using a silver nanoparticles formed on graphene surface. Graphene substrates were prepared using a chemical vapor deposition and transfer process. Various size of silver nanoparticles were prepared using a thermal evaporator and post annealing process on graphene surface. Silver nanoparticles were confirmed by using scanning electron microscopy (SEM). Work functions of graphene surface with various sizes of Ag nanoparticles were measured using ultraviolet photoelectron spectroscopy (UPS). The result shows that the work functions of MLG could be controlled from 4.39 eV to 4.55 eV by coating different amounts of silver nanoparticles while minimal changes in the sheet resistance and transmittance. Also the Localized surface plasmon resonance (LSPR) wavelength was investigated according to various sizes of silver nanoparticles. LSPR wavelength was measured using the absorbance spectrum, and we confirmed that the resonance wavelength could be controlled from 396nm to 425nm according to the size of silver nanoparticles on graphene surface. To confirm improvement of the device performance, we fabricated the organic solar cell based on MLG electrode. The results show that the work function and plasmon resonance wavelength could be controlled to improve the performance of optoelectronics device.

Keywords: Graphene, Silver nanoparticle, Work function, Plasmon resonance

S-013

Surface Chemical Reactions for Metal Organic Semiconductor Films by Alternative Atomic Layer Deposition and Thermal Evaporation

Seong Jun Kim[1,2], Pok Ki Min[1], Jong Sun Lim[1], Ki-Jeong Kong[1], Ki-Seok An[1,2]

[1]Thin Film Materials Laboratory, Korea Research Institute of Chemical Technology, Yuseong Post Office Box 107, Daejeon, [2]Nanomaterials Science and Engineering, University of Science and Technology, Daegeon, Korea

In this work, we demonstrated a facile and effective method for deposition of metal tetraphenylporphyrin (MTPP) thin film by a combined a thermal evaporation (TE) and atomic layer deposition (ALD). For the deposition of Zn-TPP thin film, Tetraphenylporphyrin (TPP) and diethyl zinc (DEZ) were used as organic and inorganic materials, respectively. Optimum conditions for the deposition of Zn-TPP thin film were established systematically: (1) the exposure time of DEZ as inorganic precursor and (2) the substrate temperature were adjusted, respectively. As a result, we verified that the surface reaction between organic semiconductor (TPP) and metal atom (Zn) was ALD process. In addition, we calculated activation energy by using Arrhenius equation for the substrate temperature versus area change rate of pyrrolic nitrogen. The surface and interface reactions between TPP with Zn were investigated by X-ray photoelectron spectroscopy, Raman spectroscopy, UV-vis spectroscopy, and scanning electron microscopy. These results show a facile and well-controllable fabrication technique for the metal-organic thin film for future electronic applications.

Keywords: ZnTPP thin film, ALD