Graphene-based gas molecular sensor and hybrid transparent electrode applications

HongKyw Choi[1], Jinsik Choi[1], Seung-Bok Yang[2], Il-Doo Kim[2], Sung-Yool Choi[3], Young-Jun Yu[1], Choon-Gi Choi[1]

[1]Creative Research Center for Graphene Electronics, ETRI, 305-700, Daejeon, KOREA
[2]Dept. of Material Science and Engineering, KAIST, 305-701, Daejeon, KOREA
[3]Dept. of Electrical Engineering and Graphene research center, KAIST, 305-701, Daejeon, KOREA
yjyu@etri.re.kr, cgchoi@etri.re.kr

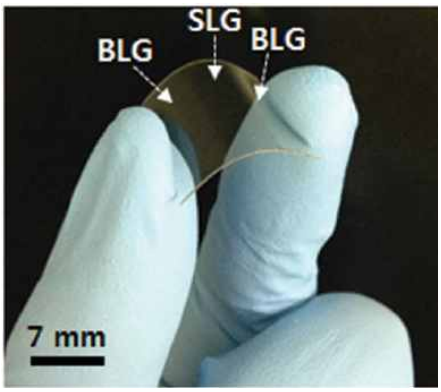
In this work we presents our recent results on the applications of graphene based materials to flexible and transparent graphene gas molecular sensor and AgNWs-graphene hybrid transparent electrode with IPL sintering.
Utilizing the electrical response to adsorbed molecules on sp^2-bonded carbon networks, field effect transistors based on graphene and graphene oxide have been used in gas sensor applications. In our work we demonstrates that the fast responsive and significantly sensitive graphene gas sensor without hampering of both flexibility and transparency, the high quality of sp^2 carbon bonding for sharp sensing response. Here, we demonstrated large-sized flexible and transparent gas molecules sensor based on high quality graphene on polyethersulfone substrate. This combination structure allows us to optical transmittance higher than 90% and invariable sensing performance under 0.7 % of bending strain.

For years, the industry of transparent conductive electrodes has been dominated by ITO. However, from the beginning, ITO was expensive and difficult to apply for thin film of sufficient quality due to high processing temperature, film brittleness, and low abundance. For these problems, AgNWs network is most promising due to the highest electrical conductivity and high optical transmittance. However, AgNWs have some obstacles, including the increase of contact resistance by the sulfurization and thermal oxidation of AgNWs. Here we reported that graphene layers facilitated the heat transfer from graphene to AgNWs by effectively absorbing light energy, resulting in improved sintering efficiency at the contact between Ag wires. We demonstrates that optical sintering is an efficient way to provide facile welding of Ag wire-to-wire junctions in a stacked electrode of graphene/AgNWs, leading to enhanced conductivity as well as superior long-term stability under oxygen and sulfur atmospheres.

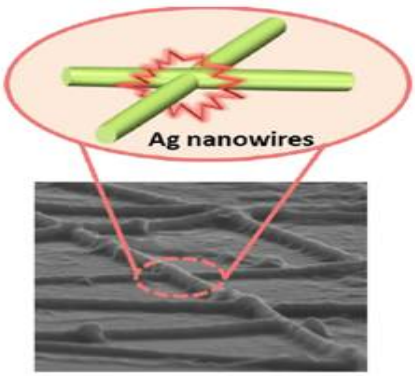
References

[1] H. Y. Jeong, et. al. *Appl. Phys. Lett.*, 96(2010), 213105
[2] J. Lee, et. al., *Adv. Funct. Mater. 23* (2013), 4171-4176

Figures



<Flexible and transparent graphene gas sensor>



< AgNWs-graphene hybrid transparent electrode>