Study of Graphene Field Effect Transistor using Electrolyte Gate

Chan Kim [1]
Sungwook Hong [2]

[1] *Department of Physics, Kyungpook National University, 80 Daehakro, Bukgu, Daegu 41566, South Korea*
2 Division of Science Education, Daegu University, 201 Daegudae-ro, Gyeongsan-si, Gyeongsangbuk-do 38453, South Korea

chankim@knu.ac.kr

Abstract

The electric field effect in graphite or graphene can be observed by the change of the resistivity(ρ) and the hole resistance(R_H) by the gate voltage (Vg). Since the resistivity and carrier density of graphene vary with gate voltage, graphene can be used as the channel layer of a field effect transistors (FET). Studies have been conducted on the application of electrolyte gates to make high carrier densities because by increasing the carrier density of graphene by the gate voltage cab improve the electrical properties of graphene.
In this study, the field effect transistor with a single layer of graphene as a channel layer was compared and evaluated in the case of a general gate structure with SiO_2 insulating layer and the case of using an electrolyte as a gate. The graphene was formed by a typical CVD method, transferred to a SiO_2/Si substrate, and a gold pattern electrode was deposited to measure electrical characteristics. The change in resistivity at a lower gate voltage was confirmed when using an electrolyte gate, compared to a typical gate structure with a SiO_2 insulator layer, which means that the increase in carrier concentration of graphene is much more advantageous for the electrolyte gate.

References

[1] A. K. Geim and K. S. Novoselov, Nature materials, 6 (2007) 183
[2] A. K. Gein, Science, 324 (2009) 1530
[3] D. K. Efetov et al, Phys. Rev. B, 84 (2011) 161412
[4] D. Costanzo et al, Nature nanotechnology, 11 (2016) 339
[5] T. Katase et al, PNAS, 111 (2014) 3979
[6] R. C. Ordonez et al, Scientific Reports, 7 (2017) 10171

Figures

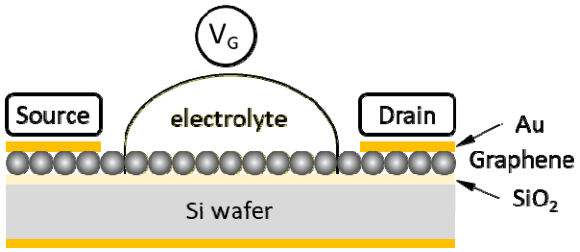

Figure 1: Schematic of graphene channel field effect transistor with electrolyte gate