Dry-transfer process and interface engineering for high performance graphene transistor

Sung-Yool Choi
Dept. of Electrical Engineering and Graphene Research Center, KAIST

Graphene has attracted explosive attentions due to its unique and outstanding electrical, optical, and mechanical properties. Chemical vapor deposition (CVD) has been most widely utilized among various production methods of high quality graphene, because it enables low-cost growth of large area, high quality graphene with good electrical properties. In this talk, I will discuss recent advances in the dry-transfer process for CVD-grown graphene and the interface engineering between graphene channel and dielectrics for graphene transistors with high electrical performance.

Applying CVD-grown graphene channels to electronic devices requires a transfer process to dielectric substrates. Although PMMA-assisted wet transfer of graphene has been used, ionic impurities from etchant and by-product of metal etching trapped at the interface between graphene and target substrate result in the degradation of electrical performance and the reliability of the fabricated devices [1]. For realizing high-performance graphene transistor, the integration of high quality gate dielectrics on graphene is also a key technical challenge because the quality of interface between the dielectrics and graphene channel affects the electrical characteristics of graphene devices, such as operating voltage, scaling capability, and device reliability [2]. To address these issues, we propose a novel method for graphene transfer on various substrates with direct delamination of graphene and a new approach for integration of high-k dielectrics on graphene using a functionalized graphene monolayer as an ultrathin seed layer on top of the graphene channel [3]. Graphene transistors with top gate structure fabricated on SiO_2 using these methods show narrower distribution of Dirac voltages and enhanced device performances. In addition, the related issues for transfer and device fabrication on flexible substrate will be discussed.

[1] W.C. Shin et al., Doping suppression and mobility enhancement of graphene transistors fabricated using an adhesion promoting dry transfer process, Applied Physics Letters, 103, 243504 (2013)
[2] W.C. Shin et al., Functionalized Graphene as an Ultrathin Seed Layer for the Atomic Layer Deposition of Conformal High‐k Dielectrics on Graphene, ACS Appl. Mater. Interfaces, 5, 11515 (2013)
[3] S. Y. Yang et al., Metal etching-free, direct delamination and transfer method of single layer graphene, (in review)