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Simultaneous Transfer and Patterning of CVD-Grown Graphene with No Polymeric Residues by Using a Metal Etch Mask

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Graphene, two dimensional single layer of carbon atoms, has tremendous attention due to its superior property such as high electron mobility, high thermal conductivity and optical transparency. Especially, chemical vapor deposition (CVD) grown graphene has been used as a promising material for high quality and large-scale graphene film. Unfortunately, although CVD-grown graphene has strong advantages, application of the CVD-grown graphene is limited due to ineffective transfer process that delivers the graphene onto a desired substrate by using polymer support layer such as PMMA(polymethyl methacrylate). The transferred CVD-grown graphene has serious drawback due to remaining polymeric residues generated during transfer process, which induces the poor physical and electrical characteristics by a p-doping effect and impurity scattering. To solve such issue incurred during polymer transfer process of CVD-grown graphene, various approaches including thermal annealing, chemical cleaning, mechanical cleaning have been tried but were not successful in getting rid of polymeric residues. On the other hand, lithographical patterning of graphene is an essential step in any form of microelectronic processing and most of conventional lithographic techniques employ photoresist for the definition of graphene patterns on substrates. But, application of photoresist is undesirable because of the presence of residual polymers that contaminate the graphene surface consistent with the effects generated during transfer process. Therefore, in order to fully utilize the excellent properties of CVD-grown graphene, new approach of transfer and patterning techniques which can avoid polymeric residue problem needs to be developed. In this work, we carried out transfer and patterning process simultaneously with no polymeric residue by using a metal etch mask. The patterned thin gold layer was deposited on CVD-grown graphene instead of photoresists in order to make much cleaner and smoother surface and then transferred onto a desired substrate with PMMA, which does not directly contact with graphene surface. We compare the surface properties and patterning morphology of graphene by scanning electron microscopy (SEM), atomic force microscopy(AFM) and Raman spectroscopy. Comparison with the effect of residual polymer and metal on performance of graphene FET will be discussed.

Keywords: CVD grown graphene, Transfer, Patterning, Polymer residue, Metal etch mask