Epoxy-Enabled Simultaneous Intact transfer and Highly Efficient Doping for Roll-to-Roll Production of High-Performance Graphene Films

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Flexible transparent conductive film (TCF) is an essential component of next-generation wearable optoelectronic devices. Graphene has been considered to be an ideal candidate for flexible TCF because of its excellent electrical conductivity, high optical transmittance, good flexibility and chemical stability. Chemical vapor deposition (CVD) growth of monolayer graphene on Cu foil and subsequent transfer to transparent substrates such as polyethylene terephthalate (PET) has been widely used for producing large-area flexible graphene TCF. However, two bottle-neck issues must be addressed prior to its commercialization including the lack of a low-cost continuous process for intact transfer and the lower overall performances relative to commercial ITO film. In this work, we report that one type of epoxy adhesive is a robust multifunctional layer for low-cost scalable production of high-performance flexible graphene TCFs. Different from the common adhesives, the epoxy adhesive enables the intact transfer of graphene due to its high solvent stability as well as sufficient adhesion force and conformal contact with graphene. More importantly, this particular adhesive serves as not only a simple binding layer but also an efficient doping layer by in situ generating a highly strong and stable dopant, which substantially reduces the sheet resistance of pristine graphene by 95% with excellent stability. By integrating epoxy adhesive with bubbling transfer and roll-to-roll process, we demonstrate the continuous production of graphene TCFs with overall performances superior to those produced by typical dopants or common transfer methods. We further show that the high-performance graphene film can be used as the transparent electrodes in typical optoelectronic devices.

References

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