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Scalable and Facile Production of Conformal Graphene as Low-Cost Transparent Electrodes for Organic Photovoltaics

Abstract.

Transparent electrodes are a key component in many modern optoelectronics devices. Traditionally, this role has been well served by indium tin oxide (ITO). However, with indium (In) as a rare earth material, using ITO as transparent electrodes faces challenges of rising costs and unstable supply. To address this grand challenge, this interdisciplinary team proposes to use graphene to replace ITO for transparent electrodes. The overarching ***goal*** of the proposed research is to achieve scalable and facile nanomanufacturing of conformal graphene electrodes on dielectric substrates for meter-scale organic photovoltaics (OPVs) application. Research efforts will be made to achieve the following objectives: 1) computer-aided mechanism investigation of graphene formation and Ni evaporation in the RTP process, 2) controllable formation of graphene on dielectric substrates, 3) scalable nanomanufacturing of conformal graphene electrodes, and 4) fabricating graphene-based OPV. The *interdisciplinary* team will establish a scalable and facile approach to nanomanufacturing conformal graphene electrodes on dielectric substrates for fabricating meter-scale organic photovoltaic panels. Direct formation of graphene will be achieved on various dielectric surfaces via a single-step rapid thermal processing (RTP) of dielectric surfaces coated with carbon (C) and nickel (Ni) without further catalyst etching and graphene transfer processes. High-quality graphene will be obtained uniformly at a full coverage with a controlled number of graphene layers. Successful implementation of the proposed project will achieve scalable and facile nanomanufacturing of conformal graphene on dielectric substrates to replace ITO for transparent electrodes. The proposed research will provide a pathway to realize large-scale and cost-effective production of graphene-based OPVs. Scientifically, the project will expand understanding of graphene synthesis from catalytic metals (such as Ni).