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Direct Deposition of Graphene Nanomaterial Films on Polymer-Coated Glass by Ultrasonic Spraying

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Abstract

In this work, suspensions of two types of graphene nanomaterials – graphene nanoflowers (GNFs) and multilayer graphene (MLG) flakes – were ultrasonically sprayed into micrometer-sized droplets to directly form films on glass and methacrylic acid copolymer (MA)-modified glass substrates. Poly(vinylidene fluoride) (PVDF) was added to the suspensions to enhance the structural robustness of films. While PVDF enhanced nanomaterial binding, the MA coating boosted nanomaterial adhesion to the substrate. The films' morphology, adhesion, and electrical properties were investigated. MLG flakes produced highly irregular films, conversely GNFs formed thinner and more uniform layers. In the case of MLG flakes, films on MA-coated glass showed lower resistances compared to those on glass. GNF suspensions sprayed on MA-coated glass resulted in graphene nanostructures embedded in a predominantly dielectric polymer matrix. Thus, in the case of GNFs, films on glass exhibited lower resistances compared to those on MA-coated glass. The approach described herein can be readily extended to create films of other graphene-based materials on a variety of substrates.

Keywords: Graphene nanoflowers; Multi-layer graphene; Poly(vinylidene fluoride); Ultrasonic spray; Adhesion.

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