Strong and lightweight multi-functional macro-scale CVD graphene/PMMA nanolaminates

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ABSTRACT

Graphene, with its superior mechanical, electrical and thermal properties, is the perfect candidate as reinforcement in lightweight, high strength composite materials with interesting multi-functionalities. Since now, graphene has been adopted mainly in the form of separate flakes (e.g. GNPs) for the production of large scale composites. Nonetheless, the overall mechanical performance of GNP-reinforced composites may be far below the expectations and this has been attributed to the small lateral size of GNPs that leads to inefficient stress transfer with the polymer matrix [1]. An alternative way to overcome this issue is represented by the incorporation of large size CVD graphene sheets in polymer laminates [2, 3]. In this contribution, we propose a novel bottom-up approach for the production of macro-scale CVD graphene/polymer nanolaminates based on the combination of ultra-thin casting, wet transfer and floating deposition. Actually, by casting ultra-thin polymer films (<50 nm), we produced macroscale nanolaminates with the potential to outperform the current state-of-the-art graphene-based composite materials in both mechanical properties (Eeff~846GPa) and electrical conductivities (up to 90 S/cm). Moreover, the CVD graphene/polymer systems present multifunctional capabilities such as tensile strain sensing, EMI shielding efficiency (~25dB) and an outstanding specific EMI shielding effectiveness (~ 40000 dB cm2 g-1).

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement GrapheneCore2 785219. Furthermore, the authors acknowledge the financial support of the European Research Council (ERC Advanced Grant 2013) via project no. 321124, Tailor Graphene.

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