Preparation of Three-Dimensional (3D) Macroscopic Structure of Graphene-Cellulose Composite using Freeze-drying Technique

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Abstract

The assemblage of graphene sheets into three-dimensional (3D) macroscopic structure without graphite-stacking formation is a crucial technique required among its widespread applications. By taking advantage of cellulose, we propose a simple fabrication of structurally adaptive and 3D macroscopic form of graphene-cellulose composite through a freeze-drying technique. The graphene-cellulose suspension was obtained by adding hydrolyzed cellulosic material to a stabilized graphene-SDS suspension. The graphene-cellulose suspension with a measured or specified ratio composition was subjected to freeze-drying for the preparation of hierarchical structure of graphene-cellulose composite. Transmission electron microscopy and Scanning electron microscopy analysis were both carried out for imaging analysis of graphene and graphene-cellulose composite. Thermal gravimetric analysis was conducted to probe the thermal property of the materials. Imaging and structural analysis of the composite shows that surfactant-assisted prepared graphene tends to have a micro-encapsulation property towards the cellulosic fibres. Thus, the construction of 3D macroscopic form of graphene without stacking arrangement can be achieved through the fibrous and 3D hydrogen bonded network structure of cellulose using a simple freeze-drying technique. Since the marriage chemistry of graphene with cellulose is sparsely investigated, we believed that the combination and preparation of such fascinating material can provide possibilities to explore a great potential of graphene-cellulose composite in its 3D macroscopic form.

References

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Figures