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FLEXIBLE FREE-STANDING COMPOSITE FILMS HAVING 3D CONTINUOUS STRUCTURES OF HOLLOW GRAPHENE ELLIPSOIDS

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Recently, the use of three-dimensional (3D) graphene networks in polymer matrices has attracted a great deal of interest as a new strategy for fabricating highly flexible and conductive graphene-based polymer nanocomposites. In the present work, we investigated 3D continuous network structures based on graphene ellipsoids and the effects of their pore morphology on the properties of their polymer composites. For that matter, the hollow graphene ellipsoids and the free-standing graphene films based on 3D continuous structures of hollow graphene ellipsoids were fabricated and their properties were examined in terms of the structural factor. In order to obtain graphene ellipsoids, positively charged polystyrene (PS) spheres were first wrapped with negatively charged graphene upon simple mixing and their core-shell assembly of spherical nature were transformed to ellipsoids by unidirectional stretching. Graphene-wrapped PS ellipsoids were assembled into films by simple jet-spray coating, and finally, careful calcination of the graphene-PS assembly film resulted in successful formation of 3D networks of hollow graphene ellipsoids. Due to their improved continuity, composites based on the ellipsoids have lower sheet resistances than those based on spherical nanoparticles. Upon folding and application of pressure, composites based on the hollow graphene ellipsoids exhibited superior electrical conductivity and structural stability owing to their high mechanical strength and effective electron transport pathway. The ability to control the face-contact structures of graphene in a polymer matrix by means of particle morphology represents an effective strategy for future composite engineering.

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