GRAPHENE- RUBBER FUNCTIONAL NANOCOMPOSITES:STRUCTURE AND PROPERTIES

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ABSTRACT

Functional elastomers having enhanced electrical and thermal conductivity are desirable in many applications. Graphene can fetch this property, if it is effectively incorporated into the rubber matrix. The great challenge in preparing graphene-rubber nanocomposites is in formulating a scalable and economical method to produce defect free graphene and its homogeneous dispersion into rubber matrices. We have examined several simplemethods to produce defect free few layer (2-5) graphene, capable of being easily dispersed into synthetic and natural rubber. The resulting composite showed large increase in thermal conductivity (480-980 %) along with 40 % increase in tensile properties and 60 % improvement in electrical conductivity. This study provides a novel and generalized approach for the preparation of graphene based thermally conductive rubber nanocomposites.

The success of developing graphene based biomaterials depends on its ease of synthesis, use of environmentally benign methods and low toxicity of the reagents and chemicals involved as well as biocompatibility of the final products/devices.Most graphene preparation methods use neither safe compound for exfoliation of graphite nor provide high production rates. We report, herein, a simple, scalable and safe method to produce defect free few layers graphene using naturally available phenolics i.e. curcumin/tetrahydrocurcumin/quercetin, as solid-phase exfoliating agents with high productivity. The production method can also be employed in liquid-phase using a ball mill and a sand grinder or even an internal mixer. The combined effect of π-π interaction and charge transfer (from curcumin to graphene) is postulated to be the driving force for efficient exfoliation of graphite. Aqueous graphene dispersions, thus produced, were used for the preparation of its thin film nanocomposites with the natural rubber (NR) latex. The obtained nanocomposites show superior tensile strength with low modulus and no loss of % elongation at break compared to NR latex thin film. In-vitro and in-vivo investigations demonstrate that the prepared nanocomposite is biocompatible. This approach could be useful for the production of materials suitable in products (gloves/condoms/catheters), which come in contact with body parts/body fluids.