Facile preparation of graphene-based chitosan films : enhanced thermal, mechanical and antibacterial properties.

ABSTRACT

Chitosan is considered a model polymer because of its excellent biocompatibility, biodegradability, antibacterial property and metal binding ability. Despite the favorable properties, the poor mechanical strength and the loss of structural integrity limits the applications of chitosan. Graphene's intrinsic low weight with excellent thermal stability makes it an ideal filler for reinforcing polymers. In this work, we prepared graphene oxide (GO) via Hummer's method and simplified Hummer's method using graphite powder and graphite flakes as starting materials, respectively. The GO obtained using Hummer's method and simplified Hummer's method had a small area of less than 50 μm2 and a large area of about 7000 μm2, respectively. The small area GO and large area GO were reduced by sodium hydroxide, in which the reduced GO (rGO) with small area and large area were incorporated into a chitosan matrix, respectively, using a simplistic drop-casting technique to produce a thin film. Glass transition temperature (Tg) and mechanical strength of chitosan/large area rGO at concentrations of 0.3, 0.6 and 0.9 wt.% of GO were found to be better than chitosan/small area rGO. We also investigated the Tg and mechanical strength between chitosan/small area GO and chitosan/small area rGO, where we discovered that the former had better thermal and tensile properties. By comparing the Tg and mechanical strength of chitosan/small area GO against chitosan/large area GO, we found that the latter displayed superior thermal and tensile properties. Antibacterial tests were performed on the graphene-based chitosan composites and their ability to act as bactericide was manifested in the retardation of the growth of Pseudomonas aeruginosa. These composite materials with excellent thermal, tensile and antimicrobial properties find real-life applications in the physical, chemical, mechanical, electrical and bioengineering fields.

Keyword: Antibacteria; Chitosan; Film; Graphene oxide; Nanocomposite.