SYNTHESIS AND CHARACTERIZATION OF GRAPHENE-POLYHYDROXYALKANOATES COMPOSITES

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ABSTRACT

The effectiveness of solvent casting synthesis of functional biomaterials based on microbial bioplastics that can be produced via exploitation of organic wastes and graphene materials, was investigated. Subsequently, the potential applications the final composites as active elastic packaging, and electronics properties were assessed via properties analysis.

Among the key parameters that need to be fulfilled for the achievement of homogeneous composites are the good dispersion and interfacial interactions of the nanomaterial in a polymer matrix. Since graghene has poor affinity with most polymers, due to the inert chemical character of their surfaces, their homogeneous distribution in the polymer matrices remains a challenge.

In the current study the embedding of graphene materials into the biopolymers was performed by the solvent casting methodology based, almost throughout the experimental process, on the use of shear mixer and aiming at the same time to achieve a good dispersion as well as further exfoliation of the nanomaterials. Tests were carried out with three different biopolymers, i.e. commercial poly-3-hydroxybutyrate-3-hydroxyvalerate (PHBHV), with monomeric ratio 88:12 (mol:mol), the commercial Poly-3-hydroxybutyrate (PHB), BIOMER P209 a laboratory produced PHBHV with monomeric ratio 97:3 (mol:mol). The graphene materials tested were graphite, graphene, graphene oxide (GO) and reduced graphene oxide (rGO). The factors examined for optimization homogenization during solvent casting were the speed and temperature of mixing, the temperature of evaporation of the solvent, the type of solvent (chloroform and isopropyl alcohol) used for dispersing the nanomaterial, the synthesis of the container used during casting (glass, Teflon), the ratio of solvent to materials (v/w) and the ratio of nanomaterial to biopolymers (w/w). In each test, upon visual assessment of the mixing efficiency in terms of the homogeneity of the composites, SEM analysis, analysis of the thermal properties, and Raman analysis were further performed. Based on the above an optimized protocol was developed, while the composite of the laboratory synthesized PHBHV with GO was identified as the material with optimal properties.

KEYWORDS: functional biomaterials; grapheme, polyhydroxyalkanotes, composites