Mechanical behavior of high crystalline graphene oxide nanoplatelets in a thermoplastic polymer matrix

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The discovering of graphene with its impressive properties has involved the development of large-scale production methods, which is still challenging. Some techniques have been reported in the literature [1]: lithographic, chemical vapor deposition, chemical exfoliation, even methods that unzip carbon nanotubes into graphene layers or nanoplatelets. One of the most feasible, nowadays, is the chemical exfoliation [2]. This technique, traditionally performed from graphite [3], has been recently updated using CNTs as starting material [4], and consists of the intercalation and oxidation of graphene layers in graphite or CNTs to space them into separate graphene. The oxidation is followed by mechanical or thermal exfoliation, improving the yield of the separation into single layers. As innovation, in this work, we propose the use of helical-ribbon carbon nanofibers (HR-CNF), economical alternative of CNTs, as starting material for graphene synthesis by chemical exfoliation. High quality graphene oxide nanoplatelets (GONP) were produced [5].

This new material was introduced in a PMMA thermoplastic polymer matrix. Dispersion, tensile properties and fatigue of GONP/PMMA nanocomposites were studied and compared with PMMA nanocomposites containing pristine HR-CNFs and functionalized HR-CNFs with oxygen and nitrogen groups. GONP are easily exfoliated and more homogeneous dispersion is achieved compared to HR-CNFs (Figure 1 A and B). Furthermore, they provide better mechanical properties, with improvements never seen before with HR-CNFs (Figure 1 C), suggesting high potential of GONPS as reinforcement materials.

References

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Figures

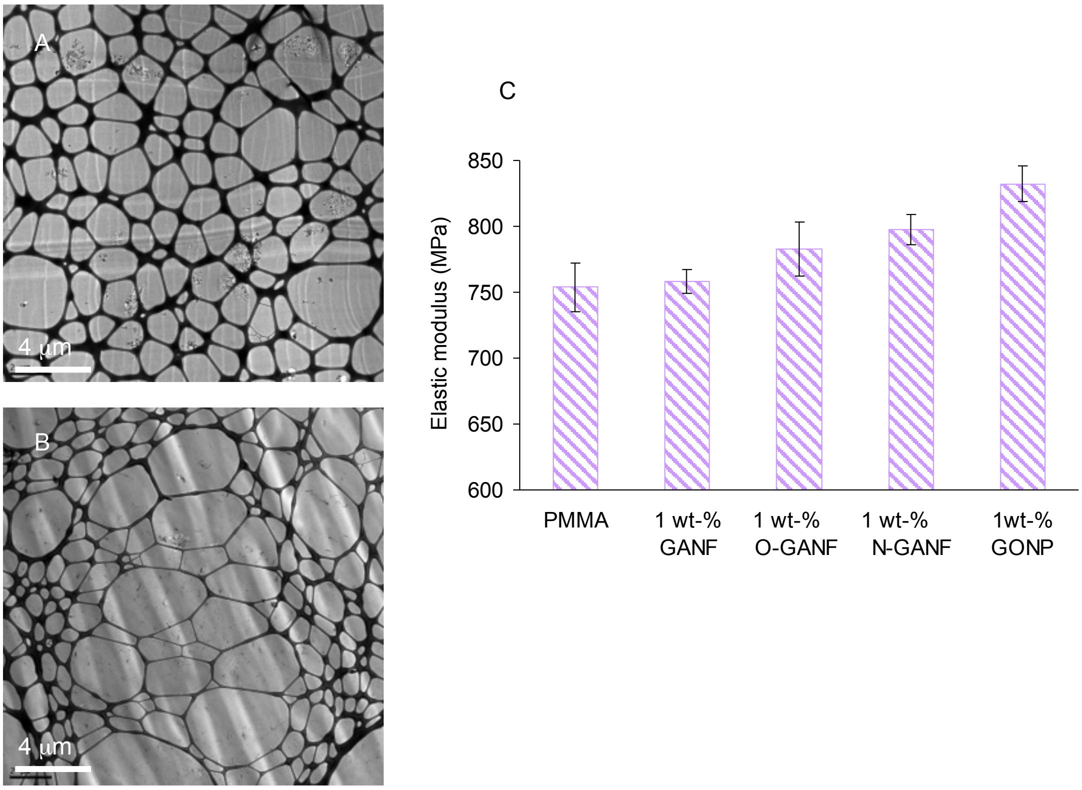

Figure 1. Comparison of GONP/PMMA and HR-CNFs/PMMA nanocomposites: A) Dispersion of HR-CNF/PMMA; B) Dispersion of GONP/PMMA; C) Elastic modulus of pristine and functionalized HR-CNF/PMMA and GONP/PMMA