Modification of graphene with ionic liquid to reduce the electrical percolation threshold in bio-based TPU nanocomposites

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During the last years, the development of polymeric materials obtained from renewable resources have become one of the most interesting research fields due to environmental and economical issues [1]. Bio-based thermoplastic polyurethanes (bTPU) are one example of these kinds of bio-based polymers that are already commercially available.

Several properties of these bio-materials, including mechanical, thermal or electrical properties, can be improved by the addition of nanofillers, such as graphene, obtaining high-performance nanocomposites (NCs). However, one of the main drawbacks when attempting to effectively disperse nanofillers in the polymeric matrix, is their tendency to re-aggregate [2]. As a consequence, the electrical percolation threshold is usually rather high and the extent of mechanical properties' improvement limited.

In this work, bTPU/graphene NCs were obtained by melt mixing. In order to reduce the re-aggregation of neat graphene during processing, it was previously modified with an ionic liquid. The NCs were obtained by extrusion and the standard test specimens were obtained by injection and compression moulding. The phase structure, the nanostructure and the electrical and mechanical properties were characterized and compared.

The modification of the graphene with the ionic liquid caused an improved dispersion that led, in turn, to a significantly lower electrical percolation threshold (Figure 1). However, the Young's modulus of the NCs was not affected because the positive effect produced by the improved dispersion was counteracted by the negative effect provoked by ionic liquid (Figure 2).

References

[1] Gandini, A., Green Chem., 13 (2011) 1061.
[2] Phiri, J., Gane, P., Maloney, T.C., Mater. Sci. Eng., B, 215 (2017) 9.

Figures

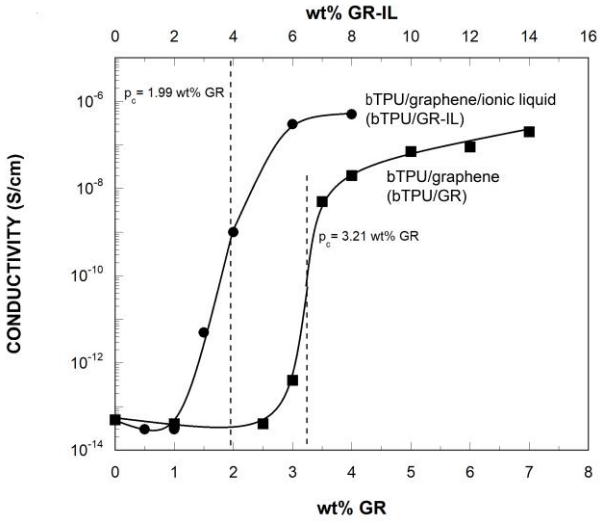

Figure 1: Electrical conductivity of bTPU/GR-IL (●) and bTPU/GR (■) NCs, as a function of both GR and GR-IL contents.

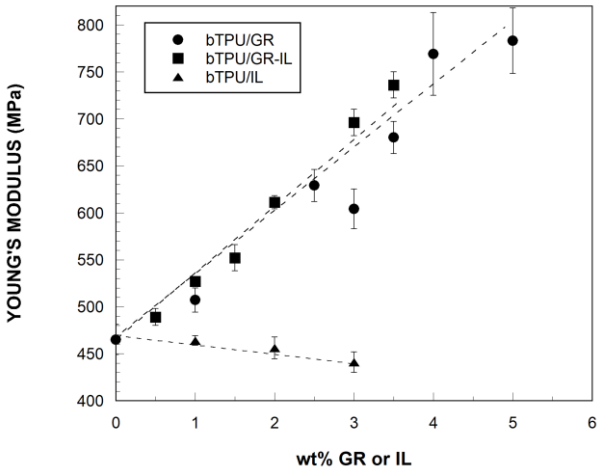

Figure 2: Young's modulus of bTPU/GR and bTPU/GR-IL NCs and bTPU/IL blends.