INFLUENCE OF GRAPHENE NANOPARTICLES ON THE THERMAL STABILITY OF POLYCARBONATE NANOCOMPOSITE FOAMS

Gabriel Gedler, Marcelo Antunes, Vera Realinho, José Ignacio Velasco

Centre Català del Plàstic, Departament de Ciència dels Materials i Enginyeria Metal·lúrgica, Universitat Politècnica de Catalunya-BarcelonaTech. C/Colom 114, E-08222 Terrassa (Barcelona), Spain.
(*gabriel.gedler@upc.edu*)

Graphene-based nanocomposites is an important subject of interest nowadays.[1] Knowledge of foams made from these materials is still pretty scarce, mainly due to their multiphase nature, direct result of the combination of a complex developed cellular structure and polymer microstructure.[2] So far, only a few works have investigated the thermal degradation of graphene-based foamed composites.[3-4]

In the present communication, a thermogravimetric study under both nitrogen and air atmospheres was carried out on unfilled and graphene-reinforced solid and foamed polycarbonate composites. The polycarbonate (PC) foams with graphene were prepared using a sc-CO_2 dissolution process. It was found that the decomposition occurred in a one-step decomposition process under nitrogen and in a three-step degradation process in air (Fig. 1). The thermal stability of PC increased with foaming, with the lower relative density materials being the ones that delayed decomposition the most during the first stage in both atmospheres, which was related to their higher thermal insulation. A linear relationship was found between the temperature of maximum mass loss and relative density. In addition, the well dispersed graphene nanoparticles improved the thermal stability of polycarbonate due to their barrier effect, delaying both the escape of volatile decomposition products as well as the thermo-oxidative degradation of the material.[5] Finally, a complete thermo-oxidative decomposition of the char formed in the first process was observed in air, accelerating the degradation process and resulting in zero residues obtained at the end of the process.

The results presented in this work demonstrate that the combination of incorporating small amounts of graphene nanoparticles to a polycarbonate matrix and later foaming significantly improves the thermal stability of

polycarbonate, opening up a wider range of applications of this material as thermally-improved lightweight component.

References

1. Sengupta R, Bhattacharya M, Bandyopadhyay S, et al. Prog. Polym. Sci. 36:638-70, 2011.
2. Beechem T and Lafdi K. Carbon 44:1548-59, 2006.
3. Verdejo R, Saiz-Arroyo C , Carretero-Gonzalez J, Barroso-Bujans F, Rodriguez-Perez M, Lopez-Manchado M. Eur. Polym. J. 44:2790-7, 2008.
4. Yang J, Wu M, Chen F, Fei Z, Zhong M. J. Supercrit. Fluids 56:201-7, 2011.
5.Gedler G, Antunes M, Realinho V, Velasco J.I. Polym. Degrad. Stab (2012), doi:10.1016/j.polymdegradstab.2012.05.027.

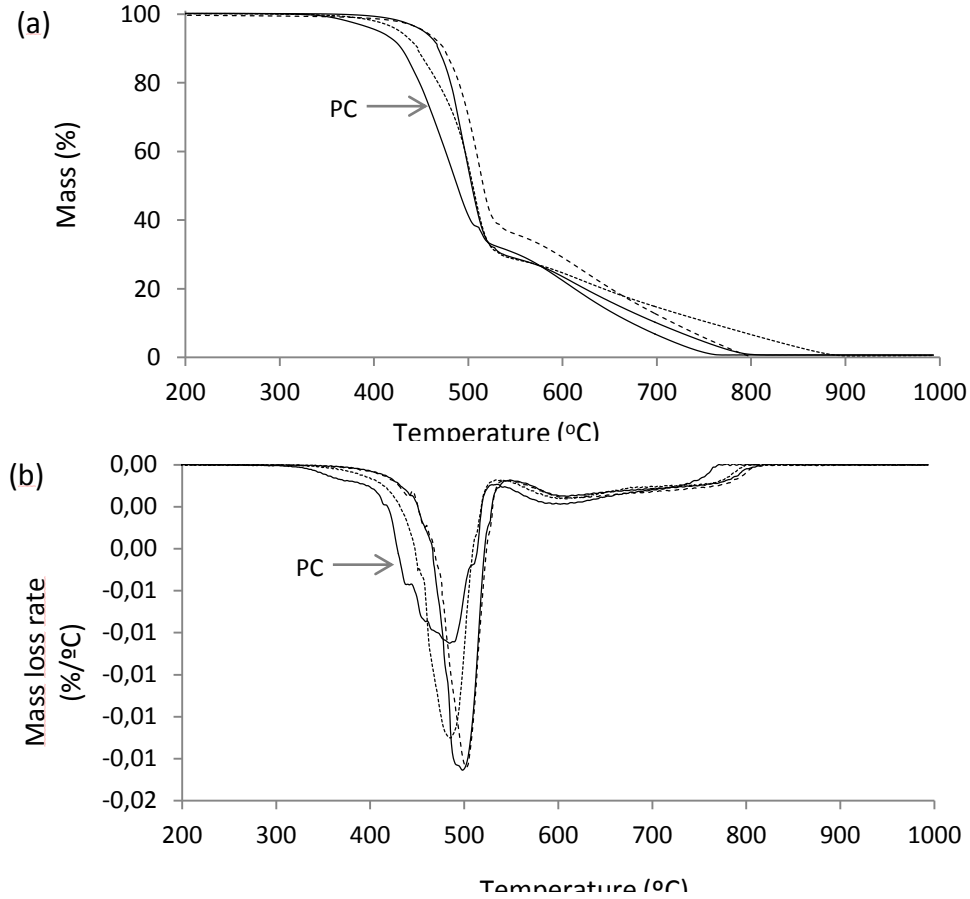

Figure 1. (a) TGA and (b) DTG curves under air atmospheres for the unfilled solid (PC), the foamed PC (PC-f, dotted line), the graphene-reinforced solid nanocomposite (PCg, continuous line) and the foamed nanocomposite (PCg-f, dashed line), obtained at a heating rate of 10 ºC/min.