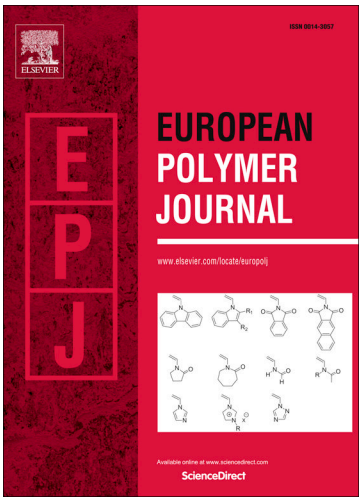

The effects of nano-sized carbon fillers on the physico-chemical, mechanical, and biological properties of polyester nanocomposites

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The effects of nano-sized carbon fillers on the physico-chemical, mechanical, and biological properties of polyester nanocomposites

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Abstract

Nanocomposites based on poly(ethylene terephthalate-ethylene dilinoleate) (PET-DLA) copolymers of different hard to soft segment ratios (40:60 and 60:40) and three different carbon nanofillers of different aspect ratios (dimensions), as 0D carbon black, 1D multiwalled carbon nanotubes, and 2D graphene, have been prepared *in situ* during two-stage polymerization. Fourier transform infrared (FTIR) and nuclear magnetic resonance (NMR) spectroscopy were used to characterize the chemical structures of the obtained nanocomposites. Scanning electron microscopy (SEM) indicated very good dispersions of all carbon nanofillers in both polymer matrices. Differential scanning calorimetry (DSC) results revealed that the addition of nano-sized fillers eliminated cold crystallization of materials containing 40% hard segments in polymer matrix. We found that the high aspect ratio, 1D nano-filler (multiwalled carbon nanotubes) strongly nucleated crystallization of materials containing 60% of hard segments. This nanofiller also yielded the greatest improvement in the Young's modulus as assessed by tensile tests, both at 24 ºC and 37 ºC. We did not observe reduced bacterial adhesion to nanocomposites, likely due to increased roughness. Importantly, *in vitro* cytocompatibility tests with L929 murine fibroblasts demonstrated cell viability and growth on all materials except those containing carbon nanotubes. Finally, both high aspect ratio nanofillers markedly improved the barrier properties of obtained nanocomposites. New materials were successfully used for manufacturing of prototype of heart assist device, with pneumatic membrane made of graphene nanocomposite.

Key words: *thermoplastic elastomers; nanocomposites; carbon nanotubes; graphene; carbon black; heart assist device*