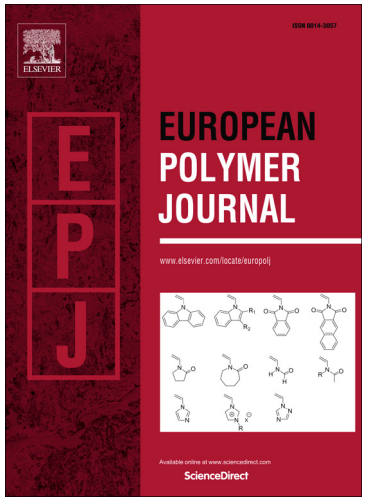

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Light and gas barrier properties of PLLA/metallic nanoparticles composite films

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Abstract

Herein we attempt to provide a deeper understanding on the influence of metal oxide nanoparticle incorporation on the gas transport properties of resulting polymer-based nanocomposites. Polylactide has been used as a model biodegradable material to develop nanocomposites containing 1 v/v % of TiO_2, SiO_2, Fe_2O_3 and Al_2O_3 spherical particles. These nanoparticles were characterized by transmission electron microscopy (TEM), X-ray and ζ-potential measurements. Thermal properties of nanocomposites were analyzed by differential scanning calorimetry (DSC), while scanning electron microscopy (SEM) has been used to correlate nanoparticle dispersion with both light and gas barrier properties. UV-Vis spectroscopy indicates a good UV-shielding performance of developed films. Water vapour transmission rate and oxygen permeability of nanocomposites were further determined and obtained results have been correlated to the effect of interactions between the incorporated nanoparticles and water/oxygen molecules. Taking into account that only 1 % of nanoparticles have been added, noticeable improvement of the barrier character of polylactide to water vapour, up to 18 %, and wet oxygen, up to 9 %, have been observed. Finally, Maxwell, Bruggeman, Böttcher and Higuchi models have been applied for our two-phase mixed matrix membranes to predict the permeability of dry oxygen. Overall, the experimental findings here shown provide better understanding towards the design of membrane devices based on biodegradable materials with tailored light and gas permeability for specific industrial applications.

Keywords: Poly(L-lactide); metallic nanoparticle, nanocomposites; gas transport; packaging.