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Polylactic acid, maleic anhydride and dicumyl peroxide: NMR study of the free-radical melt reaction product

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Abstract

In this study, a detailed characterization was carried out of a product formed in the melt reaction of poly(lactic acid) PLA with maleic anhydride, initiated by dicumyl peroxide under the reaction conditions reported herein. The chemical structure of the reaction product was determined by ^{1}H-NMR and ^{13}C-NMR spectroscopy and by DEPT-135 and ^{13}C-^{1}H HSQC techniques. It was found that, under the conditions applied in this study, instead of the well-reported grafting of maleic anhydride onto the PLA, a product was formed from the reaction of two PLA macro-radicals, which probably occurs after the β-scission mechanism. The ^{13}C-NMR spectrum of the proposed reaction product was also calculated using the GIAO-DFT method and the result is in agreement with the experimental spectrum.

Keywords: Polymer grafting, grafted PLA, chemical modification

Introduction

The chemical modification of polymers by means of grafting is an interesting way to adjust the physical-chemical properties of polymeric materials for specific applications. Polymer grafting has been employed for different purposes, for example, to improve the compatibility between components in blends and composites [1-3]. In this regard, maleic anhydride (MA) is one of the most commonly used compounds, since it can be easily grafted onto polyolefins and polyesters in the presence of a