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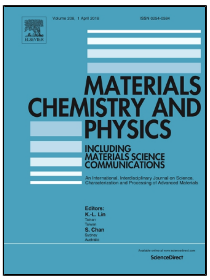

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Enhanced Mechanical and Gas Barrier Properties of Poly(ε-caprolactone) Nanocomposites Filled with Tannic Acid-Fe(III) Functionalized High Aspect Ratio Layered Double Hydroxides

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Abstract：Inspired by versatile adhesive ability of mussel adhesion proteins, tannic acid-Fe(III) functionalized high aspect ratio layered double hydroxides (LDHs@TA-Fe(III)) was firstly prepared via a facile and fast deposition of one-step assembled TA-Fe(III) coatings on the surface of layered clay. LDHs@TA-Fe(III)/Poly(ε-caprolactone) (PCL) nanocomposites were prepared by blending LDH@PDA and pure PCL via solution casting method to obtain homogeneous films. The results of thermal analysis confirm that LDHs@TA-Fe(III) can act as a nucleating agent. It is revealed that the inclusion of LDHs@TA-Fe(III) up to an appropriate level of content resulted in a remarkable enhancement in the mechanical and gas barrier properties. However, excess LDHs@TA-Fe(III) loadings give rise to a decrease in the mechanical properties. With incorporation of only 1 *wt*% LDHs@TA-Fe(III), a 47% increase in elongation at break and 21% reduction in the oxygen relative permeability are achieved. The reinforcement effect brought by LDHs@TA-Fe(III) is fairly noteworthy at low clay loadings potentially owing to the strong interfacial interactions between the clay and matrix.

Keywords: Layered double hydroxides; Tannic acid; Surface coating; Nanocomposites; Barrier properties.

1. INTRODUCTION

Food packaging allows maintenance of products in a suitable atmosphere (e.g., limited oxygen concentration or moisture content, etc.) for the duration of its shelf life.[1, 2] To prevent gas and water vapor diffusion through the packaging, composite multilayers or metallized films are traditionally used, leading to technical problems in recycling.[2, 3] Meanwhile, most of polymer based packaging films are synthesised from non-renewable fossil fuels, consumed and discarded in our environment, ending up as spontaneously undegradable wastes.[2, 3] In order to solve this problem, it is strongly essential to develop fully biodegradable polymer based packaging materials with regulatable performance in the packaging industry to alleviate the dependence on petroleum-based polymers. Until now, aliphatic polyesters are the most promising materials for the production of high performance environment friendly biodegradable plastics. Among of them, Poly(ε-caprolactone) (PCL) is a linear, and semicrystalline polyester that can be slowly degraded by microorganisms. The physical properties and commercial availability of PCL makes it a considerable substitute for conventional non-biodegradable polymers, giving rise to common

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