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Mechanical and water resistance properties of chitosan/poly(vinyl alcohol) films reinforced with attapulgite dispersed by high-pressure homogenization

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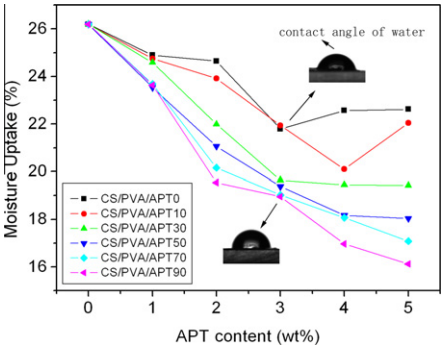
HIGHLIGHTS

- APT by high-pressure homogenization can well disperse in the CS/PVA matrix.
- Mechanical properties of CS/PVA/APT films increase due to disaggregate of crystal bundles.
- Water resistances of CS/PVA/APT films are improved according with homogenization pressures.
- Introduction of APT into CS/PVA matrix nearly not affected the optical property.

GRAPHICAL ABSTRACT



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ABSTRACT

Attapulgite (APT) is a natural one-dimensional nanorod with higher mechanical strength and shows great potential as an effective reinforce filler for deriving nanocomposites. The dispersion degree and aspect ratio of APT are keys to decide the performance of nanocomposites. However, natural APT cannot develop its nanometer reinforce advantages because it usually appears as a crystal bundle or aggregate. In this work, we effectively disaggregate the crystal bundles of APT by a simple high-pressure homogenization technology at various pressures. The obtained nanometer APT as an ideal reinforce filler was introduced into chitosan (CS)/poly(vinyl alcohol) (PVA) matrix to derive a series of nanocomposites by the solution casting method. The CS/PVA/APT nanocomposites were characterized by field emission scanning electron microscopy (FESEM) and Fourier transform infrared spectroscopy (FTIR). Tests results indicated that the nanometer APT can enhance the mechanical properties and water resistance of nanocomposites more obvious than pristine APT. The nanocomposites also were shown to be highly transparent and the introduction of APT into CS/PVA matrix nearly not affected the optical property of the films.

1. Introduction

Organic/inorganic nanocomposites have attracted considerable attentions in the past decades because the incorporation of nanoscale inorganic filler into polymer matrix brings surprising hybrid performance superior to their individual components [1–4]. Attapulgite (APT) is a natural nanometer rod-like hydrated magnesium aluminum silicate mineral, consisting of two double chains of the pyroxene-type $(SiO_3)^{2-}$ like amphibole $(Si_4O_{11})^{6-}$ running parallel to the fiber axis [5]. APT has one-dimensional nanometer structure, exchangeable cations in its framework channels and reactive Si–OH groups on its surface [6]. It has been used as effective reinforce filler for the fabrication of nanocomposites due to its excellent thermal stability, higher mechanical strength and aspect ratio in the past years. Li et al. developed a novel polyimide/APT nanocomposite [7] and found that the tensile modulus, tensile

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