Preparation and characterization of starch-based composite films reinforced by cellulose nanofibers

Mahyar Fazeli, Meysam Keley, Esmaeil Biazar

PII: S0141-8130(18)30875-4
DOI: doi:10.1016/j.ijbiomac.2018.04.186
Reference: BIOMAC 9594

To appear in:

Received date: 22 February 2018
Revised date: 2 April 2018
Accepted date: 30 April 2018

Please cite this article as: Mahyar Fazeli, Meysam Keley, Esmaeil Biazar , Preparation and characterization of starch-based composite films reinforced by cellulose nanofibers. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Biomac(2017), doi:10.1016/j.ijbiomac.2018.04.186

Preparation and characterization of starch-based composite films reinforced by cellulose nanofibers

Mahyar Fazeli [a,b,*], Meysam Keley [b], Esmaeil Biazar [c]

[a] Sharif University of Technology, Department of Materials Science and Engineering, P.O. Box: 11365-9466, Tehran, Iran.
[b] Federal university of Rio de Janeiro, Department of Materials Science and Engineering, P.O. Box: 68505, 21945-970, Rio de Janeiro, Brazil.
[c] Department of Biomaterial Engineering, Tonekabon Branch, Islamic Azad University, P.O. Box: 4684161167, Tonekabon, Iran.

Correspondence should be addressed to:
Mahyar Fazeli, Email: m.fazeli@metalmat.ufrj.br

Abstract

The current study deals with the preparation and characterization of polysaccharide-based biocomposite films acquired by the incorporation of cellulose nanofiber within glycerol plasticized matrix formed by starch. The application of starch-based films is limited due to highly hydrophilic nature and poor mechanical properties. These problems are solved by forming a nanocomposite of thermoplastic starch (TPS) as matrix and cellulose nanofiber (CNF) as reinforcement. CNF is successfully prepared from short henequen fibers which consist of almost 60% cellulose by a chemo-mechanical process. TPS/CNF composite films are prepared by the polymer solution casting method, and their characterizations are obtained by water vapor transmission rate (WVTR), atomic force microscopy (AFM), oxygen transmission rate (OTR), X-ray diffraction, light transmittance and tensile test. The 0.4 wt% CNF loaded TPS films showed approximately the maximum improvement in tensile strength. Tensile strength and elastic modulus increased by up to 80% and 170% respectively. Above 0.5 wt% CNF, tensile strength starts to deteriorate. WVTR and OTR results show improvement in water vapor barrier properties of TPS matrix. The AFM analysis shows the topography of the surface of the nanocomposite. The morphology of nanofibers is studied by using the scanning electron microscopy (SEM) and the transmission electron microscopy (TEM).

Keywords: Biocomposite; Cellulose nanofiber; Nanocomposite.