ISBN 978-85-63274-02-4

International Conference on Food and Agriculture Applications of Nanotechnologies

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São Pedro, SP
2010

1st Edition
1st print: 500 copies

Anais da 1. International Conference of Food and Agriculture Applications of Nanotechnologies – São Pedro: Aptor Software, 2010.
284 p.

ISBN 978-85-63273-02-4

1. Nanotechnologies – Events. 2. Ribeiro, Caue. 3. Assis, Odílio Benedito Garrido de. 4. Mattoso, Luiz Henrique Capparelli. 5. Mascarenhas, Sergio

International Conference on Food and Agriculture Applications of Nanotechnologies

NanoAgri 2010

Cellulose nanocrystals reinforced natural rubber

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Abstract – The focus of this work was to extract cellulose nanocrystals (CNCs) of coconut fiber and evaluate how these nanostructures affected the mechanical properties of latex films. Nanocomposite films showed an increase in tensile strength of ca. 100% and reduction of approximately 30% in the elongation at break, with filler content of 10 wt %.

The use of nanoscale materials has attracted considerable attention in recent years because they present novel properties [1]. The incorporation of nanostructured reinforcements in polymer matrices usually results in nanocomposites with better mechanical properties than the neat polymers. Nanometer-sized single crystals of cellulose, commonly referred to as whiskers, nanowhiskers, nanocellulose or cellulose nanocrystals (CNCs), can be obtained from different renewable resources. The focus of this work was to extract CNCs of coconut fiber and evaluate how these nanostructures affected the mechanical properties of latex films.

CNCs were extracted from coconut fiber by acid hydrolysis of bleached coconut fiber [2] and the nanocomposites were prepared by casting. Transmission Eletronic Microscopy and X-ray diffraction were used to study the morphology and crystallinity of the CNCs. Tensile properties of bionanocomposites were also evaluated.

CNCs, in the range of 40–150 nm, were successfully prepared from coconut fibers by acid hydrolysis (Figure 1). Its incorporation resulted in an improvement of both the elastic modulus and tensile strength of the nanocomposites based on natural rubber. When 10 wt.% CNCs were used as reinforcement, tensile strength of the natural rubber nanocomposites increased by about 100% compared with unreinforced film made with pure latex. Tensile modulus of the nanocomposites increased considerably and the elongation at break decreased approximately 30%, reducing the ductile behavior of the nanocomposites (Figure 2).

The results stimulate the use of coconut fibers, an agricultural cellulosic waste, as a novel renewable source of nanocellulose with potential as reinforcing agents in nanocomposites.

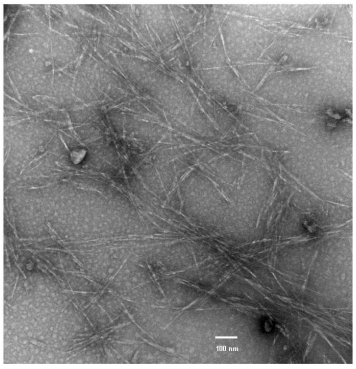

Figure 1: Transmission electron micrographs of CNCs. Scale bars: 100 nm

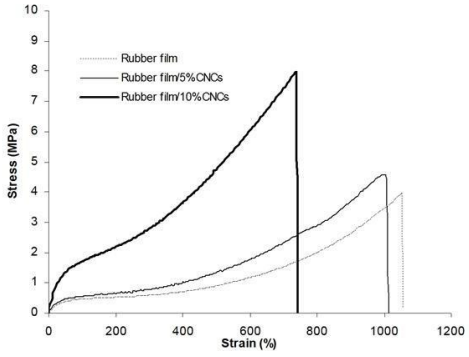

Figure 2: Stress–strain curves of rubber film and rubber/CNCs nanocomposite

References

[1] H. Zeng, C. Kuang, J. Zhang, M. Yue J Mater Sci (2009) 44:5509-5514
[2] M.F. Rosa, E.S. Medeiros, J.A. Malmonge, K.S. Gregorski, D.F. Wood, L.H.C. Mattoso, G. Glenn, W.J. Orts, and S.H. Imam. Carbohydr. Pol. (2010), *in press.*