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Development of renewable nanocomposites for packaging by the functionalization of nanopolysaccharides

0.32

0.28

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Introduction

Cellulose nanocrystals (CNC) are an organic and fully biodegradable nanocharge which can be used for the fabrication of bionanocomposites of polylactide (PLA) with improved barrier properties. In the aim to enhance the compatibility between the polymer matrix and the CNC surface, a novel surface grafting method was developed. The chemical nature of the surface grafts was furthermore designed to be a specific absorbent of permeants with the aim to enhance the barrier properties of the CNC/PLA nanocomposites.



Development of a surface grafting method to enhance CNC/PLA compatibility •

- Study specific absorbent capacity of surface modified CNC
- Study impact of surface modified CNC on PLA barrier properties



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0.24 ŝ 0.20 content 0.16 X 2 0.12 Organic compound X 2 0.08 0.04 GAB model 0.00 0.4 0.6 1.0 0.2 0.8 0.0 (C - 1)Ka Ka Organic compound activity, a 1-Ka_w+CKa_w X_m 1–*Ka*_ Xm Monolayer capacity Sample Anisole C Energy related to the heat Cyclohexane adsorption *K* Difference of free с С Xm Xm CNC 0.100 2.20 0.87 0.012 7.87 0.98 enthalpy of the solute that occur in layer above 5.49 CNC-g-BzAA 0.535 2.22 0.85 0.112 0.75 monolayer and in pure liquid **Barrier properties of PLA/CNC**

Transparent nanocomposites with surface grafted CNC



Anisole uptake in PLA/CNC nanocomposites



	wt %	P(O2) x 10 ⁻¹⁸ (m ³ m/m ² sPa)	D x 10 ⁻¹⁵ (m ² s ⁻¹)	m _{eq,F} (wt%)	m _{r_120h} (wt%)
PLA	0	2.7 ± 0.3	3.2 ± 1.6	2.6 ± 0.2	0.7
PLA/CNC	2	1.8 ± 0.2	1.6 ± 0.8	1.4 ± 0.2	0.6
PLA/CNC	6	1.7 ± 0.2	3.7 ± 1.8	0.4 ± 0.2	0.6
PLA/CNC-g-PhAA	2	1.9 ± 0.2	11 ± 6	2.2	2.2
PLA/CNC-g-PhAA	6	1.6 ± 0.2	3.9 ± 2.0	1.0	1.0
PLA/CNC-g-BzAA	2	1.6 ± 0.2	2.5 ± 1.3	1.2 ± 0.2	0.9
PLA/CNC-g-BzAA	6	1.9 ±	8.7 ± 4.3	0.3 ± 0.2	0.2

Tailoring nanoparticle surfaces allows to largely change transport properties in nanocomposites

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CNC surface sorption of organic vapors