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Development of renewable nanocomposites for packaging by the functionalization of nanopolysaccharides

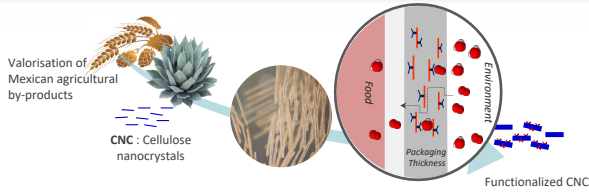
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Introduction

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.

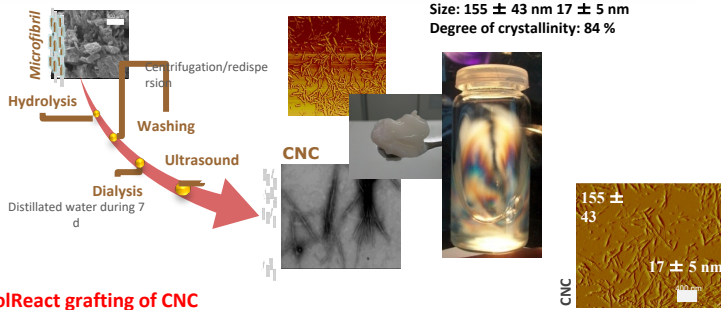
Objectives – CNC bionanocomposites



- 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

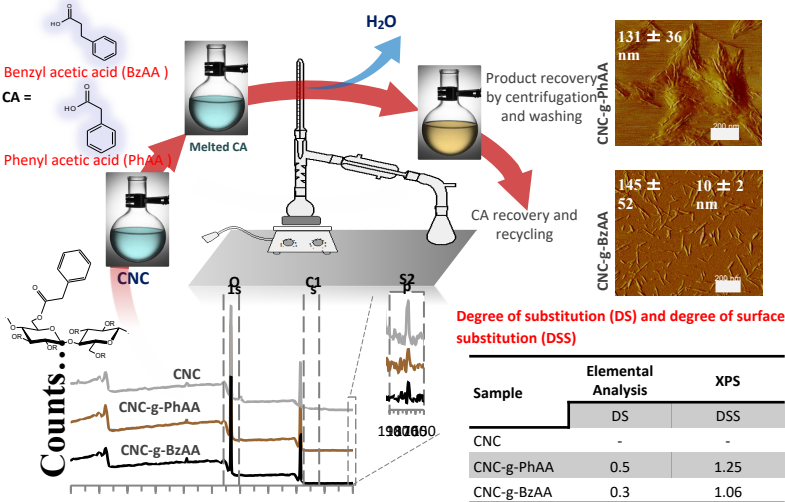
SolReact CNC surface grafting

Fabrication of CNC



SolReact grafting of CNC

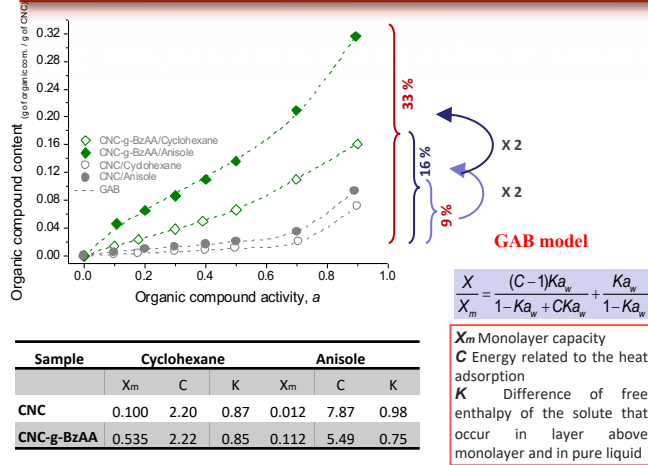
Heterogeneous surface esterification by in situ solvent exchange



Degree of substitution (DS) and degree of surface substitution (DSS)

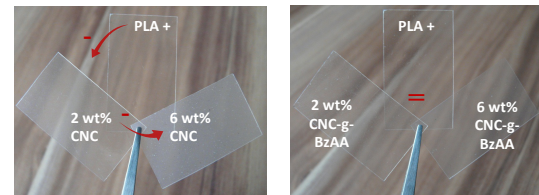
Sample	Elemental Analysis		XPS
	DS	DSS	
CNC	-	-	-
CNC-g-PhAA	0.5	1.25	-
CNC-g-BzAA	0.3	1.06	-

CNC surface sorption of organic vapors

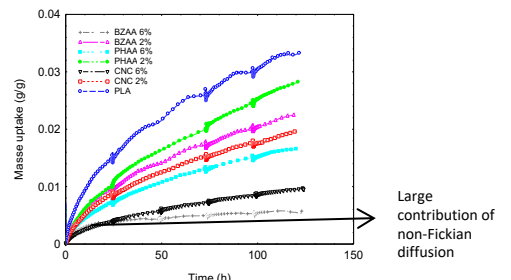


Barrier properties of PLA/CNC

Transparent nanocomposites with surface grafted CNC



Anisole uptake in PLA/CNC nanocomposites



	wt %	P(O ₂) x 10 ⁻¹⁸ (m ³ m/m ² Pa)	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 ± 0.2	8.7 ± 4.3	0.3 ± 0.2	0.2

• Tailoring nanoparticle surfaces allows to largely change transport properties in nanocomposites