PLA/CNF/C30B nanocomposites for food packaging applications

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1. INTRODUCTION

The current materials used on food packaging are non-renewable and non-biodegradable

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The biopolymers (like PLA) are still NOT good enough to be used on food packaging

→

Our material shows a dramatic improvement on the critical aspects of PLA

PLA (Polylactic acid)

- RENEWABLE SOURCE
- BIODEGRADABLE
- GOOD MECHANICAL PROP.
- TRANSPARENT
- COMMERCIALLY AVAILABLE

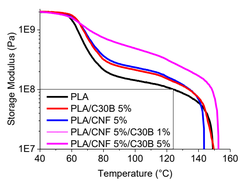
Reinforced with Nanocellulose and clay

PLA/CNF/C30B

MEDIUM BARRIER PROP.	INCREASED BARRIER PROPERTIES
POOR THERMOSTABILITY	ENHANCED THERMOSTABILITY
SLOW CRYSTALLIZATION	FASTER CRYSTALLIZATION KINETIC
BRITTTLENESS	INCREASE ON ELONGATION AT BREAK

2. ENHANCED PROPERTIES OF PLA COMPOSITE

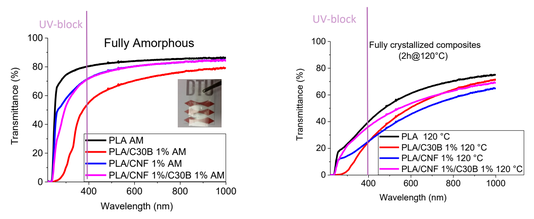
2A. THERMOSTABILITY



Films after solvent casting (Dimethyl formamide at 80 ° C). PLA (left), PLA/CNF 5% (centre) and PLA/CNF/C30B 1% 1% (right). The hybrid nanocomposites have great stability.

Enhanced thermo-mechanical resistance!

2B. TRANSPARENCY

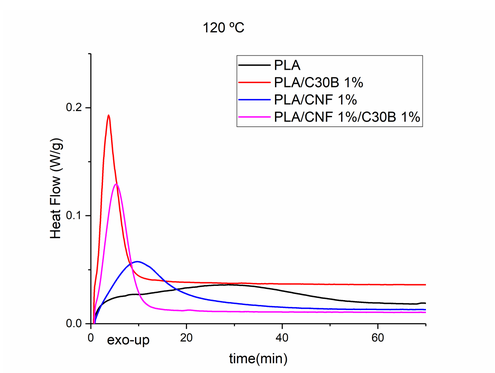


The combination of CNF and C30B in a polymer matrix doesn't significantly reduce the transparency of the films. Actually, they might show even improved optical properties due to its UV-blocking behaviour.

The crystallinity heavily affects **transparency and clarity**.

UV-blocking be-havior. Maintained transparency.

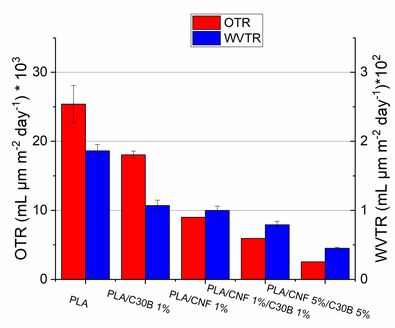
2C. CRYSTALIZATION



The PLA/CNF/C30B shows increased crystallization kinetic, furthermore it also shows a better spherulite distribution (not showed here). Both CNF and C30B appeared to have a similar effect of RAF development.

Fast crystallization

2D. BARRIER PROPERTIES



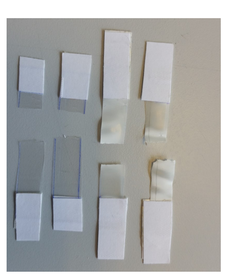
Understood the implications of the presence of nanoparticles and crystallinity upon water sorption and diffusion as well as their interaction with the crystallinity.

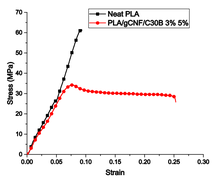
90% Decrea. OTR

76% Decrea. WVTR

3. PLA COMPOSITES AS ACTIVE PACKAGING → Added value!

3A. MECHANICAL PROPERTIES

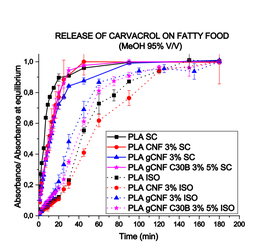




The addition of carvacrol successfully plasticises the PLA/gCNF/C30B composites.

The T_g of neat PLA was ranging between 57ºC and 62ºC regardless crystalline morphology or addition of nanofiller, but the addition of 6% carvacrol decreased the Tg to 30 ºC.

3B. CONTROLLED RELEASE



· The crystallinity is key in the release process, more than the presence of nanoparticles.

· The surface modification of the nanocellulose didn´t had a large influence on the release kinetic of the material.

· The composites prepared by solvent casting (SC) showed small spherulites (in the nano scale) while after the isothermal crystallization procedure (ISO) led to big spherulites (micro-scale). This influences dramatically the release profile of the material.

4. CONCLUSIONS

· The PLA/CNF/C30B composite shows good nucleating agent, thermomechanical and barrier properties, and the addition of carvacrol successfully plasticises the material therefore it is a promising substitute for Petrol-based packaging materials.

· The crystalline morphology (spherulite size and amorphous rigid/mobile region) plays a very significant role on transparency and mass transport properties through the PLA matrix.

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