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Hierarchical materials based on nanocellulose and poly(lactic acid)

Manon Guivier*, Giana Almeida*, Sandra Domenek*, Chloé Chevigny*
*Université Paris-Saclay, INRAE, AgroParisTech, UMR SayFood, Palaiseau, France

Nanocelluloses, i.e. cellulose nanocrystals (CNC) and cellulose nanofibrils (CNF), have shown excellent gas barrier properties which makes them of the highest interest for food packaging applications¹. However, the nanocelluloses swelling, in presence of water vapor, thwarts their good gas barrier properties². Consequently, the use of nanocelluloses in food packaging, while extremely promising, is still a challenge. A multilayer architecture starting with an hydrophobic layer of poly(lactic acid) (PLA) could be a solution to protect nanocelluloses. Different studies have been devoted to the use of nanocelluloses as fillers in a PLA matrix³, but here, a new architecture was developed by depositing layers of nanocelluloses on PLA. The effect of nanocelluloses coating on O₂ barrier properties and water vapor barrier properties was studied, as well as the organization of the nanocellulose layers (Fig.1). Very promising results were obtained, with O₂ permeation several orders of magnitude lower than PLA, thus validating this innovative process.

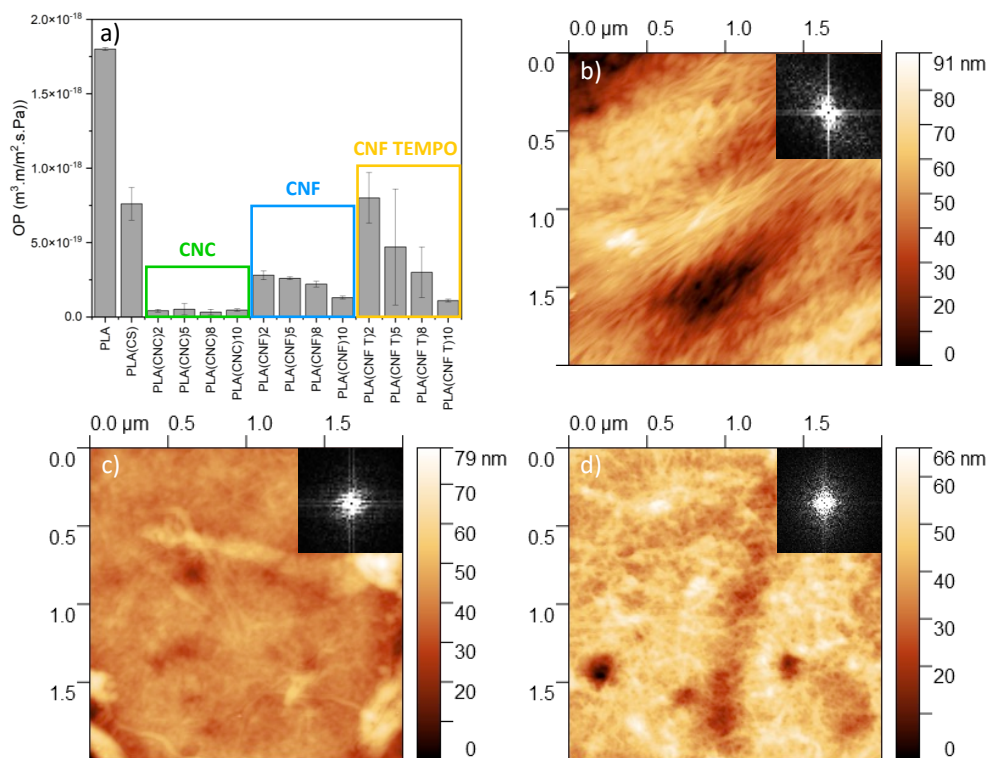


Figure 1: Oxygen permeabilities of uncoated and coated-PLA (a) and the AFM images of the sample surfaces coated with 10 deposits of CNC (b), CNF (c) and CNF TEMPO (d).

- (1) Belbekhouche, S. et al. Water Sorption Behavior and Gas Barrier Properties of Cellulose Whiskers and Microfibrils Films. *Carbohydr. Polym.* **2011**, 83 (4), 1740–1748.
- (2) Liu, A. et al. Clay Nanopaper with Tough Cellulose Nanofiber Matrix for Fire Retardancy and Gas Barrier Functions. **2011**, 9.
- (3) Espino-Pérez, E. et al. Designed Cellulose Nanocrystal Surface Properties for Improving Barrier Properties in Poly(lactide) Nanocomposites. *Carbohydr. Polym.* **2018**, 183, 267–277.

