

Dual chemical modifications of polysaccharides via Passerini three component reaction: toward biobased functional coatings

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Résumé :

The ever-rising global awareness about plastic pollution push value chain key players of the packaging market to develop new alternatives. Cellulosic fiber-based packaging materials offer environmentally acceptable solutions. However, their porous structure imparts them with poor barrier performances, making them unfit for the food industry. Barrier effects can be achieved through petro-based and poorly biodegradable/recyclable coatings, which seeks to be replaced by alternatives conjugating efficiency and sustainability. The strong chemical affinity of some polysaccharides for cellulose make them good candidates to be used as eco-friendly physically deposited coatings. However, their inherent hydrophilicity jeopardizes the long-lasting performances of polysaccharides, in particular under tropical storage conditions. Multicomponent reactions (MCRs) represent attractive routes to modify polysaccharides, by respecting some criteria of green chemistry. Indeed, their atom-economy is good, and these reactions are conducted in 'one pot' conditions, in the absence of catalysts and coupling reagent and generate low waste. Among MCRs, the Passerini three component (P-3CR) reaction, achievable in mild aqueous medium, was shown to be appropriated to bring a double modification of carboxymethyl cellulose (CMC), by using model molecules [1-2]. The present work describes the extension of this chemical approach to the dual functionalization of CMC and alginates (ALG) to lead to more sophisticated structures by conjointly employing (i) hydrophobic moieties of various structure and rigidity and (ii) thermosensitive segments exhibiting a LCST (Jeffamine derivatives), [3-4] in view to be used as novel multifunctional coatings. A large series of CMC and ALG derivatives of different compositions was thus generated, and processed as thin films. Their wettability properties were analysed in order to emphasize the impact of the hydrophobization and the one of temperature increase. Their film-forming abilities on model substrates were examined by QCM-D and completed by AFM observations. This investigation gives insights into the effect of the double chemical modification on the mode of adsorption onto solid surface. Finally, water vapor barrier properties carried out on self-supported films, allowed to elucidate the role of the chemical modification on the mechanism of water vapor permeation. [5]

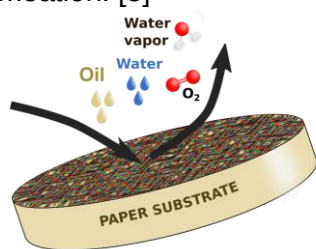


Fig. 1: Functional films formed by the deposition of Passerini-modified polysaccharides

Références :

- [1] A. Pettignano, A., Daunay, C. Moreau, B. Cathala, A. Charlot, E. Fleury, *ACS Sustain. Chem. & Eng.*, 2019, 7, 17, 14685.
- [2] L. Remy, G. Sudre, E. Fleury, A. Charlot, *Carbohydrate Polymers*, 2023, 320, 121228.
- [3] C. Vuillet, C. Le Mouel, D. Albertini, P. Alcouffe, E. Fleury, A. Charlot, *Carbohydrate Polymers*, 2025, 351, 123066.
- [4] L. Remy, V. Christophe, C. Vuillet, A. Covelli, B. Couturaud, G. Sudre, E. Fleury, A. Charlot, *Biomacromolecules* 2025, 26, 7, 4637.
- [5] C. Vuillet, V. Guillard, H. Angellier-Coussy, G. Sudre, F. Gouanvé, E. Fleury, A. Charlot, submitted.