

Biobased multilayer nanocomposites: Influence of the thickness of the confined layers on barrier properties

Nadège Follain^a, Tiphaine Messin^a, Valérie Gaucher^b, N. Delpouve^c, Stéphane Marais^a

^a Univ Rouen Normandie, CNRS, Normandie Univ, PBS UMR6270, Rouen, France

^b Unité Matériaux et Transformations, UMR 8207 CNRS/Université Lille 1, 59655 Villeneuve d'Ascq, France

^c Univ Rouen Normandie, INSA Rouen Normandie, CNRS, Normandie Univ, GPM UMR 6634, Rouen, France

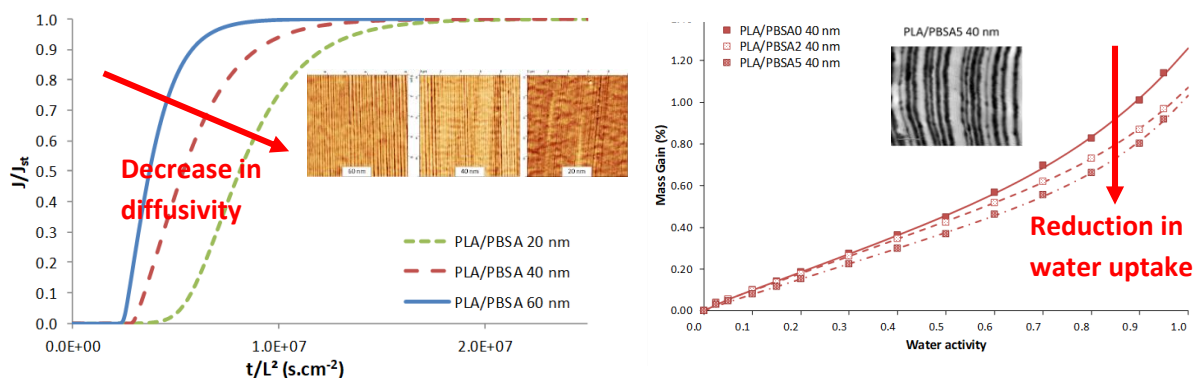
* nadege.follain@univ-rouen.fr

Mots-clés : coextrusion, confinement effect, barrier properties, poly(lactic acid), clays

Résumé :

The development of new multifunctional organic materials based on biodegradable polymers (petroleum-based or biosourced) by means of multilayer coextrusion process is a way to reach highly improved thermal, mechanical and barrier properties [1] while maintaining biodegradability. The design of recyclable and highly barrier sustainable PLA/PBSA multilayer films provides a route to solve these issues for current market needs.

The 2049-layer films composed of poly(butylene succinate-co-butylene adipate) PBSA confined against poly(lactic acid) PLA were successfully processed using a multilayer coextrusion process [2]. PBSA layers was thinned from 60 nm to 20 nm by drawing and nanoclays were incorporated into these semicrystalline layers with the aim to improve barrier properties of the PLA/PBSA multilayer films. Effects of PBSA layers thinning and clay incorporation on gas and water barrier properties were investigated. Structural, thermal and mechanical properties were correlated. Nanolayering continuity was evidenced with some defects depending on structure. Amorphous fraction in PBSA was densified with a change in crystallinity. Improvement of barrier effect by both reducing the thickness of semicrystalline layers and dispersing lamellar nanoplatelets in these thin layers is driven by the crystalline state of confined PBSA layers and structural defects. The complexity in relationships between structure and properties of biobased multilayer films was underlined.



Normalized water flux as a function of the reduced time vs. the confined layers thickness (on the left) and Water vapor sorption isotherms vs. filler content in the PBSA layers (on the right) in the PLA/PBSA multilayer films

Références :

- [1] H. Wang, J.K. Keum, A. Hiltner, E. Baer, B. Freeman, A. Rozanski, A. Galeski. Confined Crystallization of Polyethylene Oxide in Nanolayer Assemblies. *Science*, **2009**, 323, 757–760
- [2] T. Messin, N. Follain, Q. Lozay, A. Guinault, N. Delpouve, J. Soulestin, C. Sollogoub, M. Marais. Biodegradable PLA/PBSA multilayer nanocomposites: effect of nanoclays incorporation in multilayered structure on mechanical and water barrier properties. *Nanomaterials*, **2020**, 10, 2561.