Design and development of co-Extruded PLA/PEG bio-nanocomposite films with enhanced functional properties for food packaging

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Résumé :

Bio-based composite materials are increasingly regarded as sustainable alternatives to conventional plastics, in line with global strategies to reduce reliance on fossil resources and mitigate environmental impacts. Among these materials, polylactic acid (PLA) has gained significant attention for food packaging applications due to its biodegradability and bio-sourced origin [1-3]. However, its intrinsic brittleness, limited thermal stability, and relatively modest processability remain major barriers to its wider industrial adoption [4]. In this study, innovative nanocomposite films were fabricated through a co-extrusion process using plasticized PLA reinforced with lignin-containing cellulose nanofibrils and organo-modified montmorillonite. Polyethylene glycol was employed as a plasticizer to enhance film flexibility and mitigate the inherent brittleness of PLA during melt processing. The addition of LCNFs provided improved mechanical strength, thermal stability, and interfacial compatibility with the polymer matrix, while the incorporation of OMMT platelets promoted better nanofiller dispersion and enhanced barrier performance. The combined effect of these multi-scale reinforcements resulted in a clear synergistic improvement of the final material properties. Morphological observations confirmed a homogeneous dispersion of the nanofillers, whereas thermal, mechanical, and rheological characterizations demonstrated significant enhancements in stability, stiffness, and melt processability. The resulting nanocomposite films were transparent, flexible, and well-suited for the production of thin multilayer structures. These results highlight the strong potential of co-extruded PLA/PEG-based nanocomposites as sustainable and high-performance alternatives for advanced food packaging applications.

Références :

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