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Mechanical, Barrier and Antimicrobial Properties of Biodegradable Poly(*E*-caprolactone) Nanocomposites

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Abstract

Environmentally friendly antimicrobial packaging materials are of great interest because they can delay microbial growth on the surface of foods, thus enhancing shelf-life. In this study, we synthesized a new type of organically modified clay platelets with strong antimicrobial properties and incorporated them into a biodegradable poly(e-caprolactone) (PCL) matrix using the melt-blending technique. Structural analysis of the composites using X-ray diffraction and transmission electron microscopy revealed that the intercalated silicate layers were well-dispersed at low clay loadings, while agglomeration of silicate layers was observed at higher clay loadings. Tensile testing showed improvements in modulus and yield strength of composites with clay loadings when compared to those without clay loadings. The thermomechanical stability of neat PCL also increased after the formation of the composites. Composites with increased clay loading showed improved oxygen gas and water vapor barrier properties. Modified disk diffusion tests indicated that organically modified clay strongly inhibited microbial growth, while composite films did not have the antimicrobial potential to inhibit microbial growth. In summary, PCL/clay composites were shown to have the potential to develop improved barrier packaging materials; however, increasing the antimicrobial activity on composite surfaces is needed for the development of PCL-based advanced packaging materials.