ADVANCED RESEARCH OF THE FULLY RETURN-TO-NATURE POLYMER

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ABSTRACT

Upcycling of resources becomes an important social issue because of the extensive utilization of non-biodegradable polymers. Land fill is undesirable due to space limitation and ground pollution. Incineration is not also preferred because of emission of toxic gases which is generated from decomposition of polymer chains and residual additives.

Biomass derived polylactide is fully return to nature polymer and expected to replace petroleum-based commodity polymers because of its excellent physical properties. Polylactide biocomposites reinforced by nanofillers such as nanocellulose, nanosilica and zinc oxide (ZnO), were prepared for high performance biocomposites.

The various modifications of nanocellulose such as acid hydrolysis, acetylation, and alkylation were performed for dispersion enhancement, resulting in efficient reinforcement effect of modified nanocellulose in the polylactide matrix. Nanosilica and ZnO was modified with silane-based materials to obtain hydrophobicity and used to reinforce polylactide. The polylactide/modified ZnO (m-ZnO) nanocomposite prepared by adding m-ZnO to the polylacitde matrix was fabricated into ultrafine fiber using electrospinning. Modified nanosilica was applied inside or outside the polylactide hollowfiber to obtain hydrophobicity and oleophilicity.

The mechanical properties, crystallinity, and thermal stability of polylactide composites were investigated. Furthermore, the theoretical prediction in the mechanical properties and crystallization behaviors of polylactide biocomposites were additionally analyzed to clarify the reinforcing potential of modified nanocellulose. Structural analysis of the nanoparticles proved that the ZnO was modified successfully, and that the modification affected dispersibility and hydrophobicity, as observed by morphological, visual, and water repellency tests. The morphological analysis of the electrospun ultrafine fabrics under suitable conditions confirmed that the nanoparticles were well incorporated, and the desired functional changes were observed. Measurement of water repellency and mechanical, thermal properties were used to analyze the effect of nanoparticle modification and composition on fabrics. Hollowfiber with modified nanosilica was observed by the morphological analysis and and its oleophilicity and hydrophobicity were measured and confirmed.