Improvement of water resistance by combining starch and cellulose nanofiber

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Starch and cellulose are ubiquitous biomass in nature. However, each membrane lacks water resistance, which limits its application as a packaging membrane. In this study, we prepared cellulose nanofiber reinforced starch membrane, which has adequate strength and stability in water. TEMPO-oxidized cellulose nanofibers (TCNF) were combined with three different types of modified tapioca starch: hydroxypropyl starch (HPS), acetyl starch (AS) and acetyl oxidized starch (AOS), in a 3:2 weight ratio. The TCNF/starch suspension subsequently converted into a membrane by solution casting. The membrane was analyzed by measuring the water uptake ratio, mechanical strength, and optical transparency. It was demonstrated that the TCNF/starch membrane reduced its swelling in water and enhanced mechanical strength in wet condition. These results suggest that hemiacetal bonding between TCNF and starch elevated the water durability and strength of the membrane. TCNF/HPS membrane showed the highest wet tensile modulus (7 MPa) with minimum swelling in water, indicating that TCNF/HPS membrane has dense hemiacetal bonding compare to the other starch blended membranes. Therefore, the TCNF-reinforced HPS membrane opens the research for the next generation renewable, biodegradable, water-durable high performance - green packaging membrane.

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