

Highly Transparent and Hazy All-cellulose Ultra-thin Papers with Enhanced Mechanical Properties Fabricated by Electrophoretic Deposition (EPD)

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Transparent papers have gained attention as green alternatives to optoelectrics due to their great mechanical and optical properties. However, achieving high haze and transmittance remains a challenge, especially in thin paper, as there is a trade-off between haze and transmittance, and thickness. Herein, we introduce a highly transparent and hazy paper with only a few micro-thickness. The paper is made of cellulose nanofibril (CNF) and carboxymethyl cellulose (CMC), and is fabricated by electrophoretic deposition (EPD). The CMC serves as a matrix to support structure and CNF acts as a source of reinforcement and light-scattering to enhance the mechanical properties and optical haze. The negative charge of CMC and CNF allows the anodic EPD process, and the thickness of the paper was controlled over a wide range from 2.4 to 28 μm depending on the deposition time and voltage. The optical and mechanical properties of the papers are adjusted by ultrasonic treatment and the ratio between CNF and CMC, which changes the size and the amount of CNF. The resulting paper has high transparency (up to 96%) and optical haze (up to 89%) at 550 nm with superior tensile strength up to 152.2 MPa.