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Preparation of superhydrophobic paper using PDMS modified SiO₂ nanoparticles

A simple spray coating technique was used to prepare a PDMS-modified SiO₂ top layer on the paper substrate. The wettability, microstructure of the coated papers, and durability and adhesion of the coating at different pH settings of the nanosolution (pH2, pH3, pH4 and pH5) were investigated using the water contact angle (WCA) and sliding angle (WSA), Fourier transform infrared spectroscopy (FT-IR), scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), and ASTM D4060 Taber abrasion test with wheel type CS-10. The result showed that the paper coated with the nanosolution with pH4 exhibited excellent self-cleaning and superhydrophobicity, with a WCA value of 163.3° and a very low WSA of only 1.65°. The FTIR result showed that the coated paper exhibited absorption peaks related to the asymmetric Si-O and asymmetric Si-O-Si bonding, indicating the adhesion of the SiO₂/PDMS to the paper substrate. The abrasion resistance results showed that after 5, 10 and 20 abrasion cycles, the percent weight loss was 0.28%, 0.65% and 1.01%, and the WCA values decreased to 123.69°, 98.62° and 91.74°, respectively. This result shows that the weight loss of the sample after 20 abrasion cycles was only 1.01%. This result was due to the fact that the nanocomposite particles adhered to the paper surface were uniformly distributed on the cellulose fibers, which directly affected the increased surface roughness and resulted in the excellent waterproof and self-cleaning properties of the produced paper. Due to its ease of production and scalability, the produced paper can be used in practice.

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