Electronic Supplementary Information

Improvement of chemical stability and durability of superhydrophobic wood surface via filming TiO_2 coated $CaCO_3$ micro-/nano-composite particles

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Experimental

Materials

Poplar veneer (45mm*25mm*1mm) were obtained from Material Science and Engineering College, Northeast Forestry University, Harbin. Ethanol (99.7%), butyl titanate (98.0%), acetone (99.5%), acetic acid glacial (99.5%), and nitric acid (65%~68%) were purchased from Tianjin Tianli Chemical Reagent Co., Ltd. Calcium carbonate (99.3%) was provided by LinKou country Fengyuan calcium carbonate Co., Ltd. Stearic acid used for surface hydrophobic modification was purchased from Tianjin Kemiou Chemical Reagent Co., Ltd. Deionized water was self-made. All of the chemicals were used as received without further purification.

Instrumentation

The surface morphologies of the pristine and as-prepared wood surfaces were observed by using tabletop microscope (SEM, Hitachi High-Tech TM3030) operating at 15.0 kV. The surface elemental compositions were determined by utilizing Fourier transform infrared spectroscopy (FT-IR, Magna-IR 560, Nicolet) and energy dispersive X-ray spectrometer (EDX, Quantax70) connected with SEM. The water contact angles were measured with 5 μl deionized water droplet at room temperature using an optical contact angle meter (Powreach, JC2000C). The values of the water contact angles were obtained as averages of five measurements. An 8 W Hg lamp was used as the UV light source. The UV intensity was set at 3 mW/cm^2. The thermogravimetry was performed with the thermogravimetric analysis (TGA, Q50 TGA, TA Instrument) equipped with an aluminum crucible. The sample was heated in nitrogen from 25 °C to 800 °C at a rate of 5 °C/min.

Preparation of titanium dioxide precursor solution

In the present study, titanium dioxide precursor solution was prepared via the sol-gel method at the room temperature. In detail, 10 ml butyl titanate and 2 ml acetic acid glacial were added drop by drop and respectively with magnetic stirring to a

reactor containing 30 ml ethanol. The stirring was continued for 20 min. At the same time, the nitric acid and ethanol mixture solution was prepared. The specific proportion of nitric acid and ethanol mixture solution is 0.5 ml nitric acid, 10 ml ethanol and 1 ml deionized water. Then the mixture solution of nitric acid and ethanol was added into a butyl titanate solution drop by drop with magnetic stirring for 1 h followed by aging 24 h at room temperature.

Synthesis of titanium dioxide coated calcium carbonate micro-/nano-composite particles emulsion

In a typical synthesis process, 1.0 g calcium carbonate was dissolved in 150 ml deionized water and then magnetically stirred at room temperature for 0.5 h. After the calcium carbonate was dissolved completely, 18 ml titanium dioxide precursor solution was slowly added with magnetic stirring, and the mixed emulsion was continually stirred for 3 h for the hydrolyzation of titanium dioxide.

Fabrication and modification of micro-/nano-composite particles coating on the wood surface

Each piece of poplar wood veneer was cut into a size of 45mm×25mm×1mm. The wood samples were ultrasonicated in ethanol, acetone and deionized water for 15 min, respectively. After that, the wood samples were dried at 60 ºC in oven for 3 h.

The cleaned wood samples were immersed into the emulsion of the titanium dioxide coated calcium carbonate micro-/nano-composite particles for 24 h at ambient conditions. Then the composite wood sample was washed by deionized water and dried in an oven at 60 ºC for 3 h. The above impregnation and drying process was repeated three times. Micro-/nano-composite particles synthesized on the wood surfaces using above method are hydrophilic, with hydroxide groups on the surfaces of the micro-/nano-composite particles.

The surface modification of the micro-/nano-composite particles on the wood

surfaces was carried out by a self-assembly of a stearic acid monolayer. To be brief, the as-prepared wood samples were immersed into 20 ml of 0.3 g stearic acid ethanol solution at the temperature of 60 ºC for 6 h, followed by rinsing with ethanol. Finally, the wood samples were dried in an oven at 60 ºC for 3 h.