Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Fabrication of robust, damage-tolerant superhydrophobic coatings on naturally micro-grooved wood surfaces

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Experimental details

Dirt removal test: Methylene blue powders were placed on the coated and pristine wood to contaminate the surfaces. Water was then poured on the surface to test and compare the self-cleaning properties of the coated and pristine wood. The high-speed motion capture was also carried out to exhibit the dirt removal process in great detail.

Repellency towards dyed water contamination: Pristine and coated wood were immersed into methylene blue dyed water and then withdrawn from the dyed water to compare their repellency towards dyed water contamination.

Oil repellency: Pristine and coated wood were put into ethylene glycol (γ_{lv} = 47.3 mN/m) and withdrawn from the oil to compare their repellency towards oil contamination.

Finger-wipe test: The finger-wipe test was performed by pressing the coated wood with a finger, followed by immersing the wood sample into water to visualize the mirror-like phenomenon. The wood sample was then withdrawn from the water to test its water repellency by dropping water droplets (dyed in blue) to the finger-wiped surface.

Knife-scratch test: The knife-scratch test was performed by scratching the coated wood repeatedly using a sharp razor blade. Water droplets (dyed in blue) were then dropped to the scratched surface to test its water repellency.

Water spray test: The surface durability of the coated wood against water spray impacts was tested using a water jet. The sample was placed under the jet at the distance of 30 cm. Water flow rate was approximately 280 l/h with a water pressure of ~35 kPa exerted on the coated surface. The test consists of seven cycles, with each cycle lasting 10 s. CAs and SAs were measured after each water spay cycle.

UV radiation test: The durability of the coated wood against UV radiation was assessed using an accelerated weathering test chamber (Xenotest Alpha; Atlas, USA). The samples were fixed in stainless steel holders and rotated around the xenon light source with a wavelength of 300-400 nm. The radiation intensity was set at 42 W/m^2 and the black panel temperature was 62°C with a chamber temperature of 40°C and a relative humidity (RH) of 50%. The samples were exposed to continuous xenon light radiation for a total duration of 80 h. After a certain time interval of exposure, the samples were taken out for CA, SA and color measurements.

Change in color of wood surface was measured with a Minolta spectrophotometer (CR-400, Japan) using the CIE $L^*a^*b^*$ system according to the ISO 7724 standard test method. The average values of the color parameters were obtained by measuring five different positions for each sample. In the CIE $L^*a^*b^*$ system, L^* represents lightness, a^* and b^* represent chromaticity parameter. The overall color change (ΔE^*) was calculated according to the following equation:

$$\Delta E^* = \sqrt{\left(\Delta L^*\right)^2 + \left(\Delta a^*\right)^2 + \left(\Delta b^*\right)^2} \qquad (1)$$

Where, ΔL^*, Δa^*, and Δb^* represent the changes in L^*, a^*, and b^* between the initial and final values, respectively. A lower ΔE^* value means lower color change and indicates higher photostability.

Supporting Movie, Figure and Table captions:

Movie S1. Water dropping tests

Movie S2. Water dropping test (high-speed motion)

Movie S3. Self-cleaning tests (dirt removal, repellency towards dyed water contamination and oil repellency)

Movie S4. Dirt removal test (high-speed motion)

Movie S5. Sandpaper abrasion test

Movie S6. Finger-wipe test

Movie S7. Knife-scratch test

Figure S1. TEM image of FAS-modified SiO_2 nanoparticles in the coating solution.

Figure S2. FTIR spectra of the coated wood before and after 10 abrasion cycles.

Figure S3. Surface color changes of pristine wood and coated wood during accelerated UV radiation

Table S1. Surface color parameters of pristine wood and coated wood.

Figure S1 TEM image of FAS-modified SiO_2 nanoparticles in the coating solution.

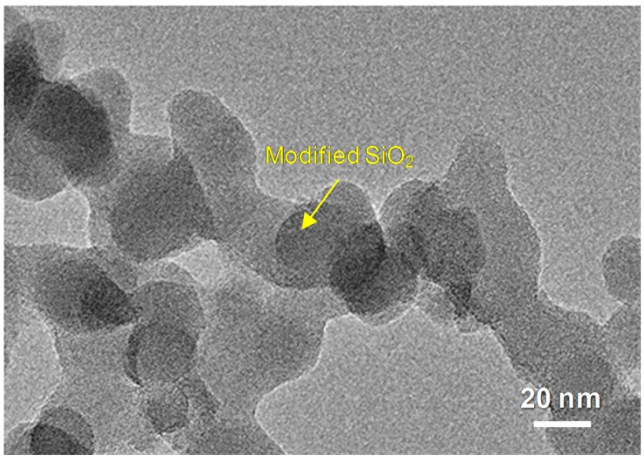
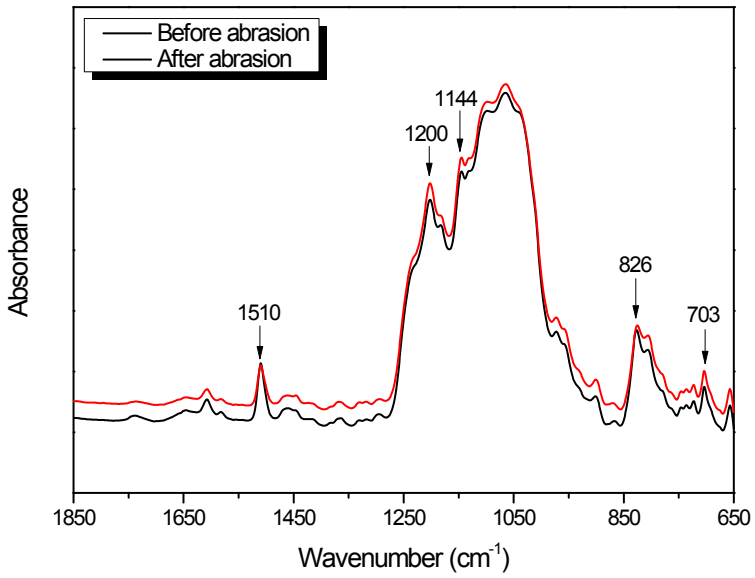
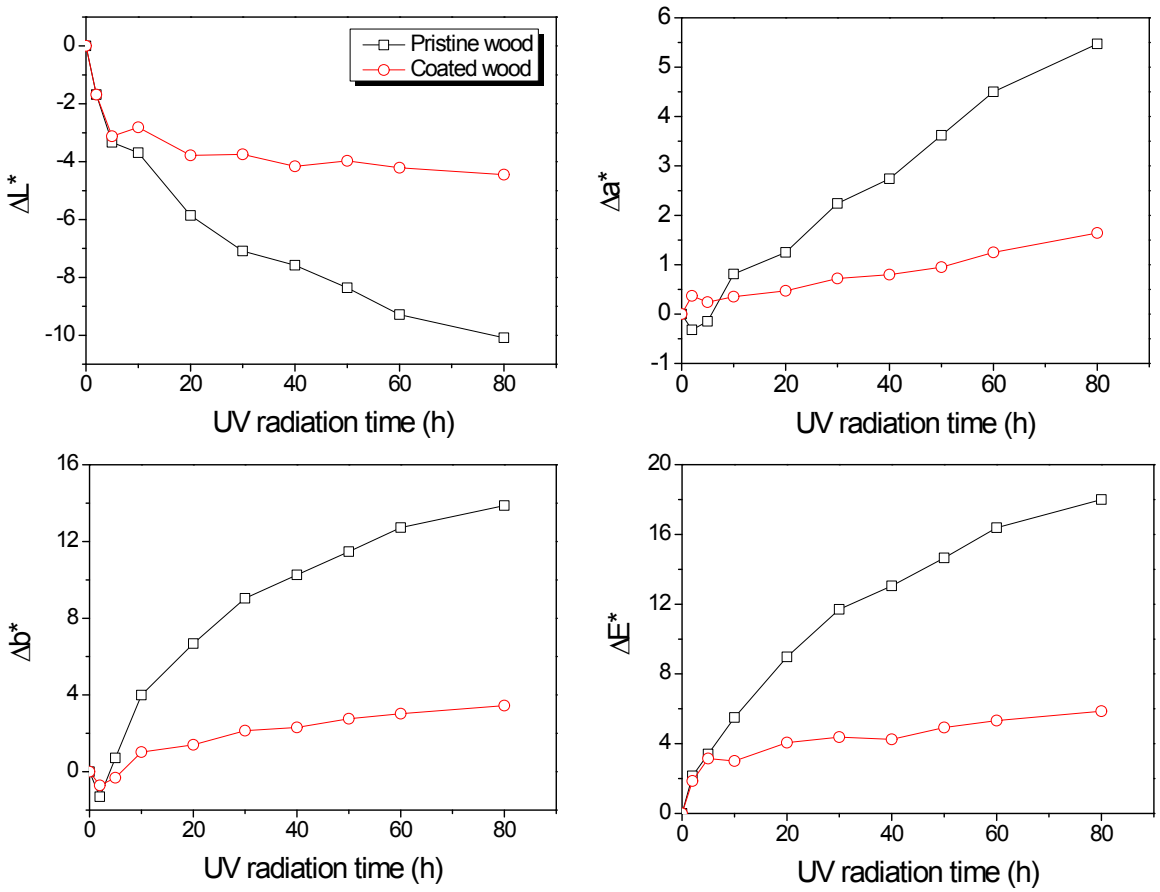


Figure S2 FTIR spectra of the coated wood before and after 10 abrasion cycles.



The main absorption peaks (826, 1144 and 1200 cm^{-1}) remained essentially unchanged after 10 abrasion cycles, which indicates that the silica/epoxy resin/FAS composition was retained in the coating in spite of being scratched repeatedly by the sandpaper.

Figure S3 Surface color changes of pristine wood and coated wood during accelerated UV radiation



The surface color of the pristine wood changed rapidly due to its susceptibility to UV radiation. By contrast, after coated with epoxy resin/FAS/silica nanoparticles, the changes in the color parameters (L^*, a^* and b^*) of the wood surface were obviously inhibited and the overall color change (ΔE^*) was remarkably decreased, indicating an improved photostability. This photostabilizing effect could be attributable to the silica nanoparticle aggregates formed in the coatings that scatter or reflect UV light, thereby protecting the underlying wood from photodegradation.

Table S1 Surface color parameters of pristine wood and coated wood.

	*L**	*a**	*b**	Δ*E**
Pristine wood	84.36±0.60	3.68±0.22	22.82±0.94	0.61
Coated wood	83.89±0.63	3.79±0.16	23.19±1.28	

The color parameters (*L**, *a**, *b** and Δ*E**) of the wood surface changed slightly after the coating treatment, and the coated wood essentially maintained its original color and aesthetic appearance, indicating that the applied coating had good optical transparency.