Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supplementary Materials

Super-Robust Superhydrophobic Concrete

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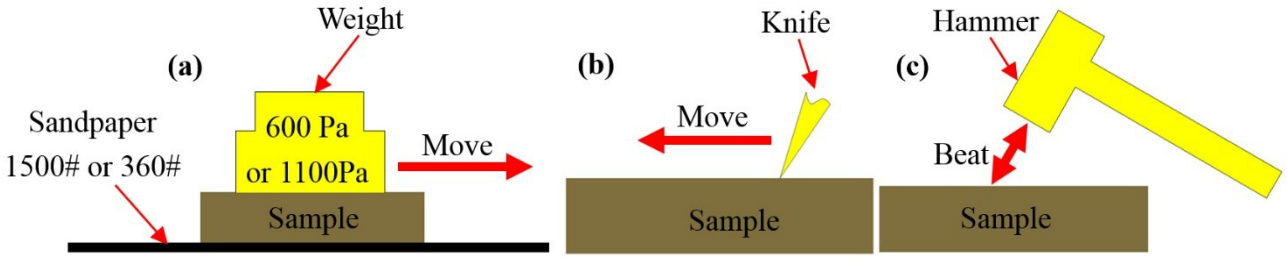

Figure S1 Mechanical robustness test. (a) Sandpaper abrasion: the samples were placed face-down to the sandpaper (sandpaper of 1500# and 360#) and abraded under certain pressure (600 Pa and 1100 Pa). (b) Knife scratch: the move direction of the knife was perpendicular with the knife edge. (c) Hammer beat: a hammer was used to continuously beat the S-concrete to further show the super-robustness of the S-concrete.

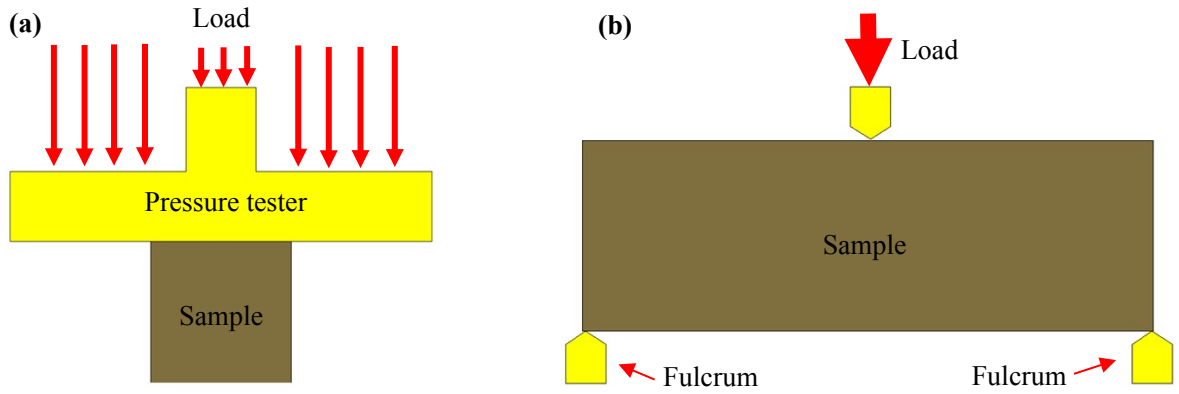

Figure S2 Schematic of the compressive strength and flexural strength test: (a) compressive strength test and (b) flexural strength test.

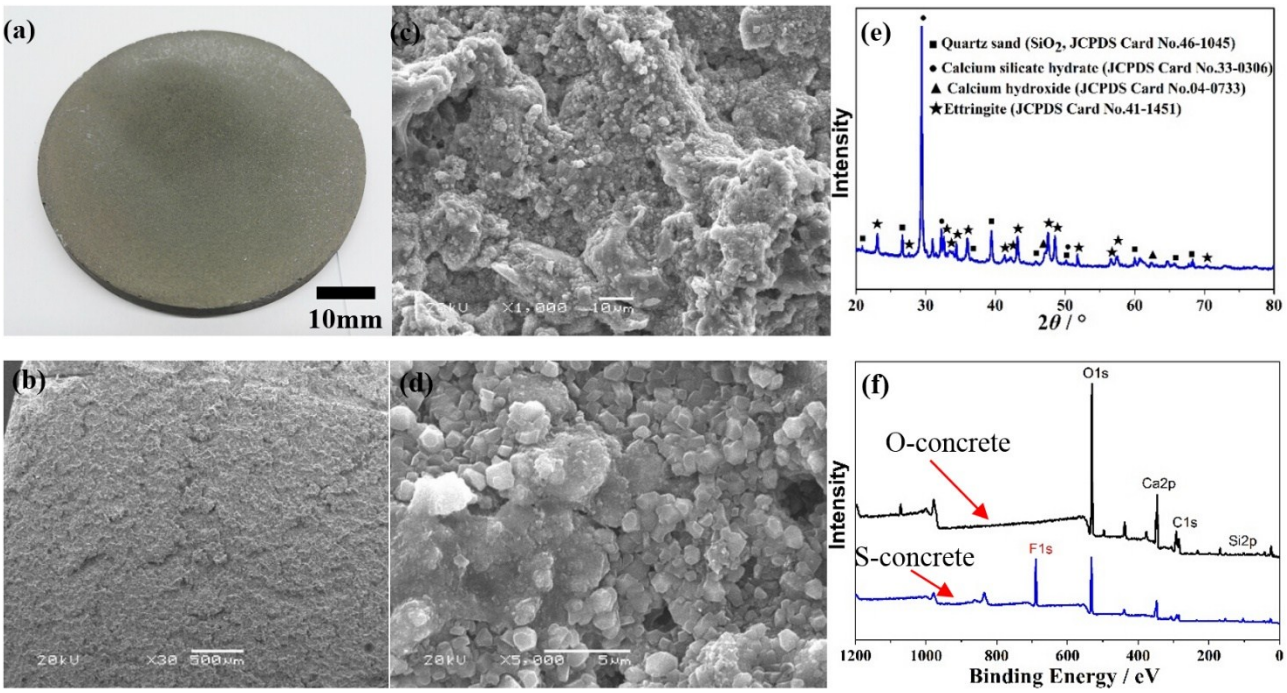

Figure S3 Surface morphology and chemical composition of the O-concrete. (a)-(d) SEM images with different magnifications. There was no sub-millimeter structures but exist micro/nano-meter scale particles on the O-concrete. (e) XRD pattern. The main composition of the O-concrete is quartz sand, calcium silicate hydrate, calcium hydroxide and ettringite. (f) XPS spectra. The peaks from F is not detected on the O-concrete but detected on the S-concrete, meaning the particles of the S-concrete were successfully coated with FAS.

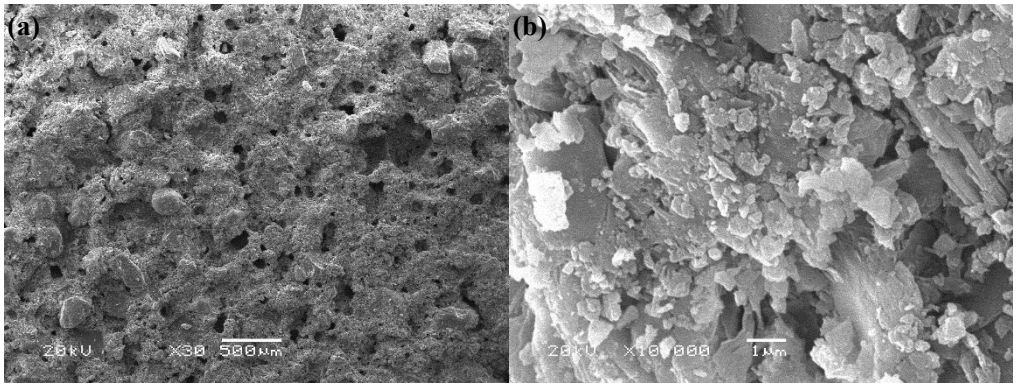

Figure S4 SEM images of S-concrete after abrasion on the standard sandpaper of 1500# at the pressure of 600 Pa for 6 m. The surface was still rather rough than O-concrete.

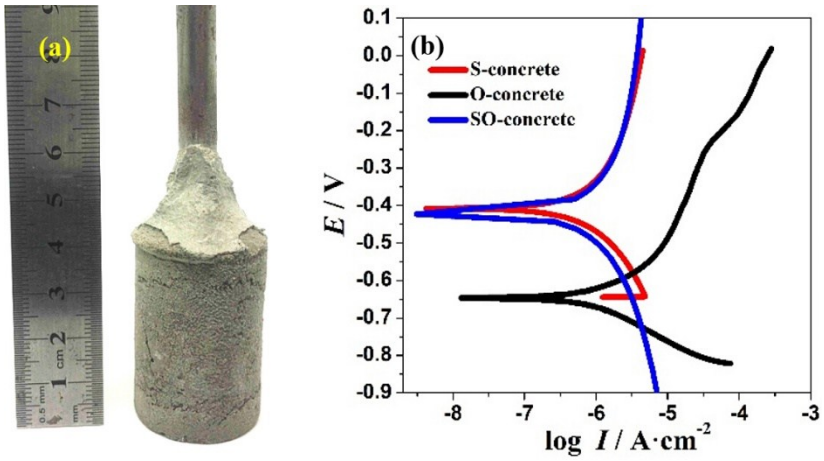

Figure S5 Anti-corrosion test of double layer concrete composed of S-concrete and O-concrete (SO-concrete). The thickness of the S-concrete and O-concrete was 5 mm, respectively. (a) Sample of carbon steel bar coated with the SO-concrete. (b) The potentiodynamic polarization curves of the carbon steel bars coated with concrete in the 3.5 wt % NaCl aqueous solution. The corrosion potential and corrosion current density of carbon steel coated with the SO-concrete were -0.42V and 4.31×10^{-6} A/cm^2. Before the corrosion, all the samples were immersed in the 3.5 wt% aqueous NaCl solutions for 24 h.

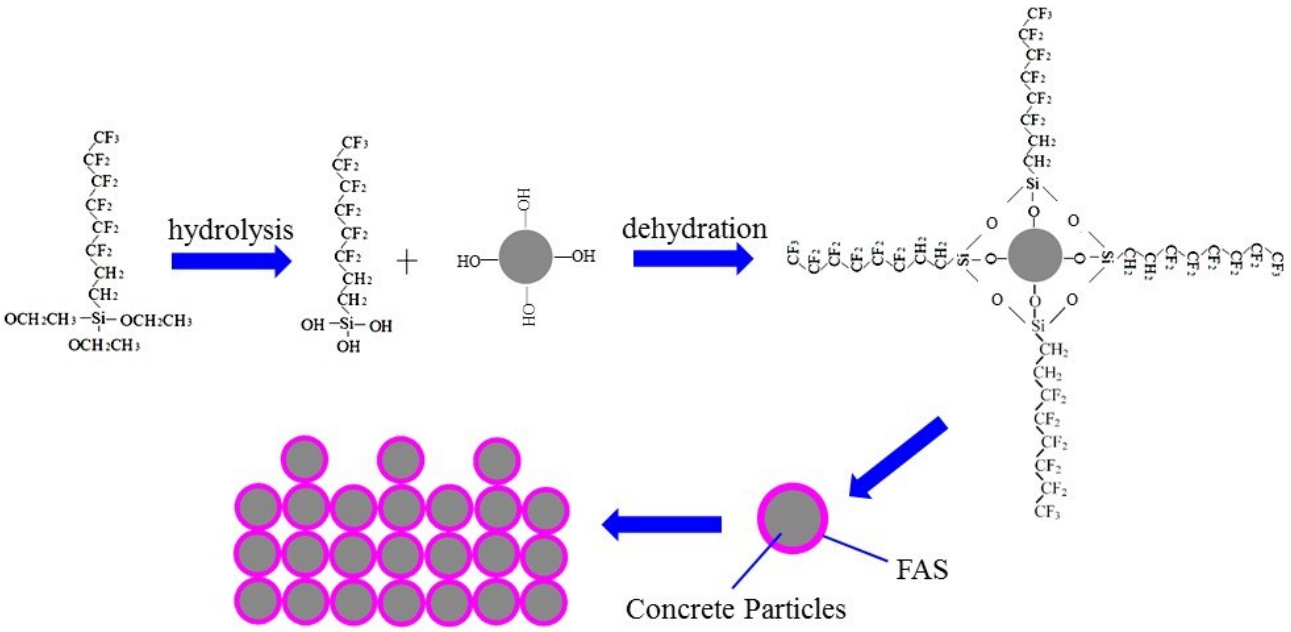

Figure S6 Formation scheme of the self-assembled FAS film on concrete.

Video S1. Dynamic bouncing processes of a 9.5 μL water droplet on the horizontal and sloping S-concrete from a height of 30 mm.

Video S2. Linear abrasion processes of the S-concrete on the 360# sandpaper under 1100 Pa. The S-concrete was still superhydrophobic after abrasion for 8 m.

Video S3. Knife scratch of the S-coating and S-concrete. Although the adhesive can improve the mechanical durability of the S-coating, when the move direction of the knife was perpendicular with the knife edge, the S-coating was easily destroyed by knife. However, after same knife scratch, the S-concrete was still superhydrophobic.

Video S4. Hammer beat processes of the S-concrete. After hammer beat, the S-concrete was still superhydrophobic.

Video S5. Anti-icing processes of the sloping S-concrete. Chamber temperature: -5 °C; rain temperature: 2.5 °C; rain droplet: 13 μL; impact velocity with concrete: 1 m/s; rainfall: 3000 μL/min; tilting angle of concrete: 30°.

Video S6. Deicing force measurement of the horizontal concrete. For an ice cube with ice-concrete contact area of 1.5 m^2, the deicing force was 336.8 N for the O-concrete and 25.5 N for the S-concrete.

Video S7. Self-cleaning processes of the S-concrete. $CaCO_3$ powder was used as dirt and placed onto the S-concrete. Water was then dropped to remove the dirt from the S-concrete.