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Supplementary Materials: A General Strategy towards Superhydrophobic Self-Cleaning and Anti-Corrosion Metallic Surfaces: An Example with Aluminum Alloy

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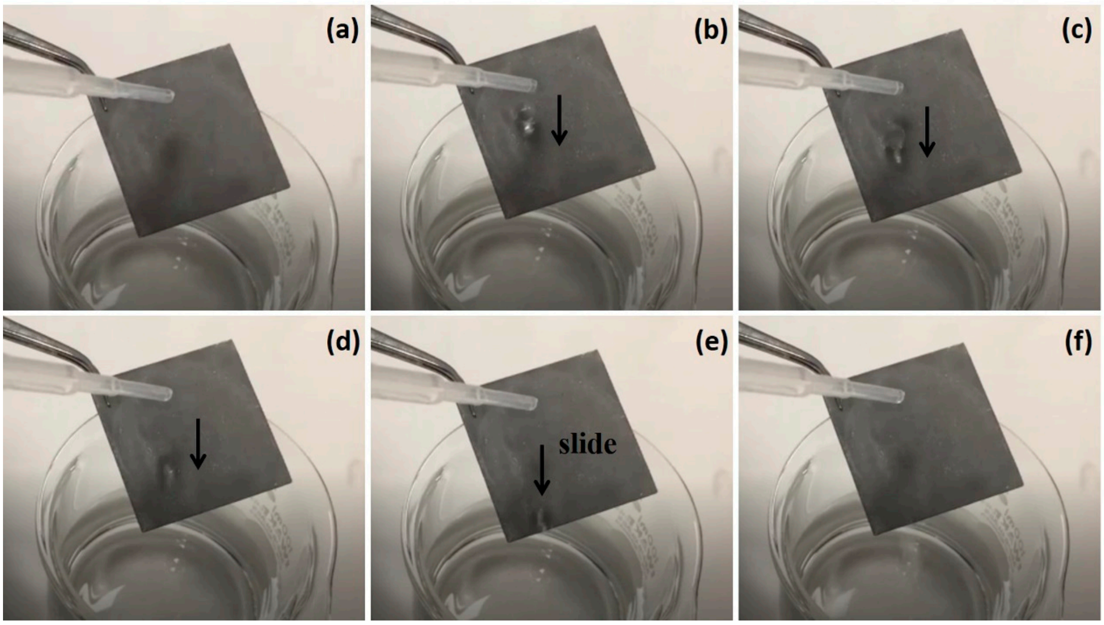

Figure S1. Water repellency of SHC.

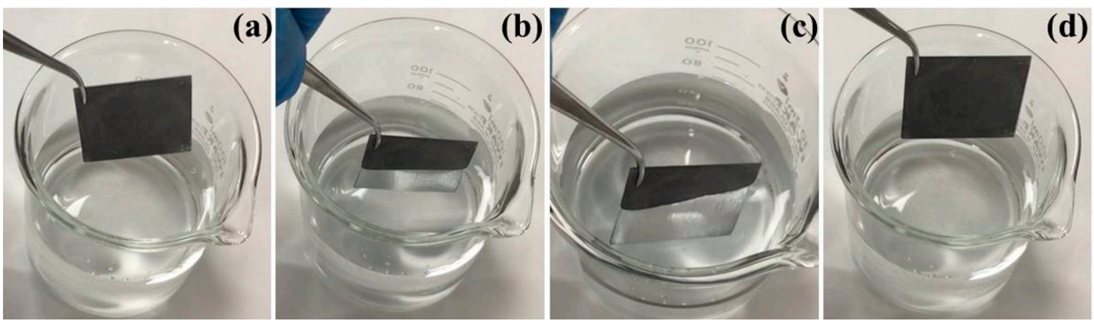

Figure S2. The mirror-like phenomenon for SHC submerged in water.

The SHC shows the mirror-like light reflection when it is immersed in water. As shown in Figure S2(b-c), the mirror effect can be observed with a certain glancing angle, due to the luminous reflectivity at the entrapped air layer on such kind of surface. There was no water droplet attached on the SHC after it was taken out of water [Figure S2d].

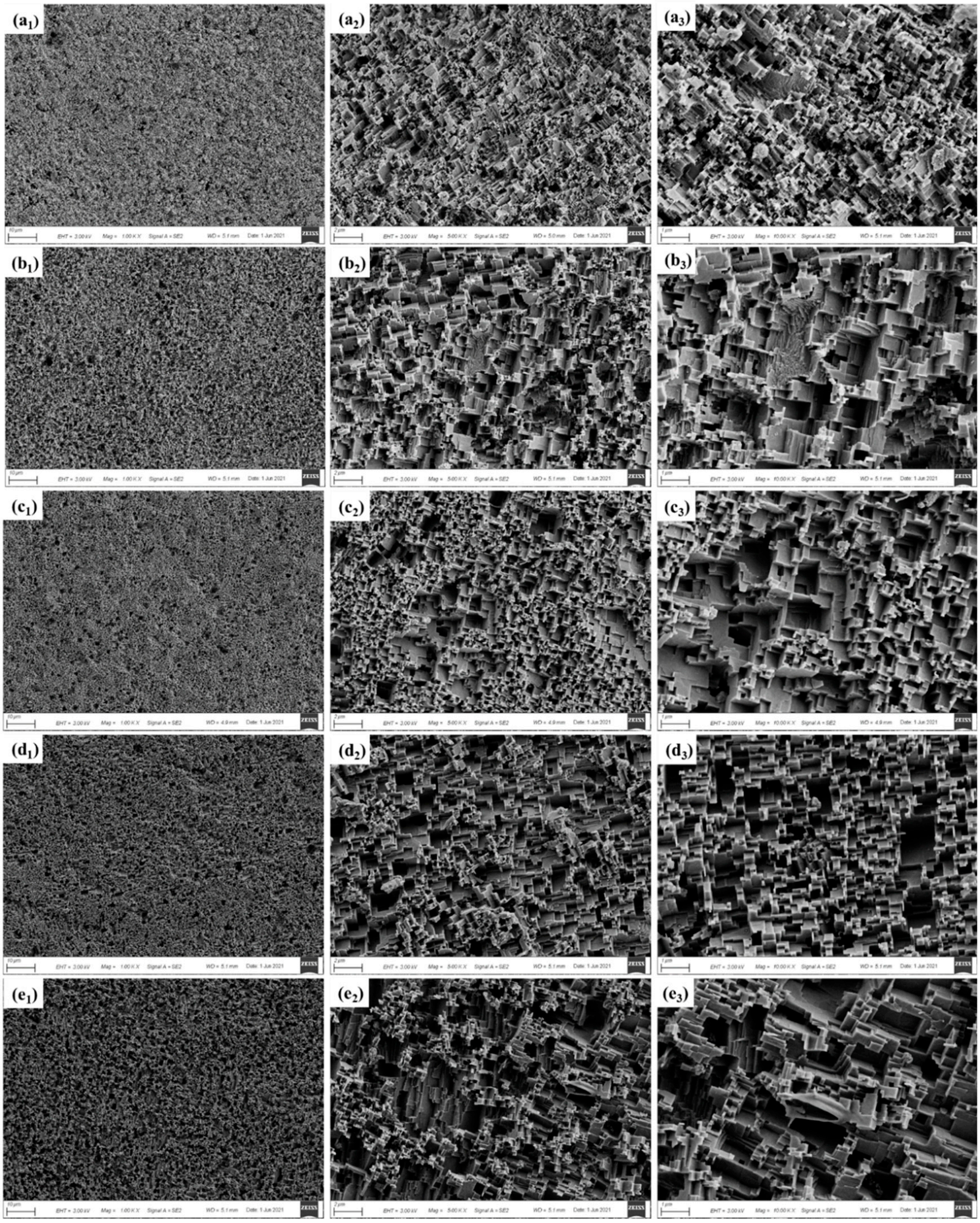

Figure S3. The FESEM images for the samples after etching in 350 g/L HCl solution with different etching time and treating with myristic acid: (a_1-a_3) 2 min; (b_1-b_3) 5 min; (c_1-c_3) 8 min; (d_1-d_3) 10 min; (e_1-e_3) 12 min.

As shown in Figure S3, the Al alloy surfaces became rough significantly once etched. With increasing the etching time from 2 to 12 min, the samples have the similar surface morphology of micro-sized pits with cubic structures. The only difference among these samples is the slight change in the size of the surface structures. And such slight change in size is insufficient to cause the change in water repellency. Thus, there is almost no change in hydrophobicity with increasing etching time to 12 min.

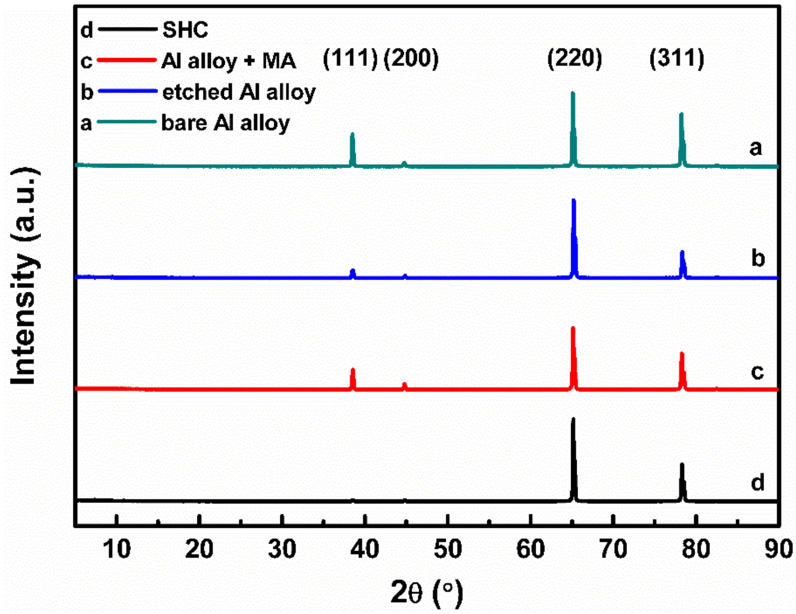

Figure S4. The XRD patterns of different samples: (**a**) bare Al alloy; (**b**) etched Al alloy; (**c**) Al + MA; (**d**) SHC. All peaks belong to the Al alloy.

As shown in Figure S4a, four dominant peaks at 38.5°, 44.7°, 65.1° and 78.3° correspond to planes (111), (200), (220) and (311) of Al (JCPDS NO.04-0787) for the Al alloy substrate. The intensity of the peaks at 38.5°, 44.7° and 78.3° decreases after etching treatment, indicating the etching corrosion may preferentially occur on the (111), (200) and (311) oriented planes of the Al alloy substrate [Figure S4b]. In comparison, there is almost no change for the peak intensity of plane (220). This phenomenon reveals that the etching treatment may cause the selective corrosion in different crystal orientations, resulting in the surface morphology change from smooth to micro-nano structure. The peak intensity for the four planes mentioned above slightly decreased after modification with myristic acid, which could be attributed to the anchor of the low-surface-energy molecular layer onto the bare Al alloy substrate and thus reducing signal intensity for all four planes mentioned above [Figure S4c]. It can be seen clearly that the peaks at 38.5° and 44.7° almost disappeared and the peak intensity of (311) plane decreased for the SHC surface, which could be ascribed to the combination of etching treatment and modification of myristic acid [Figure S4d].

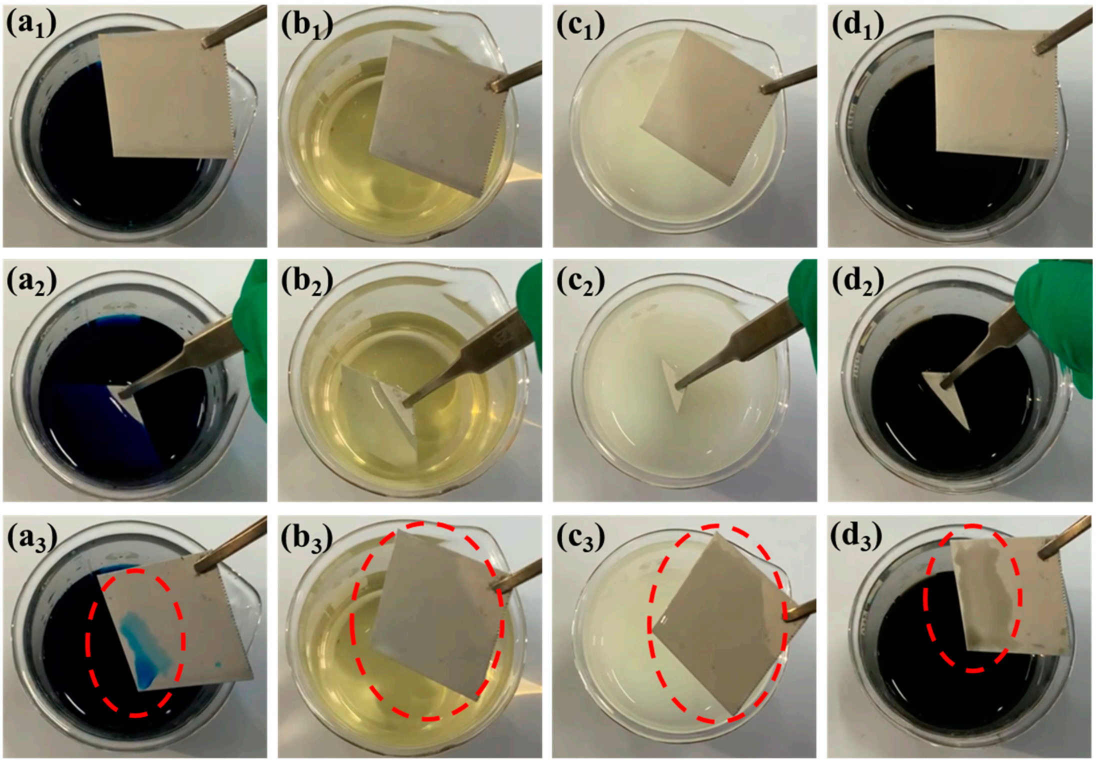

Figure S5. Dirt repellency test of bare Al alloy substrate as a reference sample: (a_1-a_3) methylene blue-dyed water; (b_1-b_3) tea; (c_1-c_3) milk; (d_1-d_3) artificial dirt mixture solution. The contaminative parts are the areas shown inside the dotted circle.

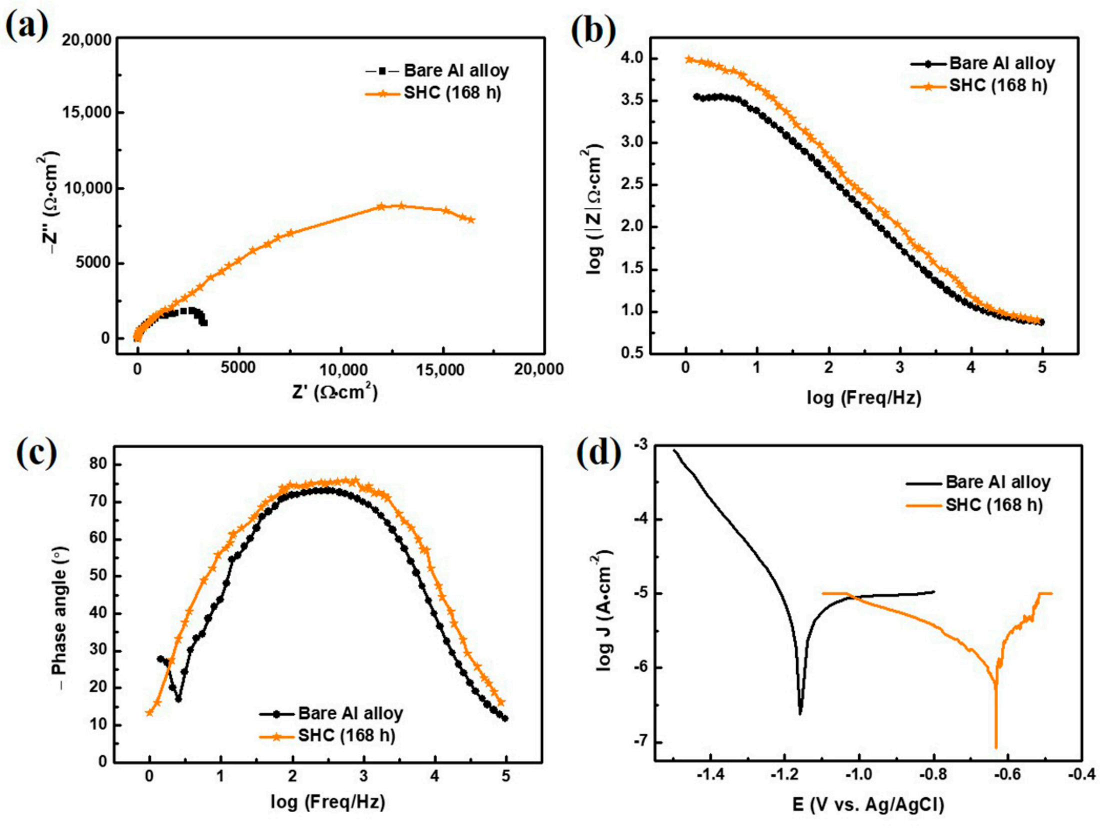

Figure S6. Electrochemical measurements for SHC after immersion in 3.5 wt.% NaCl solution for 168 h: (**a**) Nyquist plots, (**b**) Bode impedance plots, (**c**) Bode phase plots, (**d**) potentiodynamic polarization curves.

Table S1. The apparent surface energy of different samples.

Samples		Measured Apparent Surface Energy (mJ/m^2)	Dispersive Component (mJ/m^2)	Polar Component (mJ/m^2)
Bare Al alloy		60.81	3.14	57.67
Al alloy modified with myristic acid alone		23.81	22.49	1.32
HCl concentration (g/L)	50	19.92	19.54	0.38
	100	16.39	15.86	0.53
	150	13.66	11.52	2.14
	200	6.76	6.65	0.11
	250	8.02	6.81	1.21
	300	8.69	6.84	1.85
	350	12.91	11.98	0.93

Table 2. The surface roughness of different samples.

Samples	**Roughness (nm)**
bare Al alloy	90.12 ± 11.01
Al alloy + MA	119.28 ± 12.31
etched Al alloy	526.86 ± 13.25
SHC	425.16 ± 10.58

Video S1: The dynamic moving process for the water droplets impinged onto the SHC surface.

Video S2: The mirror-like light reflection forms for the SHC when immersion in water.

Video S3: 5 μL of a water droplet placed onto SHC after exposure for 6 months, indicating its low adhesion with water.

Video S4: The dynamic behavior of water droplets on the SHC after heat–humidity treatment.

Video S5: Self-cleaning test on different samples: the contaminant (carbon black powder) adhered to both (a) Al alloy substrate and (b) Al alloy + MA when the water droplet was dripped onto the surfaces. In contrast, the powder on (c) SHC was taken away, and the surface was cleaned along the path of the water droplet movement.

Video S6: The SHC possessed a self-cleaning effect for different liquid contaminants, including methylene blue-dyed water, tea, milk and artificial dirt mixture solution.

Video S7: The self-cleaning performance for SHC after heat–humidity resistance.