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

Supporting Online Materials for

Robust transparent superamphiphobic coatings on non-fabric flat substrates with inorganic adhesive titania bonded silica

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KEYWORDS: Superamphiphobic, Superhydrophobic, Transparent, Self-healability, Robust

This PDF file includes:
Figs. S1 to S11

The influence of temperature on the morphology of the films

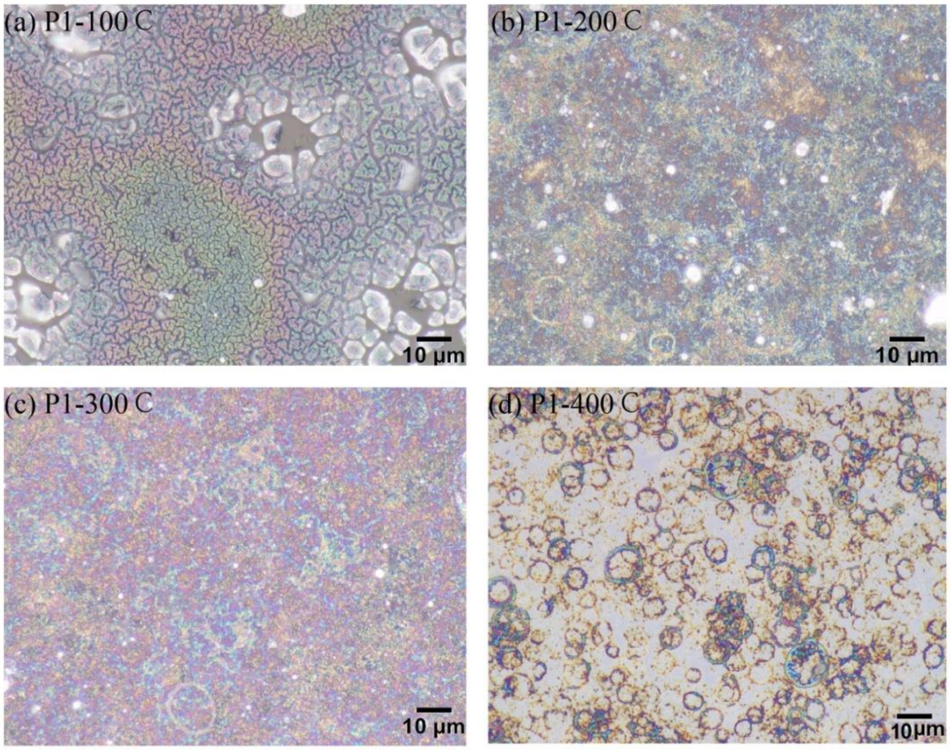

Fig.S1. (a), (b), (c), (d) are the microscope images of theparticle P1solution sprayed on different temperature substrates (100 ℃, 200 ℃, 300 ℃, 400 ℃).

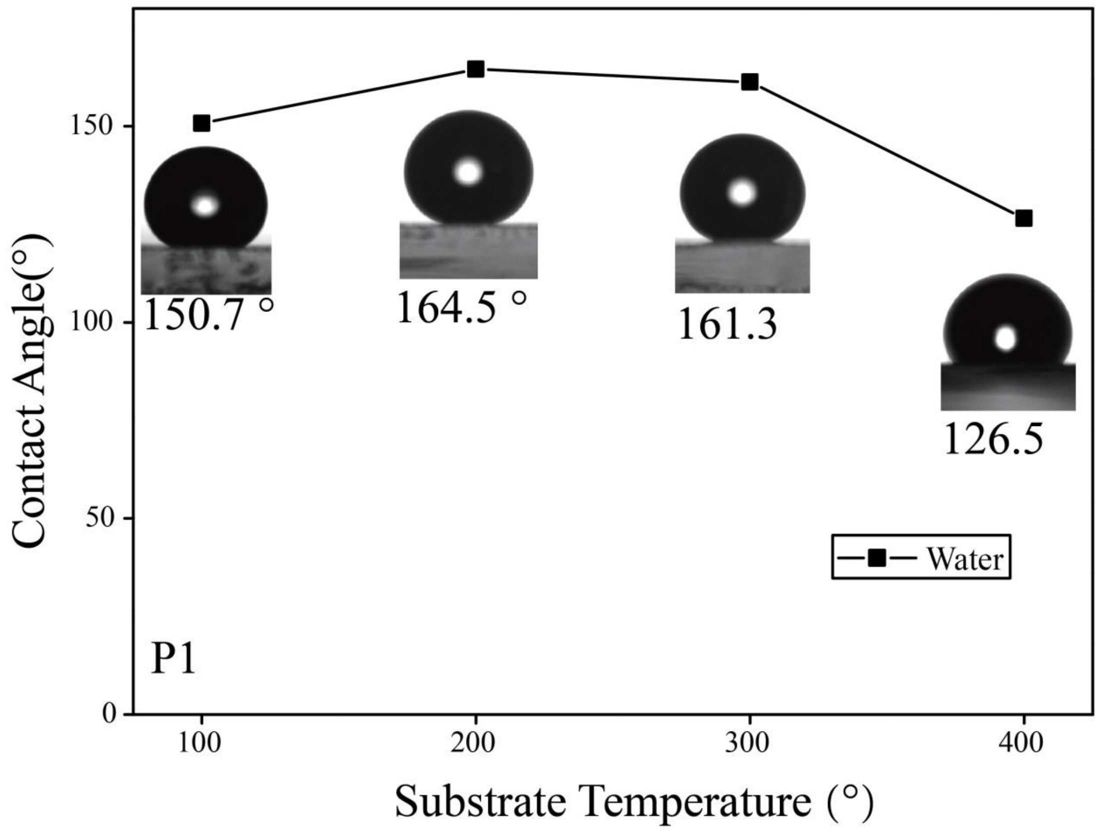

Fig.S2. The static contact angles of water drops on the films prepared by spraying the inks containing particles P1 on the glasses at different temperatures (100 ℃, 200 ℃, 300 ℃, 400 ℃).

The temperature of the substrate can influence the topography of the films (Fig. S1). When spraying the ink with nanoparticles P1, the liquid will pulverize to the fogs. The fogs contact the hot substrates and the solvents evaporate, leaving the nanoparticles to heap up into a certain shape like the coffee ring effect. The evaporation rate determines the morphology of the film. The films prepared at low temperature (100 ℃) present many cracks due to the fact that the films cannot be dried rapidly enough at such a fog flow (Fig. S1 a). The films prepared at high temperature (400 ℃) form many micro-rings (Fig. S1 d), and the evaporation is too violent, and many nanoparticles are blown away by the vapor. Therefore proper temperature is needed. Fig.S2 is the static contact angles of water drops on the films prepared by spraying the inks containing particles P1 on the glasses at different temperatures (100 ℃, 200 ℃, 300 ℃, 400 ℃).The highest static contact angle appears at the film prepared at 200 ℃.

The Cross Section of the P0-P4 films

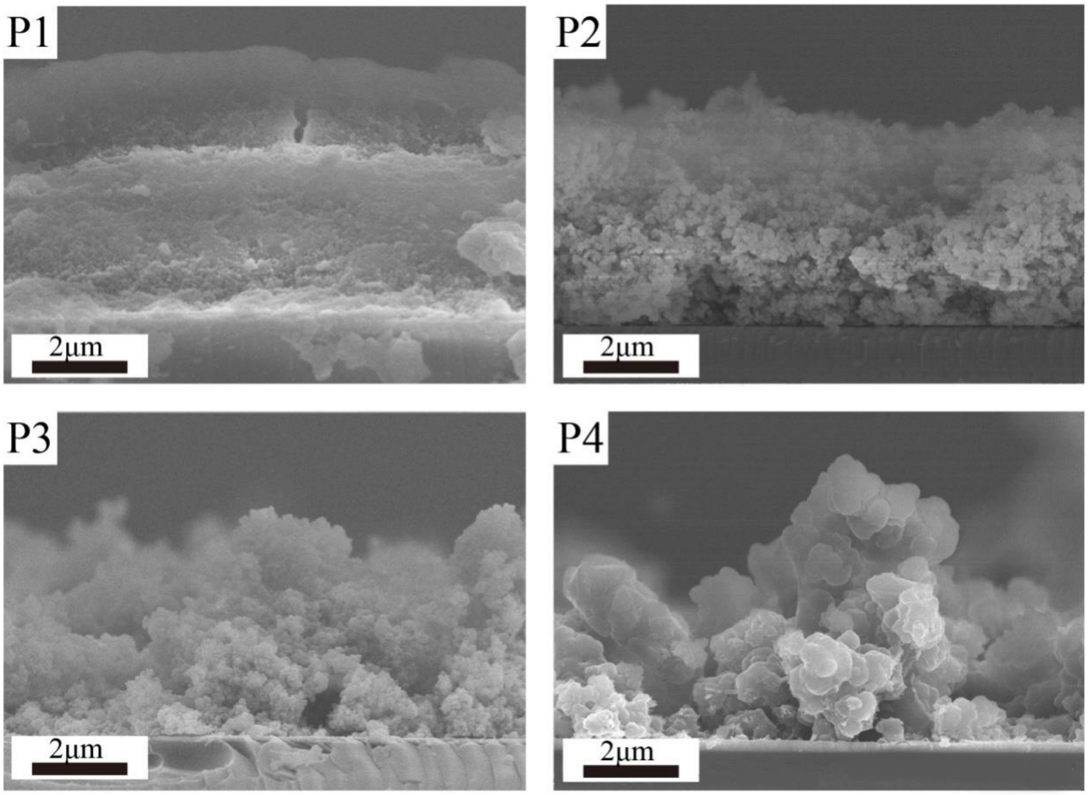

Fig. S3. The SEM cross-section images of the Films P1, P2, P3, and P4,

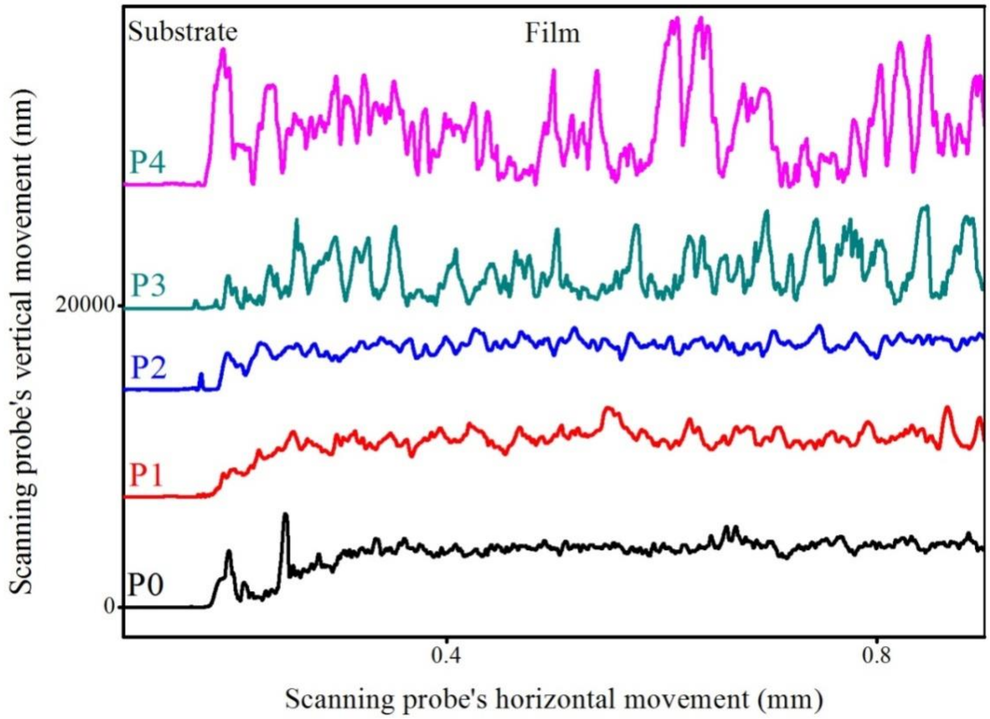

Fig. S4. The stylus profiler of the Films P0, P1, P2, P3, and P4.

The films are prepared by P1, P2, P3, P4 particles. Fig. S3 is the SEM cross-section images. The films' average thickness is about 5μm. Fig.S3 P1 shows that the particles are close-packed without obvious holes. P2 forms porous structure (Fig.S3 P2). The surface of the P3 film is not continuous, and many micro-nano over-hang structures can be found (Fig.S3 P3). P4 film has many raised microstructure. The particles of the P4 are bigger than P3. Fig. S4 shows the stylus profilers of P0, P1, P2, P3, and P4 surfaces. The stylus profilers of P0, P1, P2 films are similar without any big peaks. However, the P3 and P4 films have many big peaks, which agrees with the SEM cross-section images.

The Transmittance of the P0-P4 films

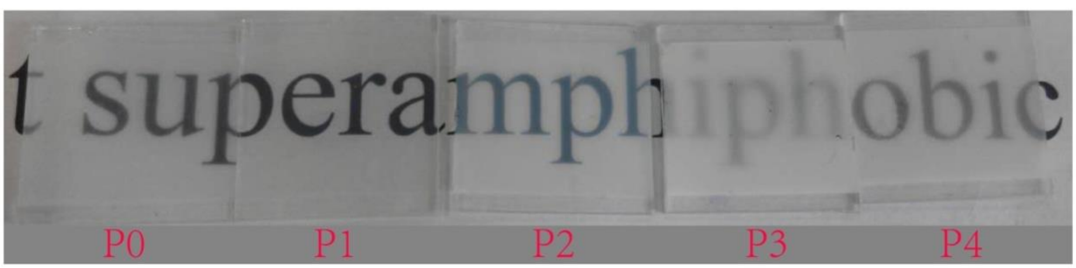

Fig. S5. The optical pictures of the Films P0, P1, P2, P3, and P4 from left to right.

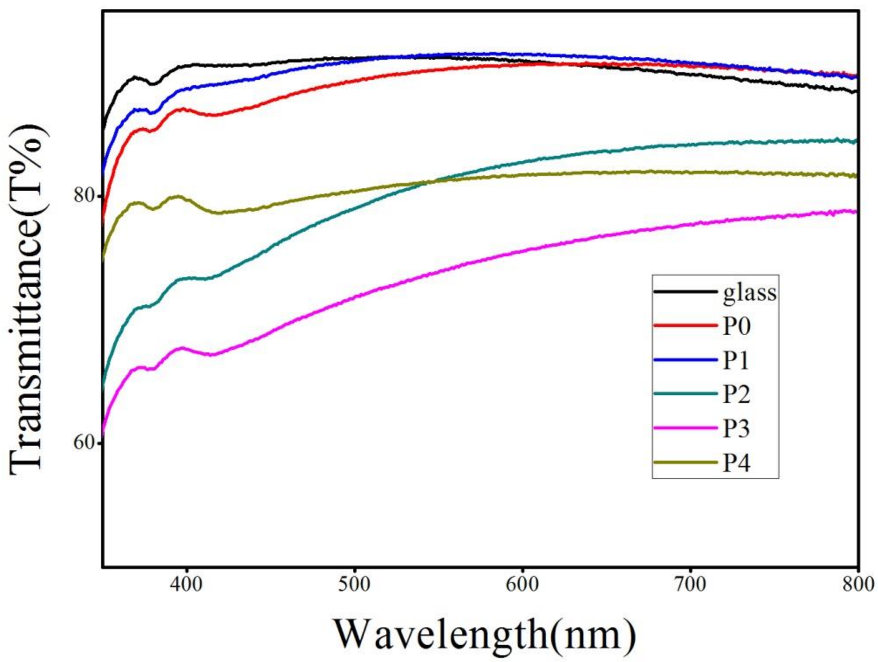

Fig. S6. The transmittance of the glass, P0, P1, P2, P3, P4 films

Fig. S5 is the picture of the Films P0-P4. The Films P0, P1, P2 can clearly transparent, and the best one is the film P1. However, the films P3 and P4 are opaque. Fig. S6 is the transmittance of the glass, P0, P1, P2, P3, P4 films and their average transmittance is 90.4%, 89.3%, 90.4%, 80.4%, 73.6%, 81%, respectively. Here, Film P3 presents the lowest transmittance, but the best superamphiphobic property, which can be attributed to the micro-nano over-hang structure.

Pencil Scratching Test

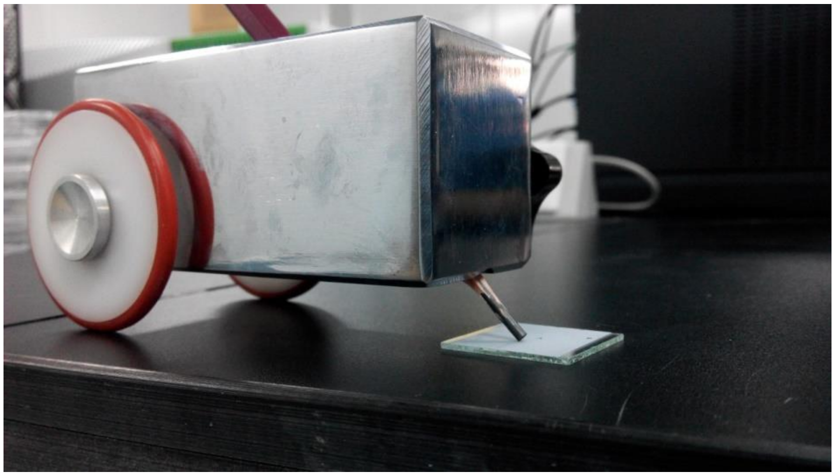

Fig. S7. The picture of the pencil scratching test

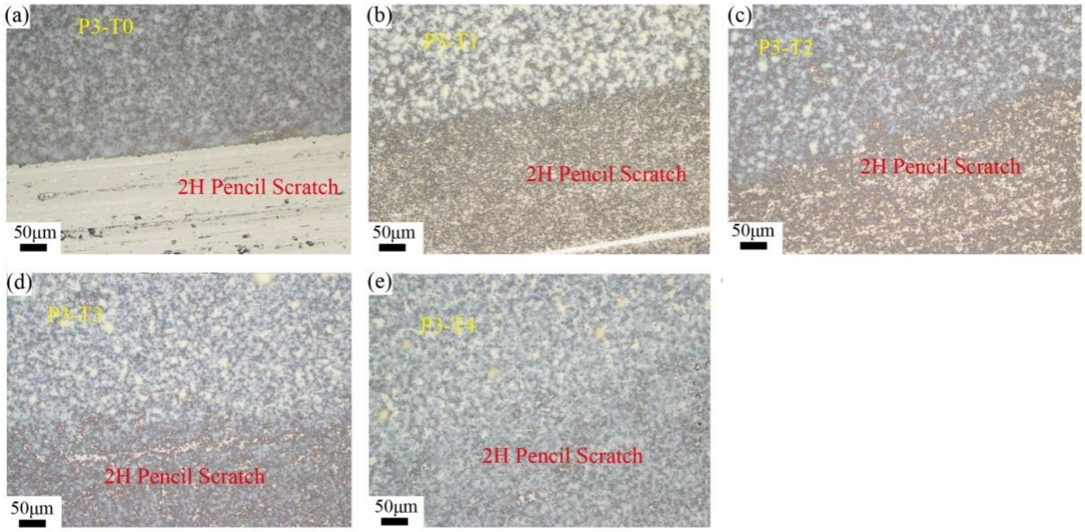

Fig. S8 The microscope of the 2H pencil scratch of the Films (a) P3-T0; (b) P3-T1; (c) P3-T2; (d) P3-T3, and (e) P3-T4.

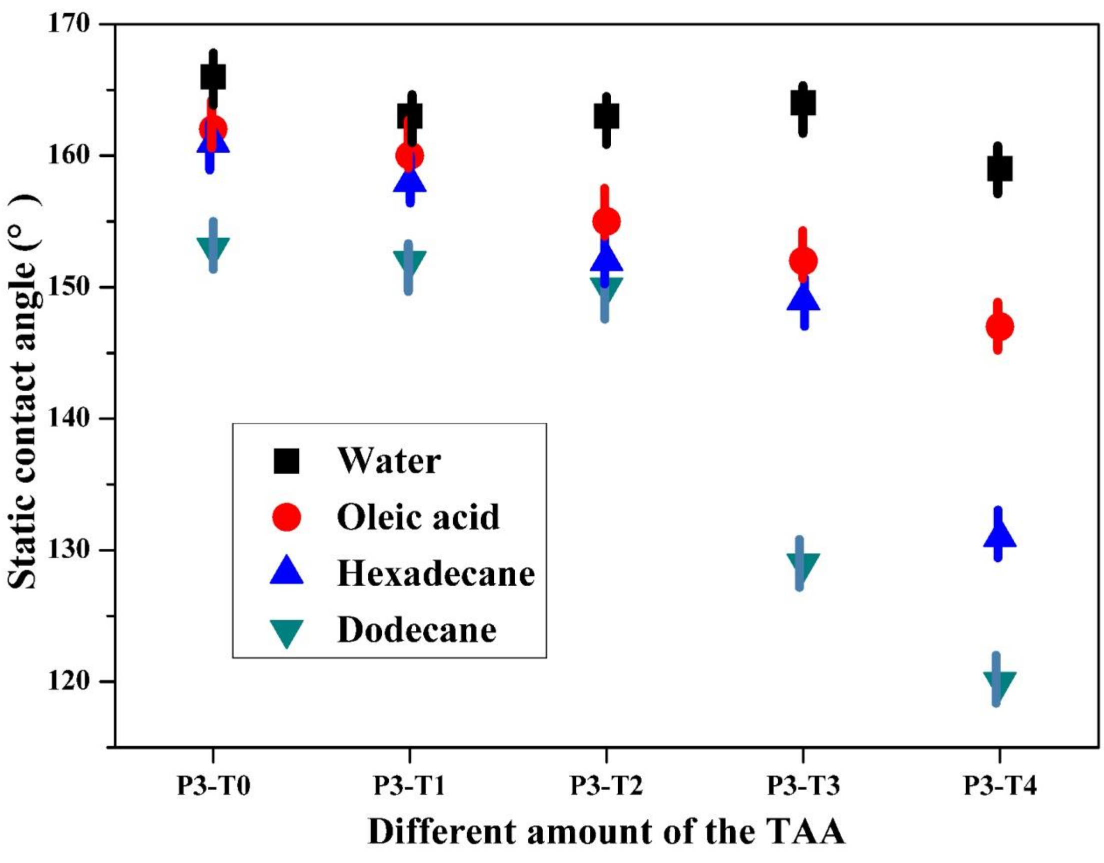

Fig. S9. The SCAs of the different liquids on the Films P3-T0, P3-T1, P3-T2, P3-T3, and P3-T4

Fig. S7 is the pencil scratching test (GB/T6739-1996). Fig. S8 is the microscope of the 2H pencil scratch of the films (P3-T0, P3-T1, P3-T2, P3-T3, P3-T4). The mechanical property of the films is improved after adding TAA. However, when too much TAA was added, such as Film P3-T4, the property of the superamphiphobic decreased obviously, and the Film P3-T4 can super-repel only water.

Self-cleaning property

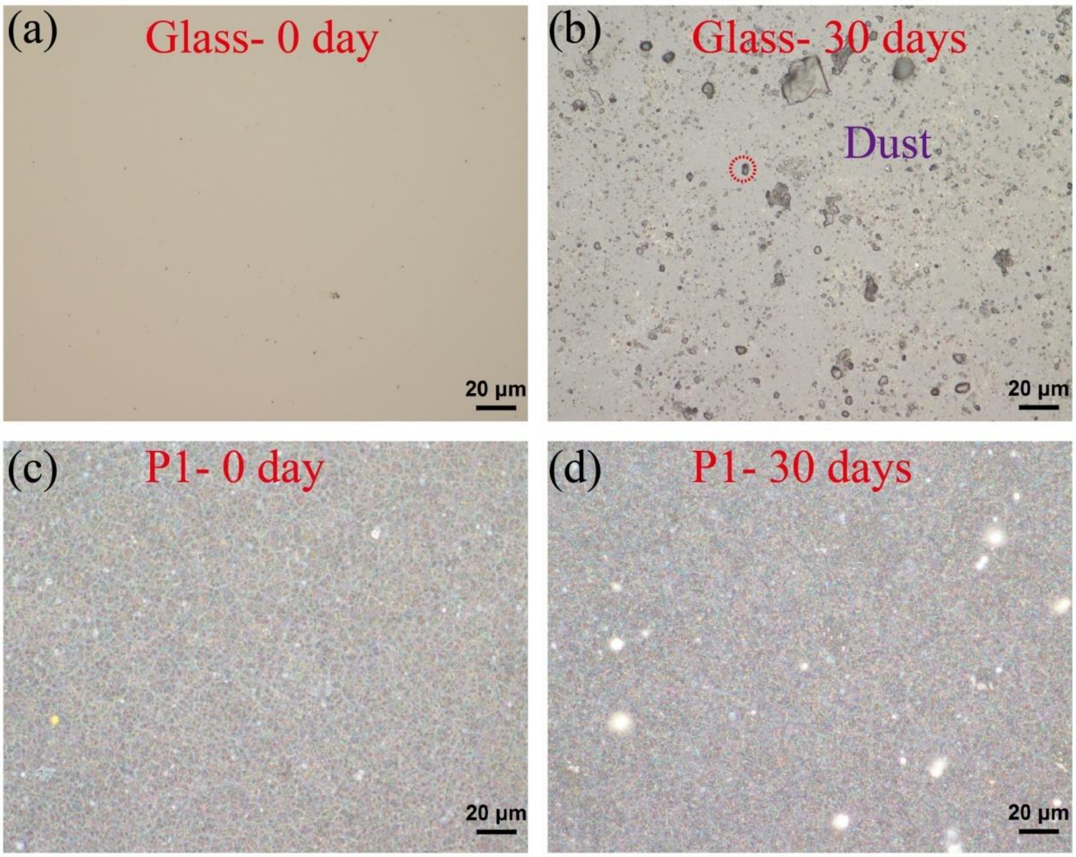

Fig.S10 Microscope images after self-cleaning tests: (a) clean glass; (b) the glass placed in outdoor environment for 30 days; (c) the clean Film P1; (d) the Film P1 placed in outdoor environment for 30 days; (all the samples were placed on the balcony at an angle of 45° to the wall and the test time is from Oct.10.2016 to Nov.10.2016)

The superhydrophobic films present the self-cleaning property. This test proved that after 30 days in the outdoor environment, the glass was covered with dirt; however the Film P1 was still clean (Fig. S10).

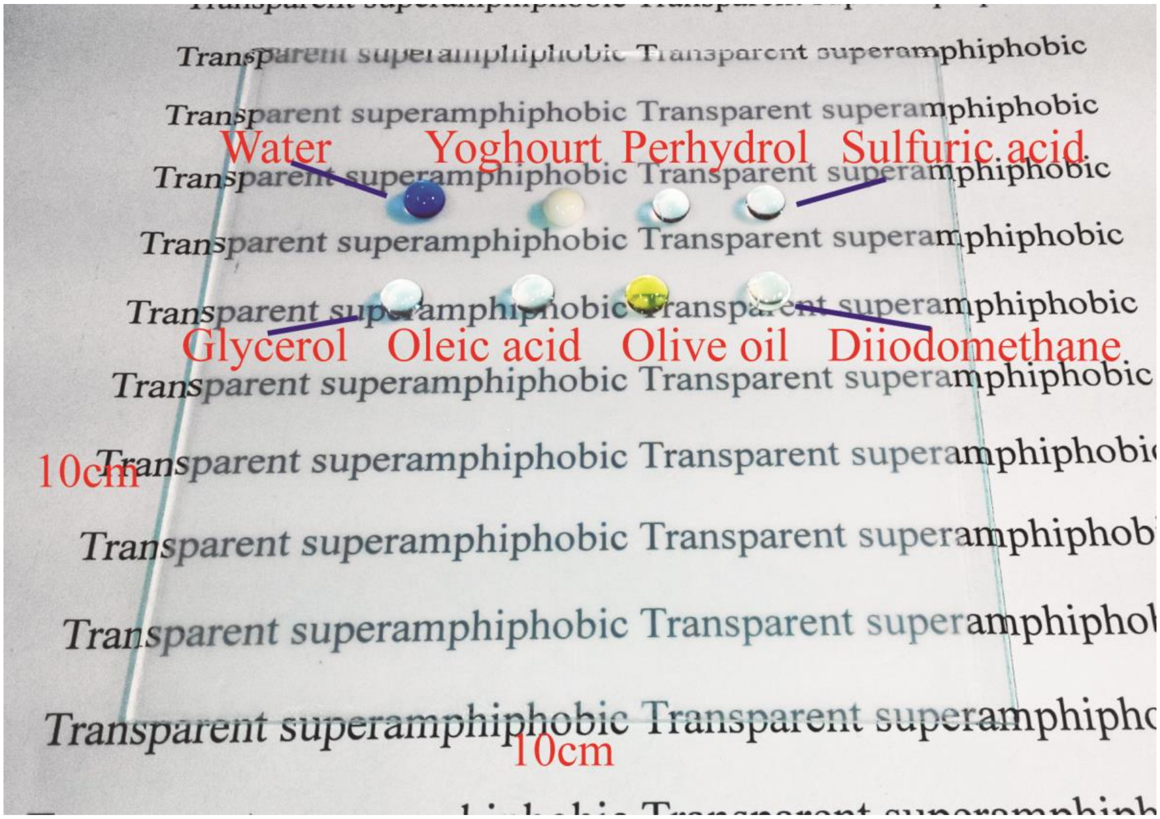

Fig.S11 Optical pictures of the liquids, water (added methyl blue), yoghourt, perhydrol, sulfuric acid, glycerol, oleic acid, olive oil, and diiodomthane drops on the superamphiphobic film (P3-C1, the area of the glass is $10*10cm^2$)