Supporting Information

Robust platform for water harvesting and directional transport

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List of supplementary materials:

S1: Anti-wetting Property

The anti-wetting property, especially the performance against dynamic droplets in rainy or dewy weather, is significant for the practical applications of water harvesting and transport. To understand the dynamics of water droplet on the SLIPS at different temperatures, we performed droplet impacting experiments on SLIPS at 0 °C, 27 °C and 100 °C respectively, as shown in Fig. S1 (a)-(c).

When the surface temperature of the SLIPS was low (0 °C), the droplet bounced back after impacting the SLIPS, and then shed from the surface at 38 ms, with a small bounce distance [Fig. S1 (a)]. When the SLIPS temperature increased to room temperature (27 °C), the bouncing process of the droplet was in 3 sections in the vertical direction. The first section refers to shedding from the substrate at 22 ms, the second section refers to the shedding at 33 ms, and the third section refers to sticking to SLIPS, with increased bouncing distance [Fig. S1 (b)]. When the SLIPS temperature further increased to 100 °C, the bouncing process of the droplet was in two sections in the vertical direction. At 24 ms, the droplet shed from the substrate, with a large bouncing height [Fig. S1 (c)]. Therefore, the phenomenon of bouncing was observed on the SLIPS, and the droplet was split during the bouncing process. With the increase of surface temperature, the droplet had a transition from a partial re-bounce to a complete re-bounce.

When water droplet impacted on a 15° tilted SLIPS, the droplet bounced and slid along the inclined surface [Fig. S1 (d)]. Continuous water jet was also introduced to further test the anti-wetting property of the SLIPS [Fig. S1 (e) and Movie S1]. The experimental results show that after the water jet impacts on the SLIPS, it did not bounce back from SLIPS, but immediately slid on SLIPS.

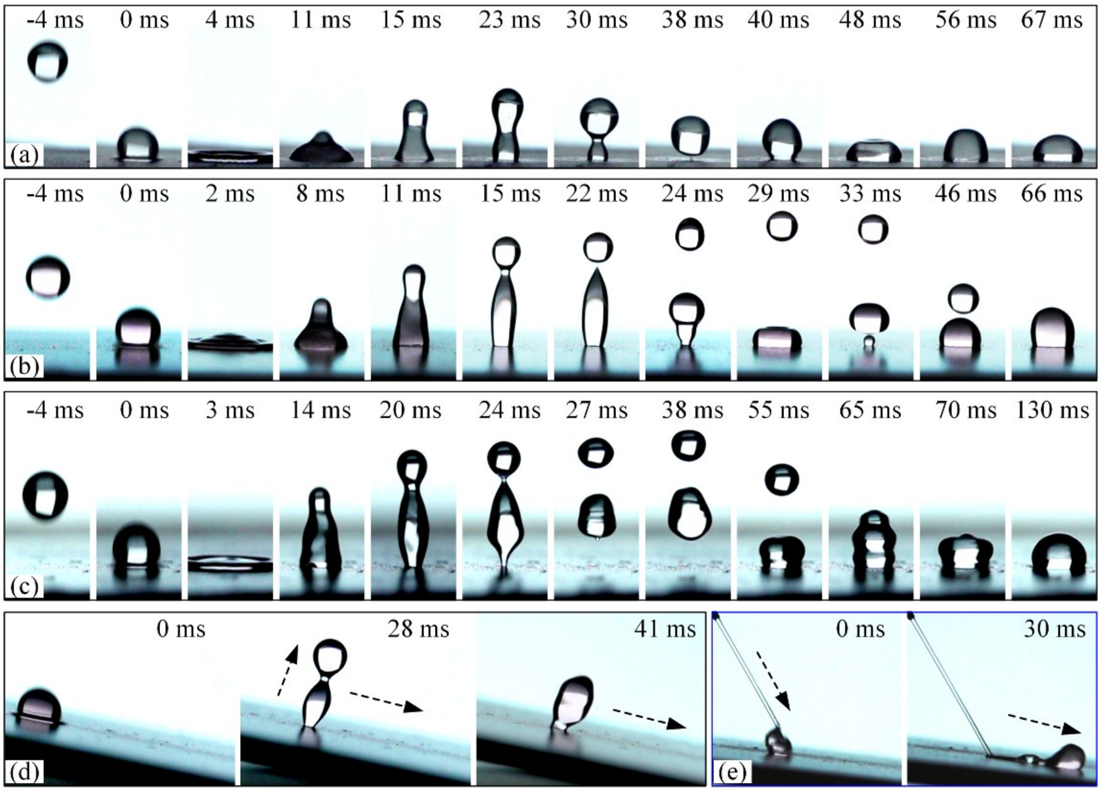

Fig. S1 (a-c) Time-lapse images of droplet impact dynamics on the SLIPS at a temperature of 0 °C, 27 °C and 100 °C (droplet volume, ~5 μL). (d) Droplet impact dynamics on the inclined SLIPS. (e) The inclined SLIPS was impacted by a water jet.

According to the above analysis, the prepared SLIPS has excellent anti-wetting properties and chemical resistance to repel both acidic and alkaline droplets. The surfaces are able to repel water at different temperatures and retain water repellent properties even under a strong water jet impact.

S2: Anti-Icing Property

Anti-icing property of the water harvesting platform directly affects its reliability and durability, especially in low-temperature environment. To further study the anti-icing properties, the freezing process of a water droplet on SLIPS and an ordinary Al plate was investigated. With water droplets constantly dropping onto the inclined SLIPS (the inclination angle was 10°, the temperature was -5 °C, and the flow rate was 10 mL/min), the freezing process of a droplet on SLIPS as well as the sample mass variation was recorded [Fig. S2 (a)]. After dropping on SLIPS, the water droplet quickly froze into ice-particles, then the ice particles shed off. When the droplet impacted on the SLIPS, the split water droplet would stick to SLIPS. After 60 min, the mass of SLIPS increased to only 0.1 g. Meanwhile, when a water droplet impacted on the ordinary surface, it spread out into a water film, then froze into ice that stuck to the surface [Fig. S2 (b)]. With the extending of time, the volume of ice gradually increased. After 60 min, the mass of the ordinary surface reached 4.2 g, which is more than 42 times compared with SLIPS.

To measure the adhesive strength between ice and substrate, the SLIPS and ordinary Al plate were placed in a low temperature test chamber, the ice blocks in the volume of 2 × 2× 2 cm^3 were formed on SLIPS and an ordinary Al plate with the assistance of a mold, then the ice was removed using a dynamometer, meanwhile the deicing force was recorded during the ice removal process [Fig. S2 (c)]. For the SLIPS, ice was very easily removed without any residual ice, the ice-SLIPS interface was very clear. For the ordinary Al plate, however, obvious residue ice was observed on the ice-SLIPS interface after the deicing experiment [Fig. S2 (d)]. After staying at -15 °C for 2 hours, the deicing force of the ordinary Al plate was over 65 N. However, in the case of SLIPS, the deicing force was approximately 10 N [Fig. S2 (e)]. Moreover, after staying at -15 °C for 4 hours, the SLIPS still had sound anti-icing properties [Fig. S2 (f)]. After staying at -30 °C for 2 hours, the deicing force of an ordinary Al plate and SLIPS were similar due to the fact that the lubricating oil on SLIPS also froze and lost its effectiveness [Fig. S2 (g)].

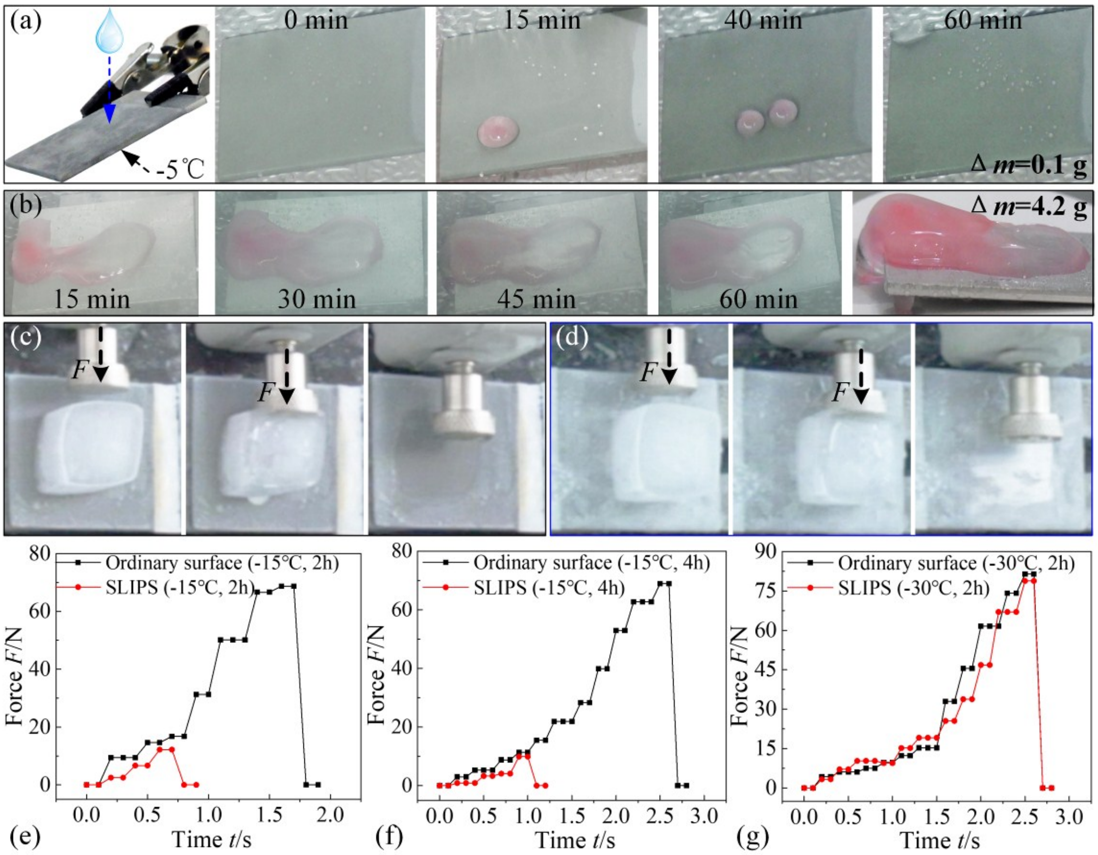

Fig. S2 The freezing process of (a) SLIPS and (b) ordinary surface after raining for 60 min with an inclined angle of 10° and temperature of -5 °C. The deicing experiment process of (c) SLIPS and (d) ordinary surface after the samples staying at -15 °C for 2 hours. (e-g) The deicing force of SLIPS and ordinary surface after freezing at -15 °C with 2 hours, -15 °C with 4 hours and -30 °C with 2 hours.

SLIPS showed perfect dropwise condensation and anti-icing properties in a freezing environment. SLIPS could directly and continuously capture the moisture from the air and collect water droplets, wherein the water collection efficiency increased with humidity. As the collected water droplet volume increased, the droplet would slip along the surface in the direction of the inclined surface under the action of gravity and would encourage further coalescence with each other. Under the temperature of -5 °C, the droplets impacted on SLIPS and quickly froze into ice particles. These ice particles slid down along the surface, rather than froze into ice blocks on the surface. Even though staying at -15 °C for 4 hours, the ice blocks could still be easily removed by a small deicing force without leaving any ice residue.