Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting information:

Supporting Movie

Movie S1 Unidirectional transport process on the resulted mesh from the unirradiated side to irradiated side for the droplet of 50% ethanol aqueous solution.

Movie S2 Blockage process on the resulted mesh from the irradiated side to unirradiated side for the droplet of 50% ethanol aqueous solution.

Supporting Table

Table 1S Surface tension for water with different ethanol concentration.

Ethanol concentration in water (v/v)	Surface tension from experiments (reference) at 19.9℃ (mN/m)
0%	72.88
10%	53.43
20%	43.71
30%	37.16
40%	33.88
50%	31.36
60%	28.95
70%	27.45
80%	26.00
90%	24.49
100%	22.85

[Data obtained from Ref: Vazquez et al, Surface Tension of Alcohol Water, Journal of Chemical & Engineering Data 2015, 40, 611-614].

Supporting Figures

Superhydrophobicity and high oleophobicity can be selectively obtained by varying the electrochemical parameters. The e□ects of electrochemical parameters such as electrochemical electrolyte concentration, etching time, and electrolyte temperature on the surface wettability for water, methanamide, and soybean oil were investigated. Their surface wettability is highly dependent on the concentration of the electrolyte, and etching time in electrochemical process whereas the etching temperature of the electrolyte are not so important.

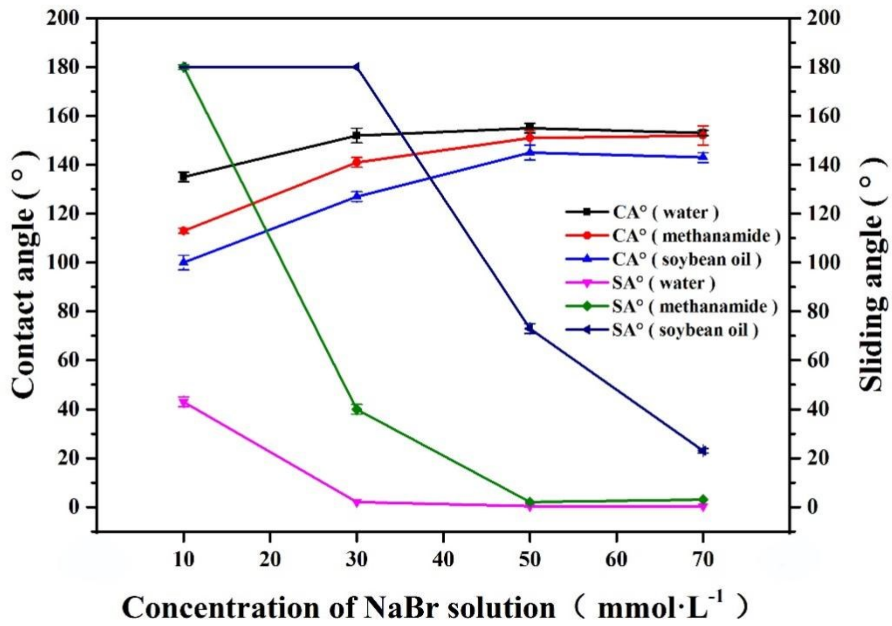

Fig. S1 Effect of NaBr concentration on the wettability.

Fig. S1 shows the relationship between electrolyte concentration and the contact and sliding angles of water, methanamide and soybean oil with different surface tension values of 72.9, 59.1 and 34.5 mN/m, respectively.

At a constant current of 400 mA and an electrolyte temperature of 60°C, the surface of Ti was electrochemically etched for 60 min, followed by the immersion of FOTS. The concentration of NaBr solution ranged from 10 to 70 mmol L-1. The results showed that when the NaBr concentration exceeded 50 mmol L-1, the largest contact angles and the smallest sliding angles were obtained for the selected liquids. As the electrolyte concentration increased continually, the irregular geometry of Ti mesh becomes thinner, eventually causing the structure to break.

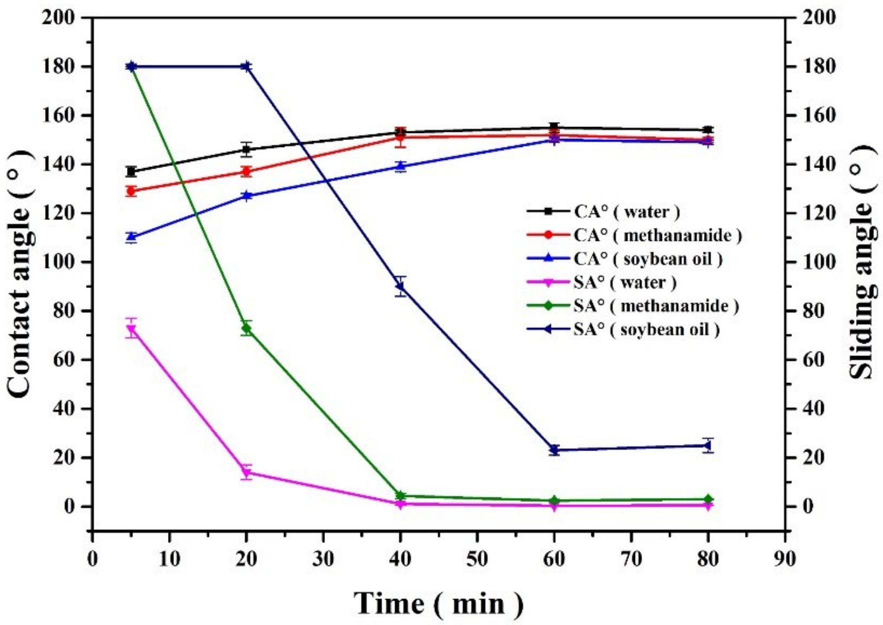

Fig. S2 Effect of the etching time on the wettability

Fig. S2 shows the relationship between the electrochemical etching time and the contact and rolling angles of water, methanamide and soybean oil. The surface of Ti was electrochemically etched in 50 mmol L-1 NaBr solution at a constant current of 400 mA and an electrolyte temperature of 60°C. The electrochemical etching time was changed in the range of 5- 80 minutes. After 60 minutes of etching and immersion in FOTS, the largest contact angles and the smallest sliding angles were obtained for the selected liquids.

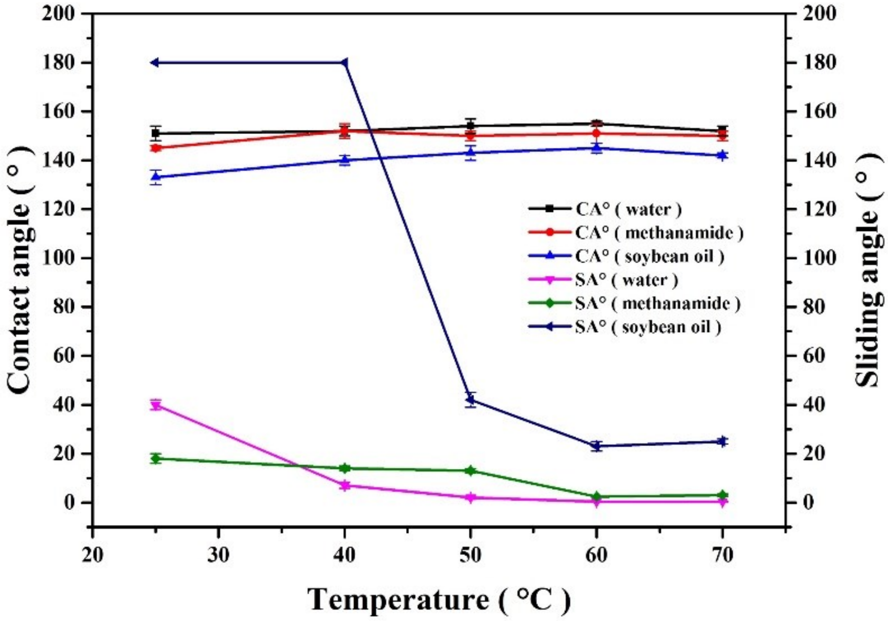

Fig. S3 Effect of the electrolyte temperature on the wettability

Fig. S3 shows the relationship between electrolyte temperature and contact angle and sliding angle of water, methanamide and soybean oil.

Using the optimal etching conditions, effects of the electrolyte temperature on the surface wettability were investigated in the range of 25-70 °C. When the temperature is kept about 60°C, the largest contact angles and the smallest sliding angles were obtained for the selected liquids.

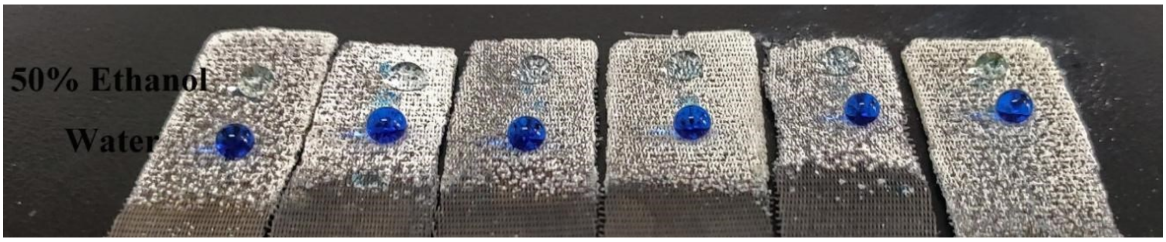

Fig. S4 Reproducible fabrication of Ti Meshes using the optimal electrochemical etching condition. Two droplets of water and 50% ethanol aqueous solution was used to evaluate the wettability. Both spherical droplets are seating on their surfaces of Ti meshes, indicating its superhydrophobic and high oleophobic status.

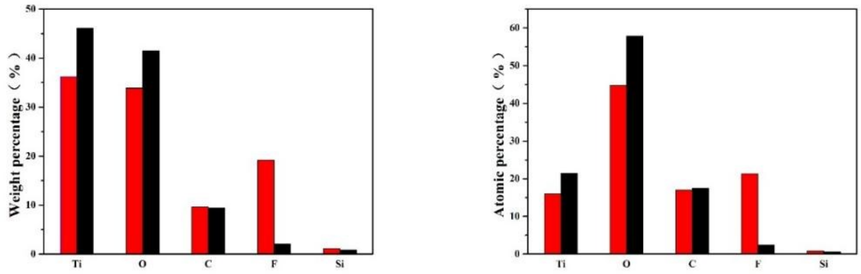

Fig. S5 Weight and atomic percentages for the Ti mesh before (red column) and after (black column) 7h UV irradiation.

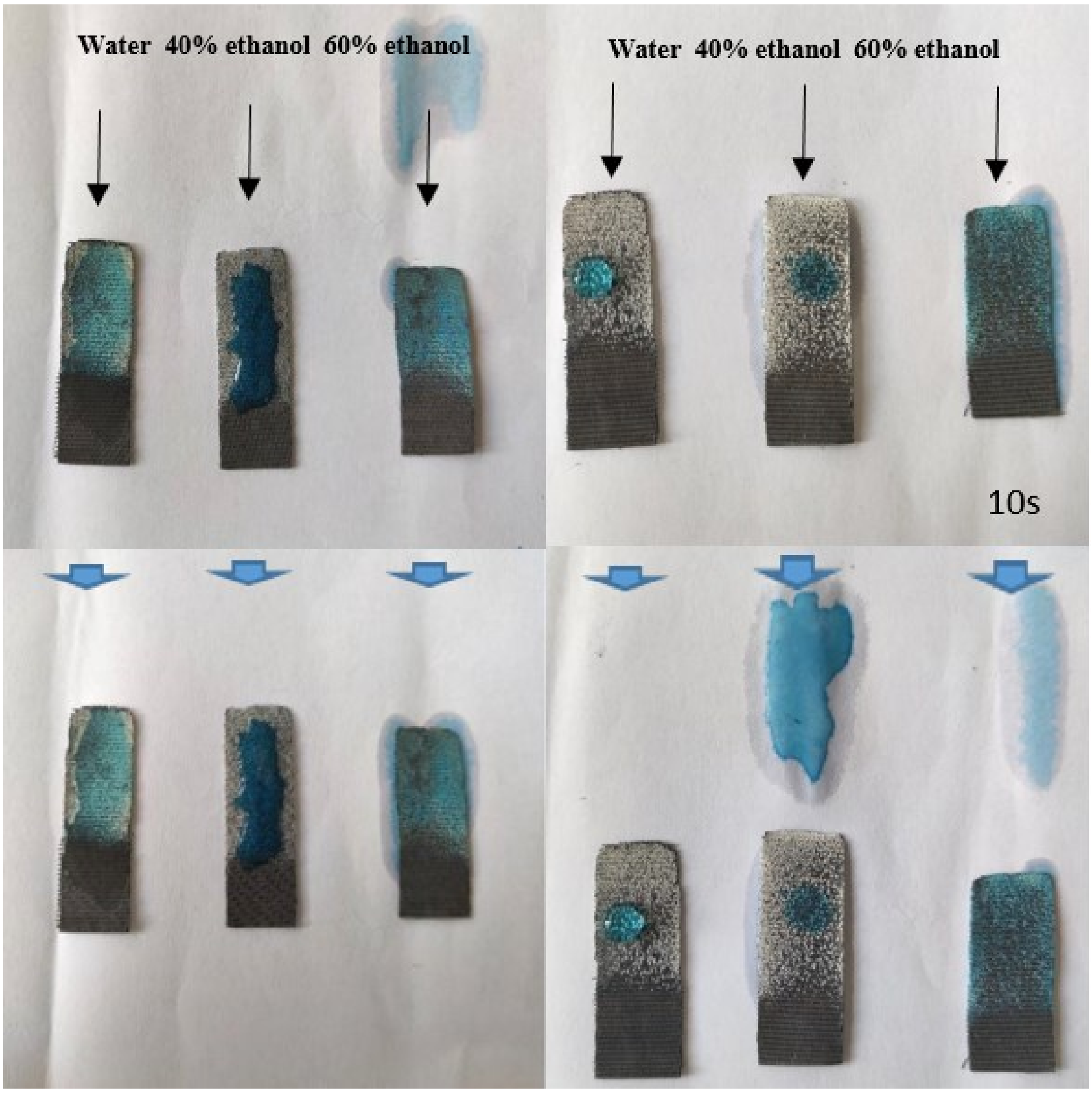

Fig.S6. Put the Janus mesh irradiated 7h on the filer papers, drop some liquid droplets with different surface tension on their surfaces, we move these mesh down after 10s. We can see some blue liquid droplets infiltrate the surface of filter papers. When the meshes are in the alignment form the superhydrophilic/superhydrophobic (left), only 60% ethanol droplet transport and leave some blue marks. In contrast, when the meshes are in the alignment from superhydrophobic/superhydrophilic (right), both 40% and 60% ethanol droplets penetrate the meshes. It demonstrates that dual-directional transport, unidirectional transport and dual-blockage transport occur for the 60% ethanol droplet, 40% ethanol droplet, and water droplet, respectively.

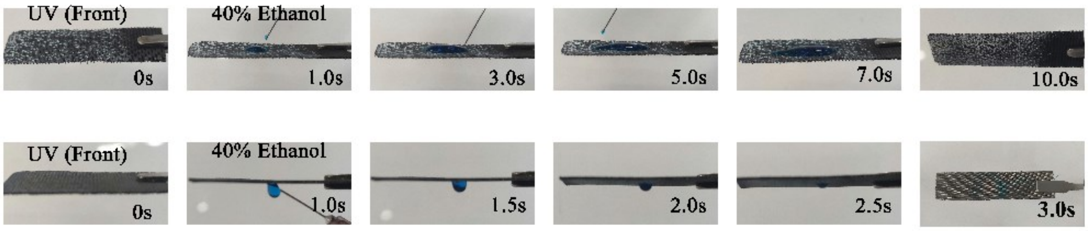

Fig.S7 shows a series of frames taken from a video to show liquid droplet (40% ethanol) transport against gravity. Once one liquid droplet of 40% ethanol was dropped on the irradiated face of the resulted mesh, it just spread onto the surface without penetrating through the mesh (entries 1-5). After the dropped droplet seated on the front layer about 10 s, the mesh was turned upside. No liquid was observed (entry 6), indicating its blockage from the lyophilic layer to lyophobic layer. To avoid effects from gravity, liquid droplet was fed upward to attach to the bottom surface (unirradiated surface) of a horizontally laid mesh and it quickly penetrate across the thickness (entries 7-11). After 3 s, it moved up to penetrate through the mesh and then spread onto the top layer (entry 12). These results clearly indicate that the modified mesh after one-side UV irradiation shows unidirectional oil-transport ability.