Supporting information:

Facile Fabrication of Superhydrophobic and Eco-Friendly Polylactic Acid Foam for Oil-Water Separation via Skin-Peeling

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Experimental section

Materials

PLA (4032D) was obtained from NatureWorks (USA), with 98% of L-lactic acid unit in its main chain. It had a number and weight average molecular weights of 1.03 × 105 and 1.25 × 105, respectively. Dioxane was purchased from Zhiyuan Reagent Co., Ltd Tianjin, China. Strong tape was purchased from a local supermarket.

Fabrication of PLA foam and the peeling process

PLA pellets (1.5 g per 50 mL dioxane) were dissolved in dioxane with rapid stirring at 40 °C for 3 h to form a homogeneous solution. After cooling down to room temperature, different amount of deionized water (0, 2 ml, 4 ml) was added into the solution under strong stirring to form samples named F0, F3, F4. Finally, the obtained mixture was placed in a -4 °C freezer for 12 h to ensure completely phase separation, and then transferred to a freeze-drying vessel (FD-1A-80, Dusi, Shanghai) at -80 °C for 72 h at 8 Pa. Finally, the PLA foam was tightly wrapped with a tape, and then the tape was slowly removed to obtain PLA foam with porous rough surface. F3 and F4 after peeling was named F3P, F4P.

In the stirring test, the foam was placed in a beaker filled with 50 ml ethanol and stirred at a rate of 150 rpm for 2 h, and then placed in a fume hood for 8h to ensure the complete evaporation of ethanol. The mass ratio was defined as follows:

$$Q = \frac{m_t}{m_0} \qquad \text{(S1)}$$

where m_0 and m_t are the initial and final weight of the sample after structural stability

test experiment, respectively.

N2 adsorption/desorption isotherms were measured with a surface area and porosity analyzer (Autosorb IQ2, Quantachrome, U.S.A.) at 77 K. Specific surface area was determined by the Brunauer-Emmett-Telle (BET) method and pore size distribution was calculated via the non-local density functional theory (NLDFT) method.

The contact angle was implemented on contact angle goniometer (SL200KS, KINO, USA) at room temperature. The droplet volume was 3 μL.

Oil-water separation performance

The capacity of the foam was tested by immersing the dry PLA foam in oils or organic solvents for 5 s and picked out for weights. The absorption capacity (Q) was defined as follows

$$Q = \frac{m_t}{m_0} - 1 \qquad \text{(S2)}$$

where m_0 and m_t are the weight of the initial sample and the adsorbed oil, respectively.

The reusability of PLA foam for the adsorption of oil was determined by simple centrifugation method. Centrifugation experiment was performed by a Cence TG16-WS high-speed centrifuge with a rotating speed of 8000 rpm for 5 min. As for the organic solvent, evaporation method was used, the samples were kept in vacuum oven at 50 °C for 1 h. As for the organic solvent, evaporation method was used, the samples were kept in vacuum oven at 50 °C for 1 h. The organic solvents used in this experiment

have excellent volatilization ability, which could be quickly volatilized at 50 °C. The adsorption efficiency (e) of the pumping experiment was defined as follows:

$$e(\%) = \frac{m_s}{m_p} \times 100\% \qquad \text{(S3)}$$

where m_s and m_p are the adsorbed and initial weight of oil in the pumping experiment, respectively.

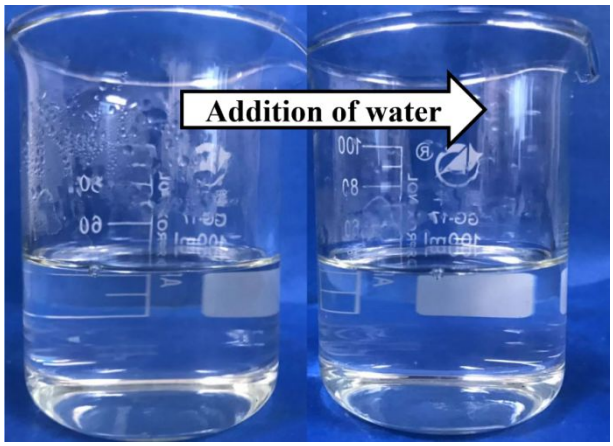

Figure S1. The solution before and after the addition of water. No precipitate was observed in the solution.

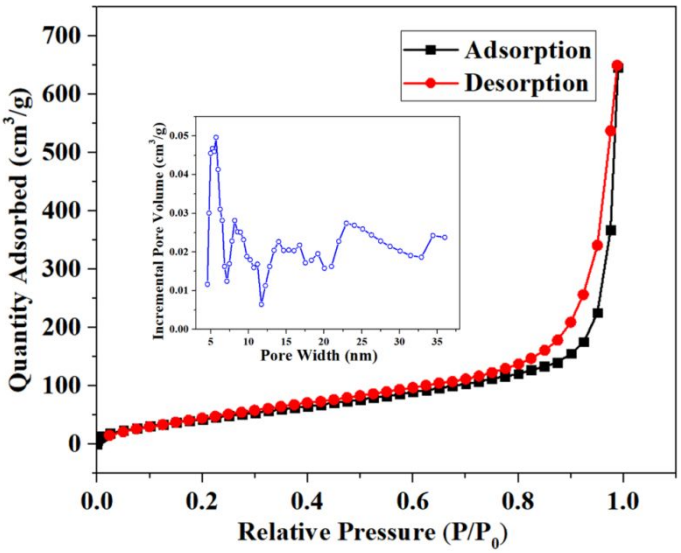

Figure S2. Nitrogen adsorption-desorption isotherm and pore size distribution plot (inset) of PLA foam (F4).

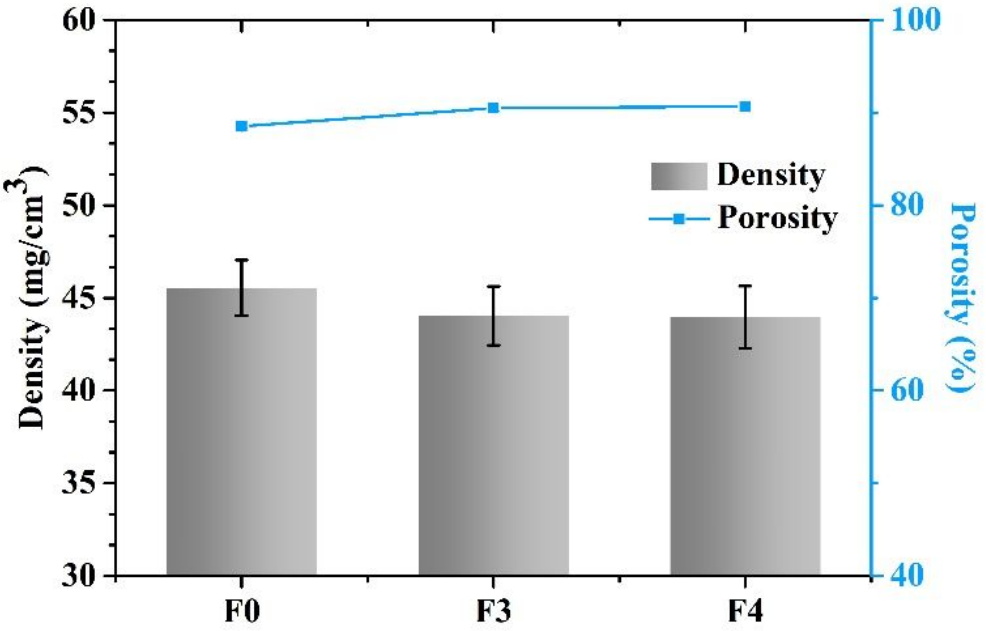

Figure S3. The density and porosity of F0, F3 and F4. F4 has a density of 43.96 mg/ cm^3 and a porosity of 90.66%.

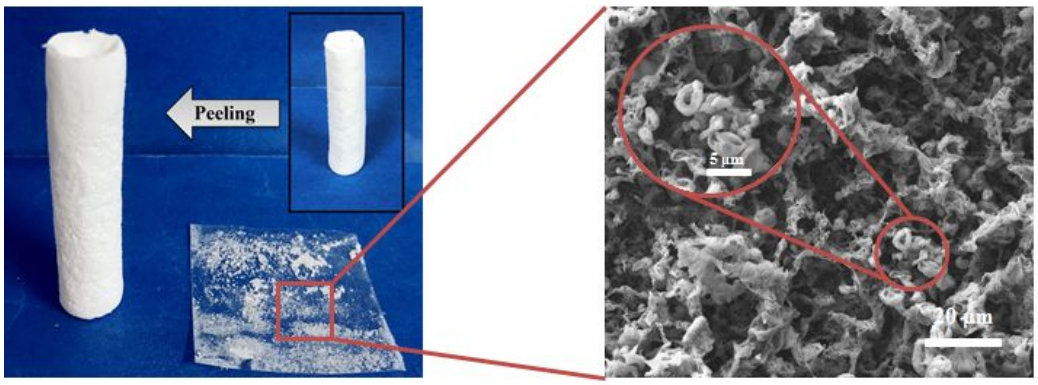

Figure S4. The peeling process of PLA foam, and the tape after peeling as well as the SEM image of the tape after peeling.

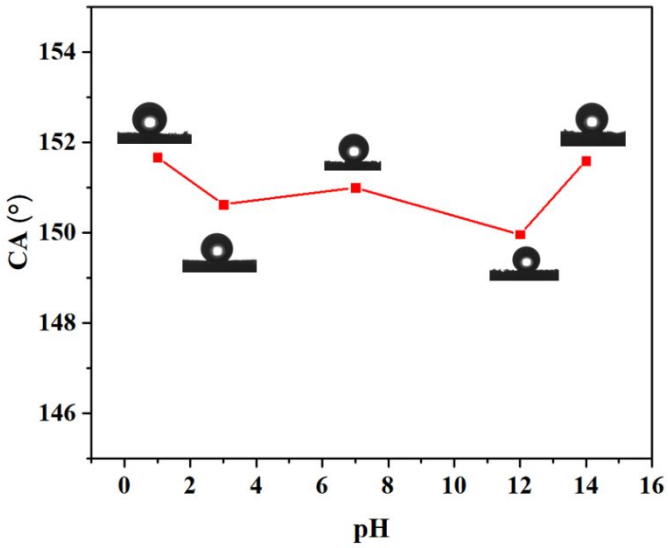

Figure S5. Contact angles of PLA foam for aqueous solutions at different pH values.

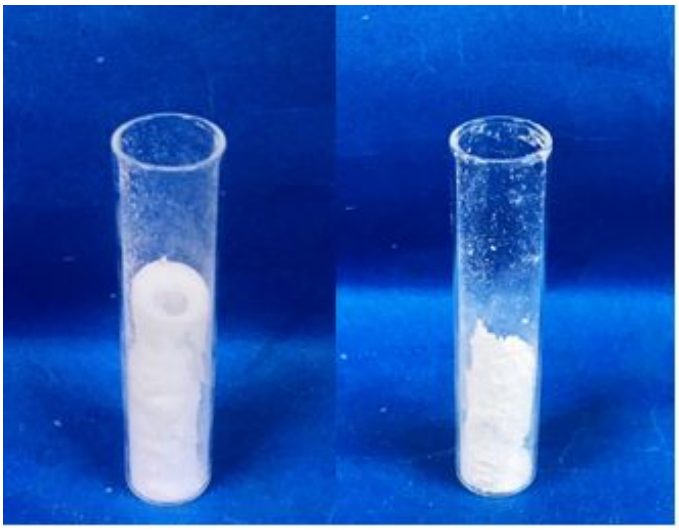

Figure S6. The foam after the addition of 4.5, 5 ml of water. The foam loses the skeleton and fail to form.

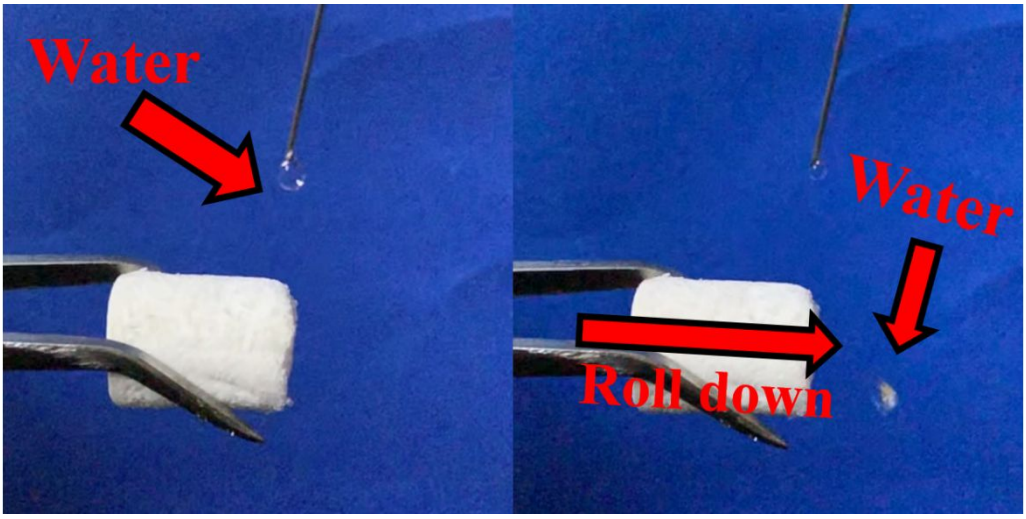

Figure S7. The photograph of water droplets rolling down the side of F4P.