Supporting Information

Is Superhydrophobicity Equal to Underwater Superaerophilicity: Regulating The Gas Behavior on Superaerophilic Surface *via* Hydrophilic Defects

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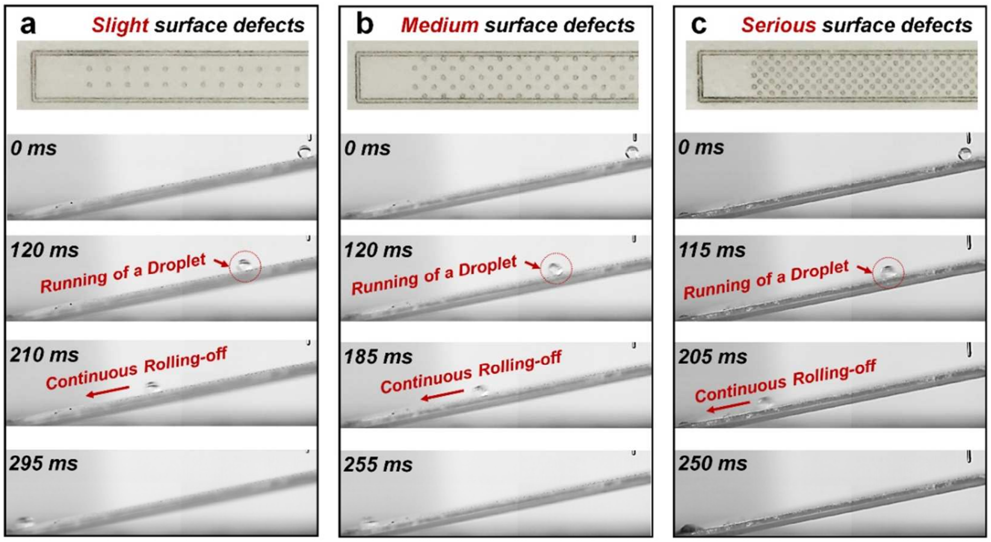

Figure S1. The droplet-on-SHB surface-in air test of the SHB surfaces with different densities of surface defects, for (a) slight, (b) medium, and (c) serious level of surface defects. Similar droplet-rolling behaviours are observed on the three types of SHB surfaces, indicating the surface defects take little effect on determining the droplet-rolling behaviours.

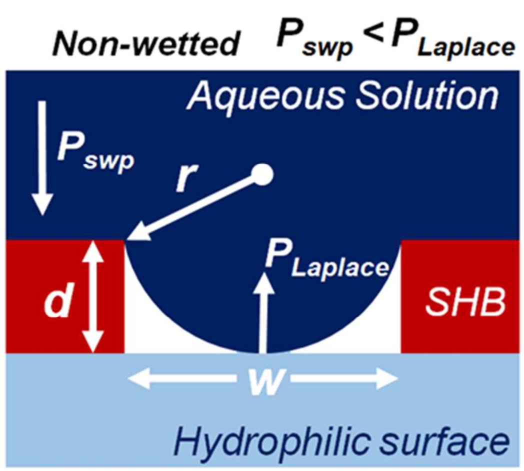

Figure S2. The formula derivation of the critical depth of water infusion.

The parameters are proposed as shown in the Figure S4. The pressure from the upper water (P_{swp}) is calculated by the Equation S1:

$$P_{swp} = \rho \cdot g \cdot h \qquad (S1)$$

The Laplace pressure (P_{Laplace}) is determined by the radius of the curved surface (r) (Equation S2).

$$P_{Laplace} = \gamma \cdot (\frac{1}{r_1} + \frac{1}{r_2}) \qquad (S2)$$

When the coating thickness (d) is larger than the half of the defect width (w), the critical radius of water infused should be w/2. Accordingly, the maximum P_{Laplace} equals to 2 γ/w for a line defect and $4\gamma/w$ for a dot defect respectively.

Therefore, the critical h for water infusion can be calculated by Equation S3:

$$h = \frac{2\gamma}{w \cdot \rho \cdot g} \cdot \varepsilon \qquad (S3)$$

where the influence of the defect character is considered by using the ε (1 for line, 2 for dot).

While the $d<w/2$, the r should be obtained by a complicate Equation S4:

$$r = \frac{d}{2} + \frac{w^2}{8d} \qquad (S4)$$

so, the correspondent h can be calculated by Equation S5:

$$h = \frac{8d \cdot \gamma}{(4d^2 + w^2) \cdot \rho \cdot g} \cdot \varepsilon \qquad (S5)$$

The calculated results of the critical depth were plotted in Figure 4d, with a certain coating thickness and a varied defect width.

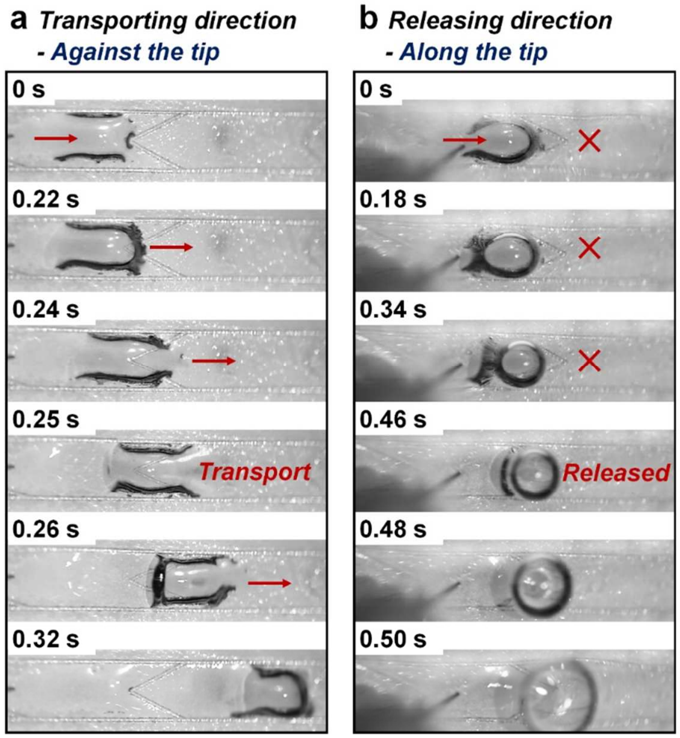

Figure S3. The top view of anisotropic gas gating process. (a) The bubble can pass through the angular defect against the tip site. (b) In the opposite direction, the bubble tends to detach from the surface due to the overlarge resistance.

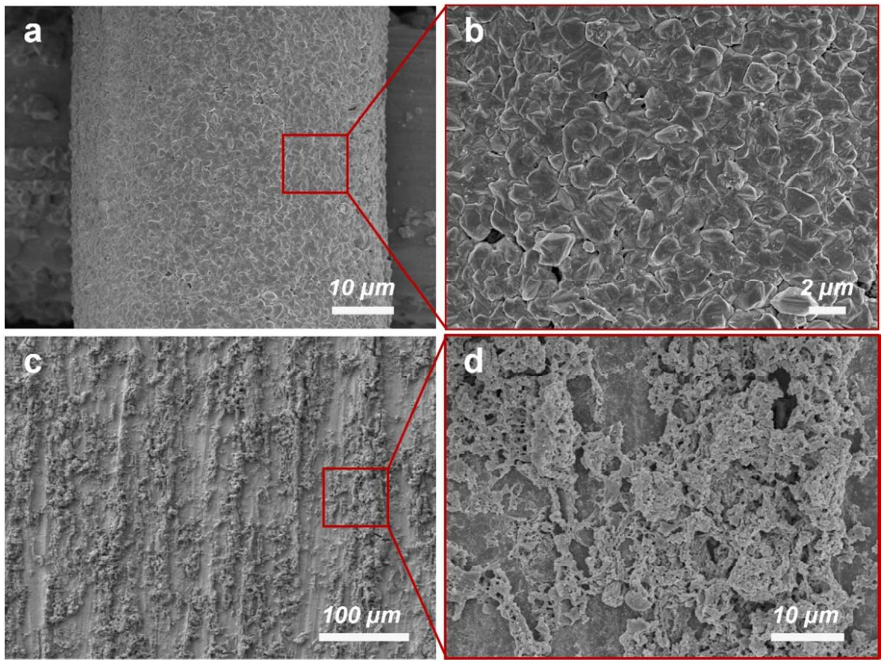

Figure S4. The SEM images of the testing sample. (a) & (b) The SHB steel mesh, and (c) & (d) the SHB copper film. The SEM images indicate that the SHB steel mesh has a relatively compact micro-structure. The coating quality of the SHB copper film may be unsatisfactory due to the partial cover of microstructure.

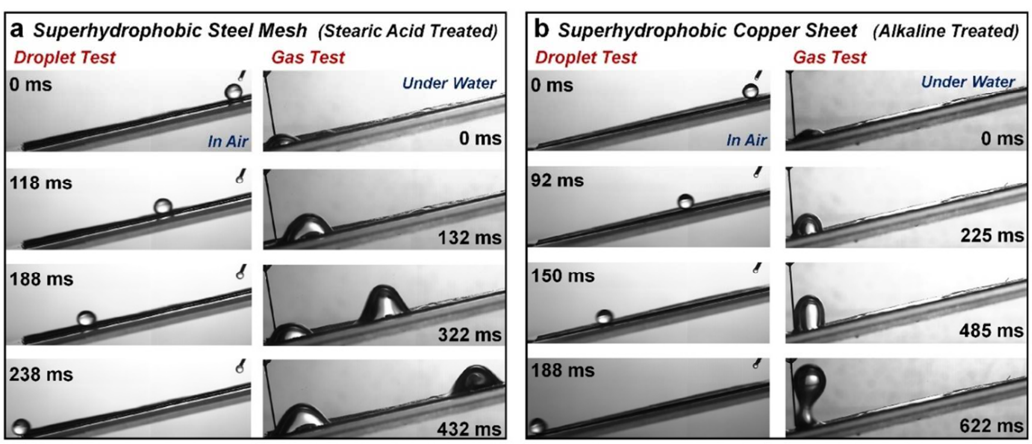

Figure S5. Two types of characterization of SHB property. (a) For SHB steel mesh, droplet can easily roll off the surface; in aqueous medium, the upward bubble running is achieved while the gas is continuously charging on the surface, indicating the surface defects on the SHB surface cannot prevent gas delivery. (b) For SHB copper film, although the droplet can also roll off the surface, the bubble cannot transport on the surface in aqueous environment, revealing that the serious surface defect has already jeopardized the gas delivery on the SHB surface. In brief, this bubble-on-SAL surface-under water test provides a high resolution of SHB characters by a facile strategy.