How does the Leaf Margin Make the Lotus Surface Dry as the Lotus Leaf Floats on Water?

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Supplementaries:

Figure S1, S2, S3, S4 and S5

Information (1): Measurement of contact angle (CA) on lotus surface and leaf margin

Information (2): The alternative wetting of the margins associated with two sides (the top and the bottom) of leaf

Information (3): Analysis on errors and reproducibility of the restriction experiments

Movie 1

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Supplementary Figure Legends

Figure S1 Schematic diagram of the experimental setup.

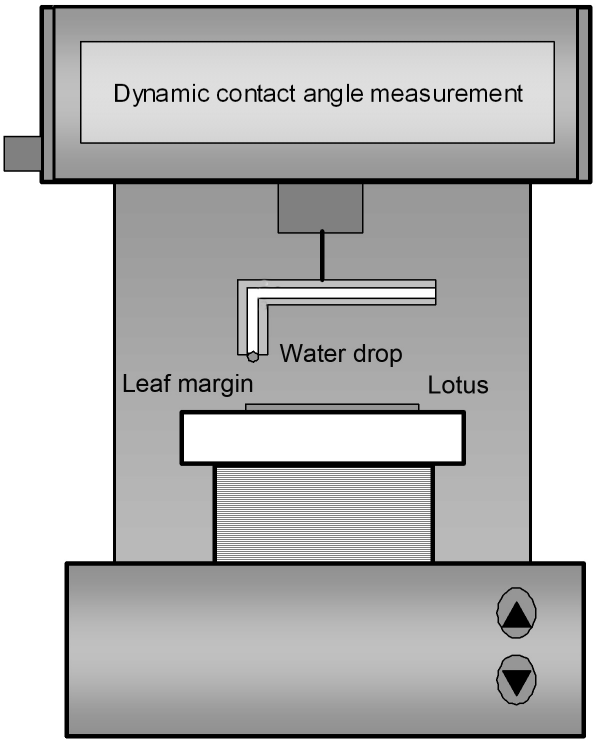


Figure S2 The ESEM image of leaf margin at the back of a lotus leaf.

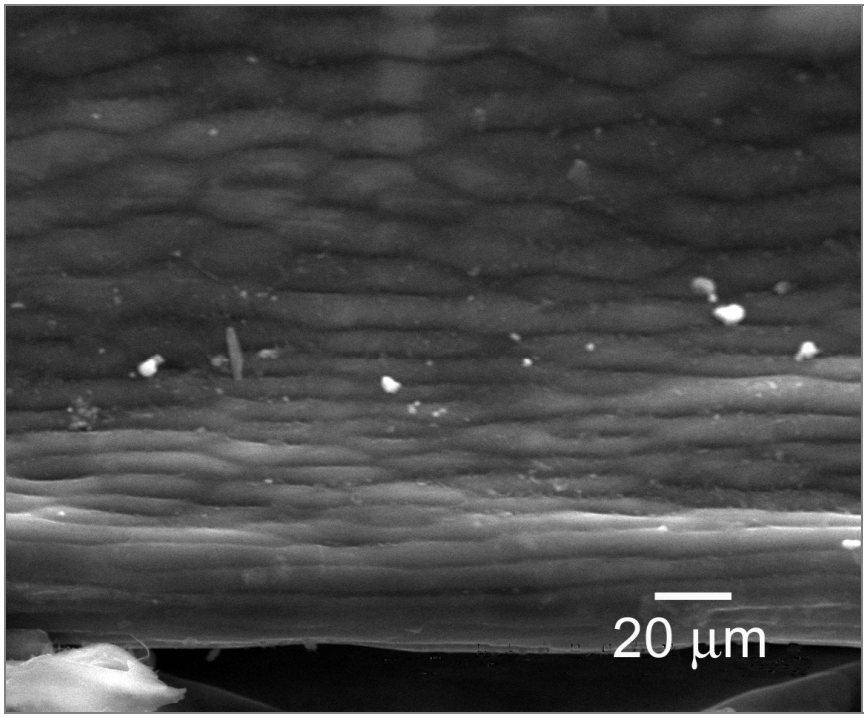


Figure S3 The ESEM image of the lotus leaf around the margin.

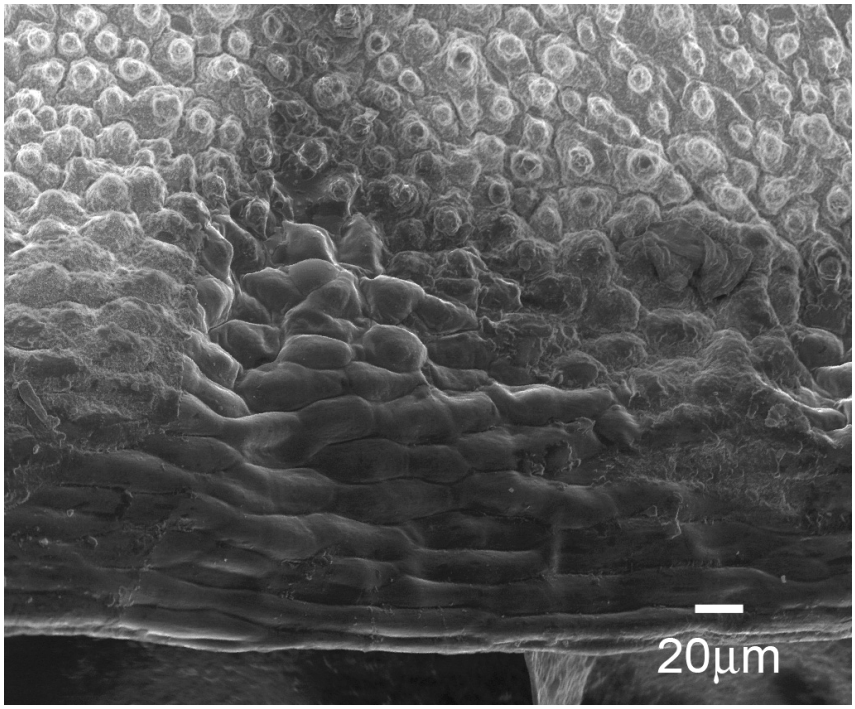
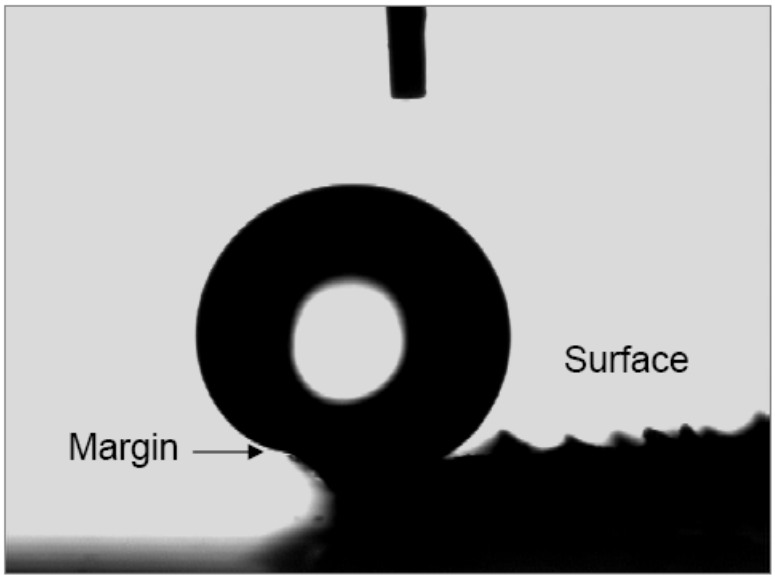


Figure S4 The optical image of a drop (3 μL) deposited on leaf margins.



Supplementary Information

Measurement of contact angle (CA) on lotus surface and leaf margin

Drops of a few microlitre (e.g. 3 μL) deposited anywhere could produce the water CA values of above 150° (Fig. S4), which seemed to display the same superhydrophobic properties between the margin and surface of leaf. However, distinguished from the microstructure, the ESEM images revealed that the width of the margin was about hundreds of micron around the leaf with papillae, thus the CA values of 3 μL deposited-drop (with ~890 nm diameter) couldn't completely represent the wettability of the margins. In order to exactly reflect the wettability of margin, alternatively, a drop with diameter of ~100 nm was adapted (can be obtained by sprayed method), and may completely fall in the region of the leaf margin. It had the CA value of 111.8 ± 1.2°, but the lotus surface had the CA value of 153.3 ± 0.6°, which both showed quite different CA values.

The alternative wetting of the margins associated with two sides (the top and the bottom) of leaf

In this investigation about the restriction of margins against water overflowing, we observe the appearance of both sides of the leave. The bottom surface of lotus (i.e. the back of leaf in the manuscript) was composed of flat turtle-shell-like topography, without any papillae (Fig. S2). This structure enables the bottom surface of lotus have a relatively weak hydrophobicity and highly adhesive feature, similar to that of margin. The energy barrier is indistinct difference of microstructure between the bottom and the margin. It makes the bottom of leaf possess the weaker edge effect than that of the top surface. Therefore, the study on the restriction of margins associated with the top surface against overflowing may be more important in the considerations of the possible applications, such as the outflow of liquid from the end of tube or microfluidic.

Analysis on errors and reproducibility of the restriction experiments

The errors and reproducibility of experiments is important because of the diversity of organism. In our experiments, the fresh lotus leave were prepared. In order to sustain the appropriate experiment result from the freshness of leaf, we measured 5 pieces of samples randomly chose around the margin of a single leaf. On the other hand, to eliminate difference of individual leaf, 15 leave were used to repeat the experiments. In order to decrease the loss of water on fresh lotus surfaces, each measurement is lasted for less than 10 min. The errors of experimental data can be estimated by proper statistic methods. Figure S5 showed the experimental results of the advancing angle θ_1 in detail as water was pressed to advance over the margins of leaves. In such case, the average of θ_1 was calculated as 119.5° on average for 15 pieces of leaves while the absolute errors was 3.8°. In contrast, the errors of experimental data from a single leaf were always less than 3°. Therefore, we concluded that the individual difference of leaves existed for the wettability of the margins. And the errors of measurements for lotus surfaces are less than that for the margins because of the narrow sizes of margins. In any case, the accuracy of measured setup and low errors (<5°) still ensured the reliability of our data and good reproducibility.

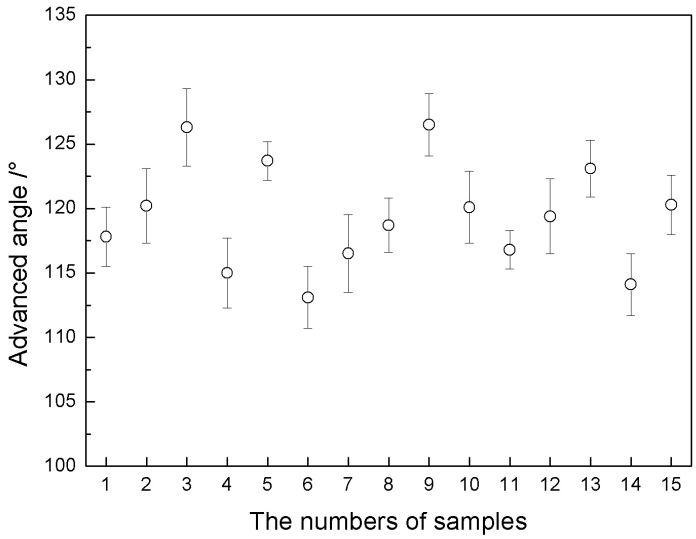


Figure S5 The experimental data of repeated measurement to θ_1 as water was pressed to advance over the margins of leaves.