Supporting Information

Large-Area Fabrication of Superhydrophobic Micro-Conical Pillar Arrays on Various Metallic Substrates

Weihao Pan, [a] Song Wu, [a] Liu Huang, [a] and Jinlong Song *[a, b]

[a] *Key Laboratory for Precision and Non-traditional Machining Technology of the Ministry of Education, Dalian University of Technology, Dalian 116024, P. R. China.*

[b] *Key Laboratory for Micro/Nano Technology and System of Liaoning Province, Dalian University of Technology, Dalian, Liaoning 116024, P. R. China.*

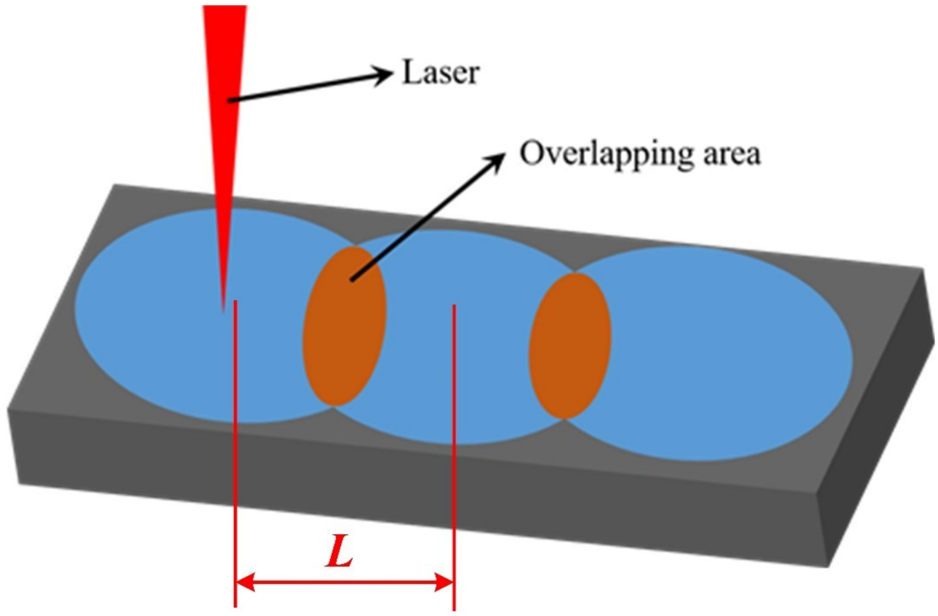

Fig. S1 Schematic of the overlapping area during the laser ablation process.

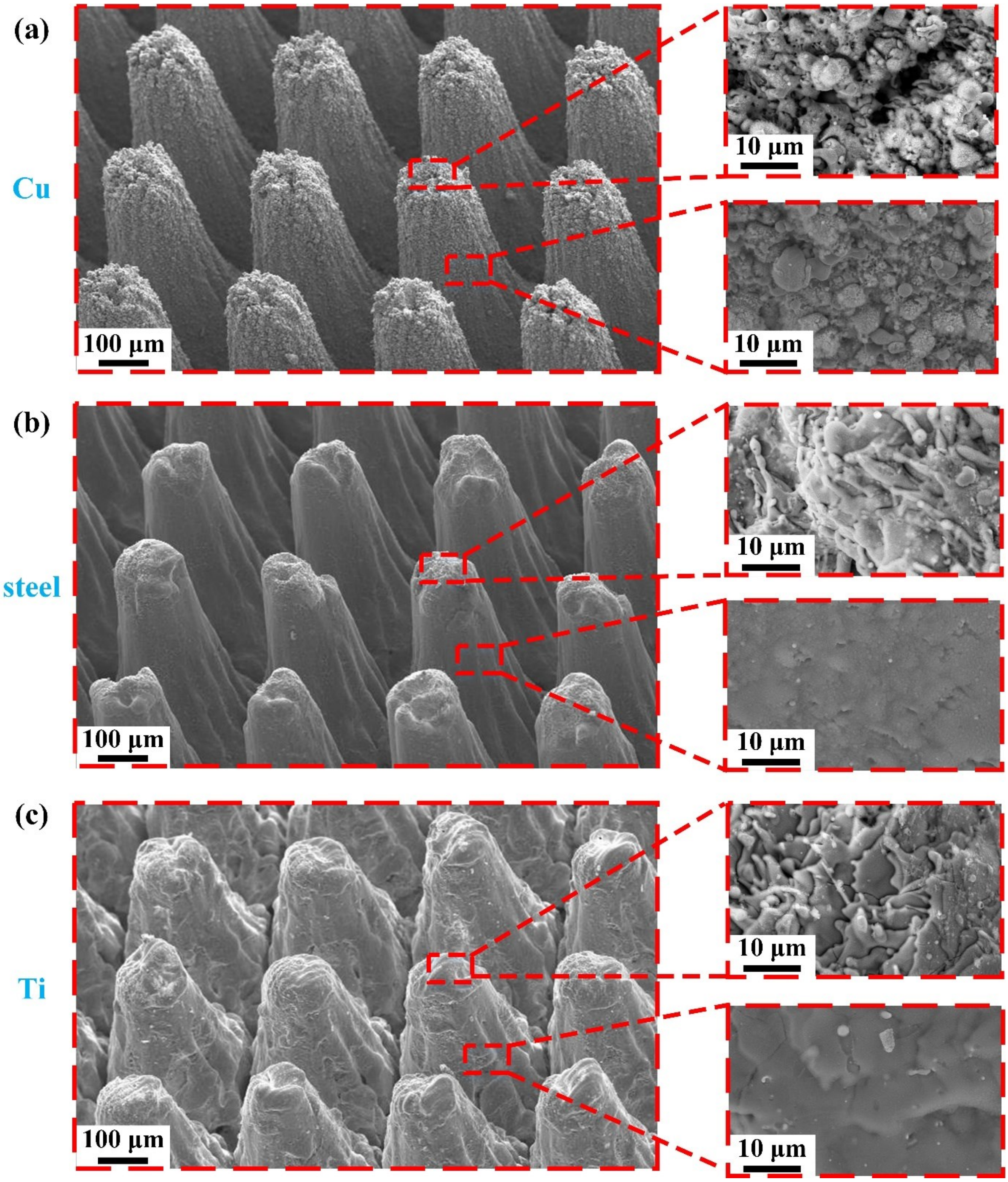

Fig. S2 Surface morphology of micro-conical pillar arrays on Cu (a), steel (b), and Ti (c) substrates fabricated by the nanosecond laser ablation at the power of 21 W, scanning time of 200 mm/s, frequency of 20 kHz, and scanning times of 80 cycles. It can be easily found that the whole sidewall and top region of micro-conical pillar arrays on these three metallic substrates were very rough and covered with protrusions of several micrometers in diameter, which were very similar to the surface microstructures in Figure 2(a2) constructed by first nanosecond laser ablation.

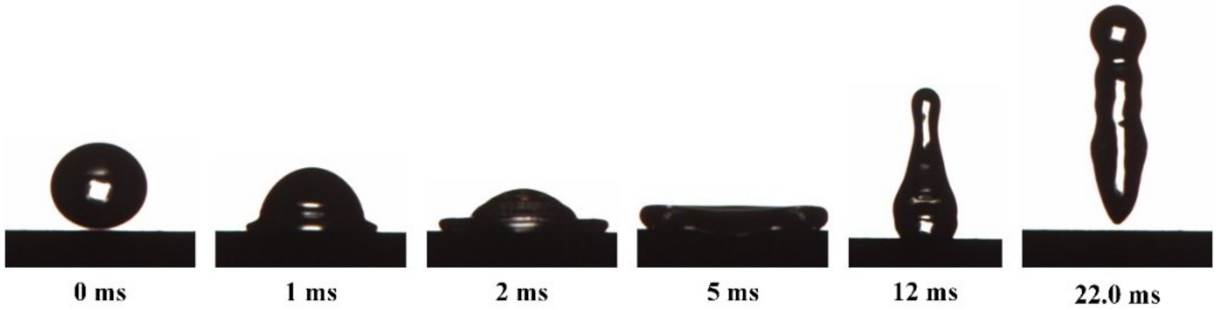

Fig. S3 Selected snapshots captured by the high-speed camera showing a water droplet (14.1 μL) impinging on the superhydrophobic flat surface at *We* = 16.7. The fabrication processes of superhydrophobic flat surface are as follows. The Al plate was ultrasonically cleaned with ethanol, acetone, and deionized water. Then, the sample was ablated by the nanosecond laser at a power of at the power of 21 W, scanning speed of 200 mm/s, and frequency of 20 kHz. Thereafter, the samples were washed by deionized water and dried. Then, the samples were modified through immersion in a 1 wt% solution of FAS in ethanol for ~40 minutes and dried at ~60 ℃ for ~1 h. Thus, a superhydrophobic flat Al plate was obtained. The water droplet shows a conventional bouncing processes with the contact time t_τ of ~22.0 ms.

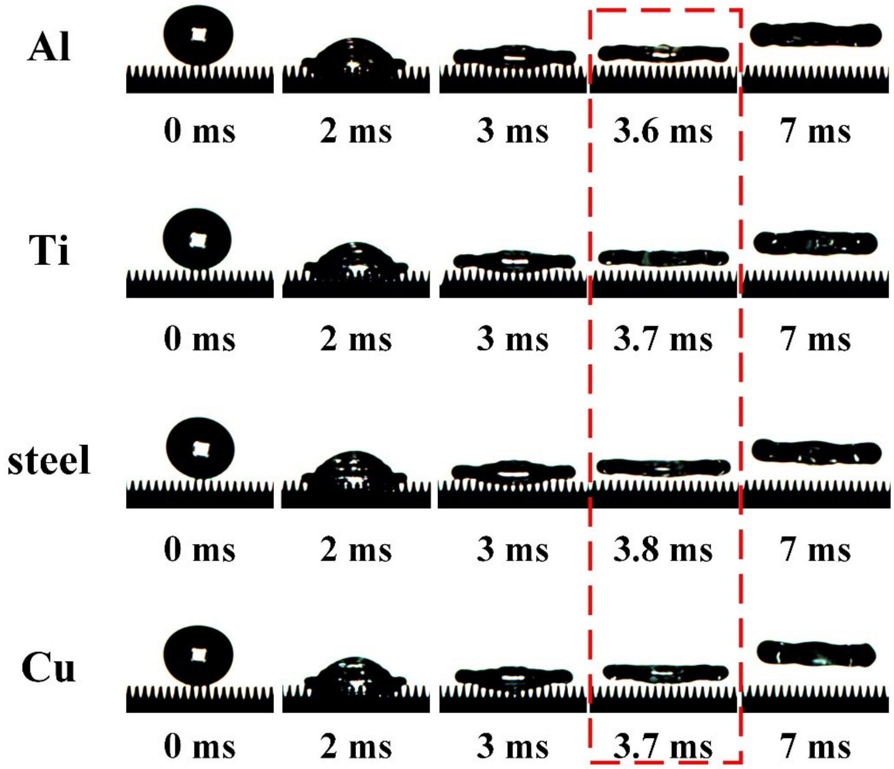

Fig. S4 Selected snapshots captured by the high-speed camera showing a water droplet (14.1 μL) impinging on superhydrophobic micro-conical pillar arrays on Al, Ti, steel, and Cu substrates (D = 150 μm, H = 650 μm, and S = 200 μm) at We = 16.7. It can be found that the contact time t_τ was ~3.7 ms for these four metallic arrays, which demonstrated that the substrate materials have little influence on the dynamic bouncing processes of the water droplet.

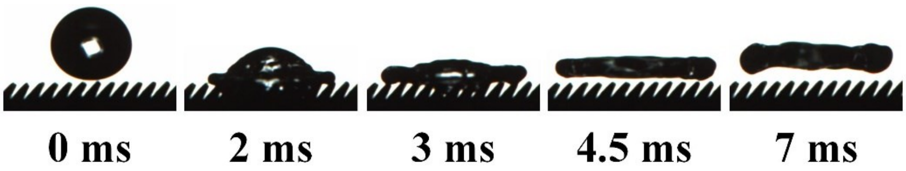

Fig. S5 Selected snapshots captured by the high-speed camera showing a water droplet (14.1 μL) impinging on superhydrophobic micro-conical pillar arrays with pillar inclination angle β = 45° (D = 250 μm, H= 750 μm, and S = 200 μm) at We = 16.7. It can be found that the water droplet detected from the arrays with a contact time t_τ of ~4.5 ms and Q of 0.98, which was corresponding to the pancake bouncing processes.

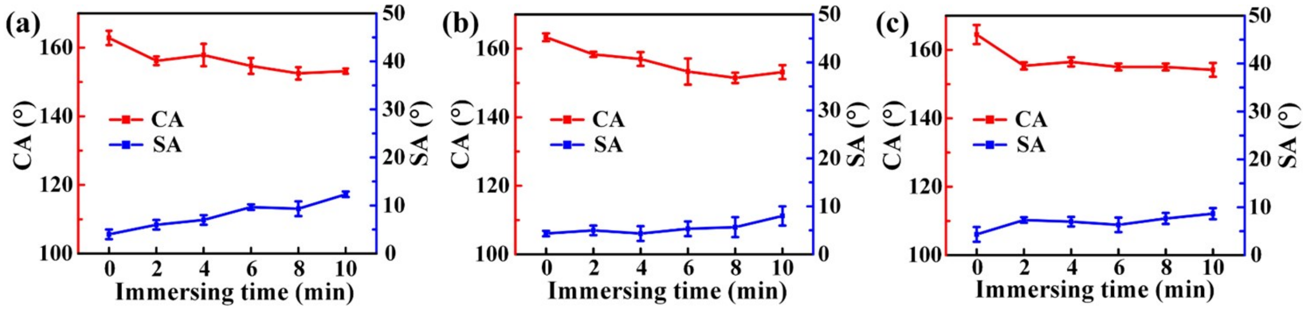

Fig. S6 Variations of the CA and SA with the immersing time inside the (a) acid (pH = 1), (b) base (pH = 13), and (c) 0.1 M NaCl aqueous solution.

Video S1

Simulation of the nanosecond laser fabrication processes of single micro-conical pillar at P = 6 W and t = 40 μs.

Video S2

The bouncing processes of a water droplet (14.1 μL) impinging on a superhydrophobic flat surface at We=16.7. The water droplet shows a conventional bouncing processes with the contact time t_τ of ~22.0 ms.

Video S3

The bouncing processes of a water droplet (14.1 μL) impinging on superhydrophobic micro-conical pillar arrays with different pillar height H (D = 150 μm and S = 300 μm) at We = 16.7. For H = 390 μm, 600 μm, and 750 μm, the water droplet shows a typical pancake bouncing processes with the contact time t_τ of 3.5 ms, 3.4 ms, and 3.5 ms, respectively. However, when H = 160 μm, the water droplet shows a conventional bouncing processes with the contact time t_τ of ~14.9 ms.

Video S4

The bouncing processes of a water droplet (14.1 μL) impinging on superhydrophobic micro-conical pillar arrays with different top diameter D (H = 685 μm and S = 300 μm) at We = 16.7. For D = 100 μm, 400 μm, and 550 μm, the water droplet shows a typical pancake bouncing processes with the contact time t_τ of 5.5 ms, 4.2 ms, and 5.5 ms, respectively. However, when D = 850 μm, the water droplet shows a conventional bouncing processes with the contact time t_τ of ~13.4 ms.

Video S5

The bouncing processes of a water droplet (14.1 μL) impinging on superhydrophobic micro-conical pillar arrays with different pillar interval space S (D = 150 μm and H = 685 μm) at We = 16.7. For S = 175 μm, 325 μm, and 400 μm, the water droplet shows a typical pancake bouncing processes with the contact time t_τ of 3.4 ms, 5.1 ms, and 5.5 ms, respectively. However, when D = 850 μm, the water droplet shows a conventional bouncing processes with the contact time t_τ of ~15.0 ms.

Video S6

The bouncing processes of a water droplet (14.1 μL) impinging on superhydrophobic micro-conical pillar arrays with pillar inclination angle β=45° (D = 250 μm, H= 750 μm, and S = 200 μm) at We = 16.7. It can be found that the water droplet detected from the arrays with a contact time t_τ of ~4.5 ms and Q of 0.98, which was corresponding to the pancake bouncing processes.

Video S7

Sandpaper abrasion test of superhydrophobic micro-conical pillar arrays with D = 210 μm, H = 685 μm, and S = 150 μm. After 10 m sandpaper abrasion under a 100 g weight, the arrays still showed superhydrophobicity.

Video S8

Chemical stability test of superhydrophobic micro-conical pillar arrays with D = 210 μm, H = 685 μm, and S = 150 μm. The acid droplets (pH = 0, 2, 4), base droplets (pH = 10, 12, 14), and salt droplets (0.1 M) impinging on the arrays could easily roll off and without any residue.

Video S9

Anti-icing test of superhydrophobic micro-conical pillar arrays with D = 210 μm, H = 685 μm, and S = 150 μm. A common Al plate with a flat surface and the superhydrophobic Al plate with micro-conical pillar arrays were fixed at a stage with a 20° tilted angle in the environment chamber with a temperature of -8℃. The rain droplets with a temperature of 2 ℃ were dropped on the samples in a flow rate of 1260 μL/min. After raining for 20 min, the rain droplets adhered to the common Al surface with a flat surface and frozen into ice, while no ice was observed on the arrays.