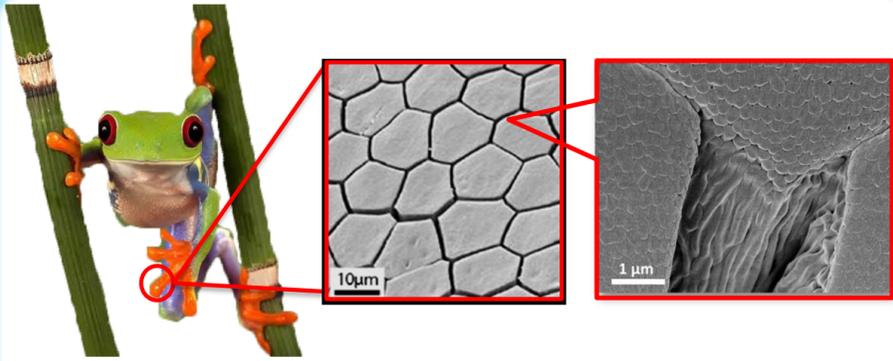




Tree Frog-inspired Hybrid Surface Patterns

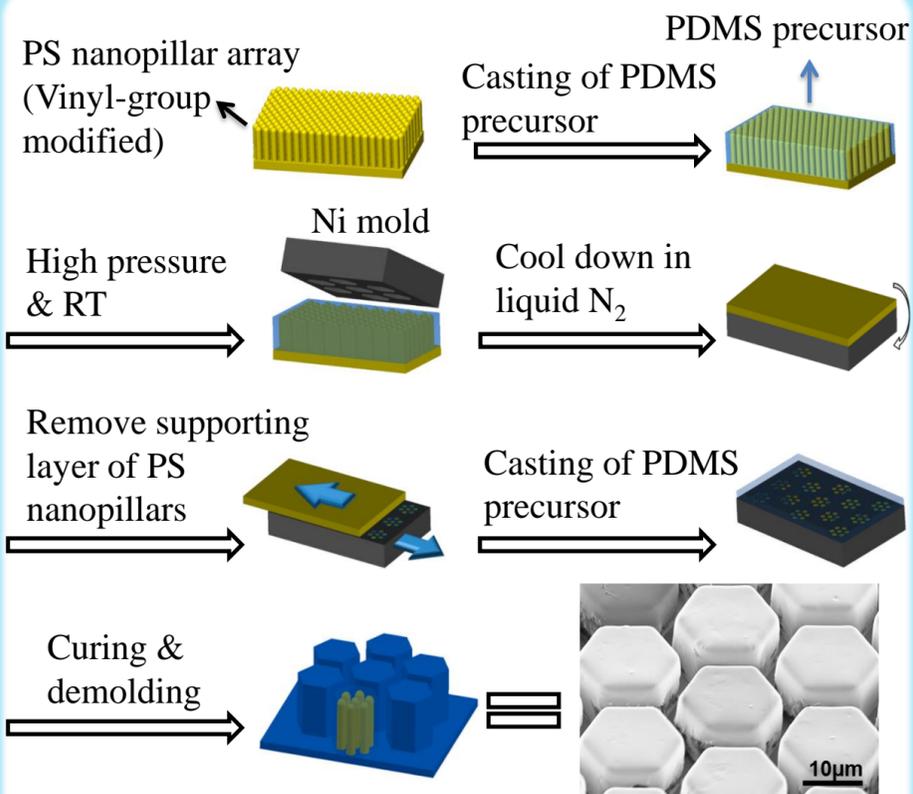


Abstract



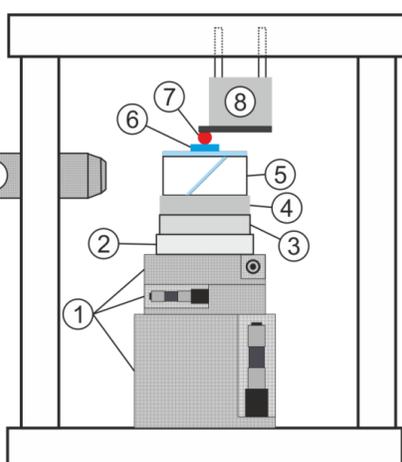
The composite structure of keratinized epithelium on the toe pad of tree frogs, in which hexagonal arrays of soft epithelial cells are crossed by densely packed and oriented hard keratin nanofibrils, endows them with a good adhesion capability. Inspired by the composite design, composite micropatterns composed of a soft matrix and perpendicularly oriented rigid nanopillars with tunable surface chemistry have been fabricated. Studies of adhesion and friction of these synthetic materials reveal a benefit of the hierarchical and anisotropic design for both adhesion and friction.

Materials & Methods

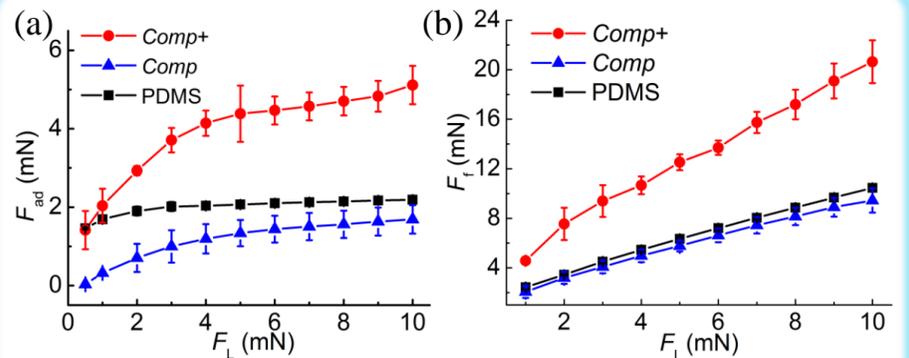


Adhesion and friction force tester

- ① Motorized xyz-stage;
- ② Vertical and ③ lateral piezo translation stage;
- ④ Lateral and ⑧ vertical load sensor;
- ⑤ Sample holder;
- ⑥ Sample;
- ⑦ Ruby sphere probe;
- ⑨ Video microscope.



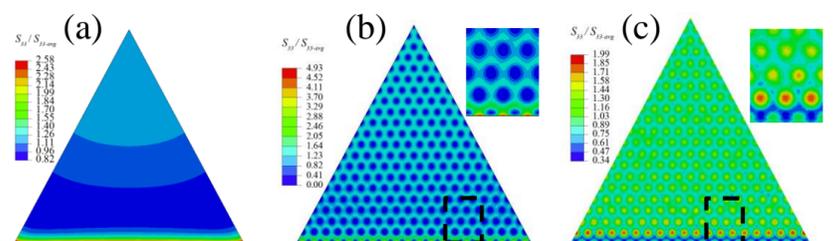
Results



(a) Dependence of adhesion force (F_{ad}) on loading force (F_L) measured on PDMS, *Comp* and *Comp+* micropillar arrays.

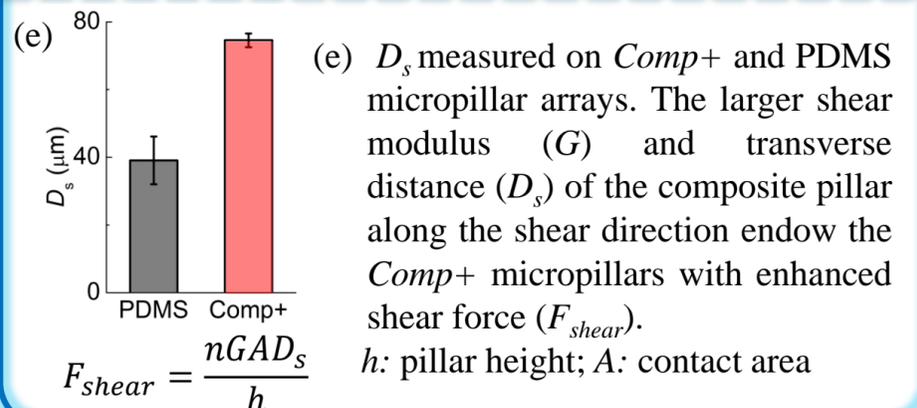
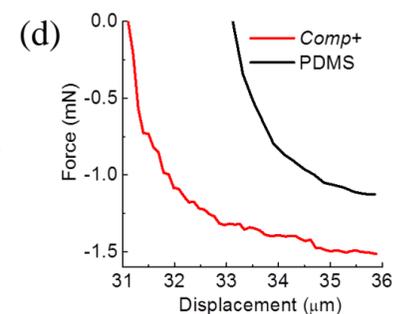
(b) Dependence of friction force (F_f) on F_L on *Comp+*, *Comp* and PDMS micropillar arrays.

Comp/Comp+: composite pillar array without/with the modification of vinyl groups



The stress distribution of PDMS (a), *Comp* (b) and *Comp+* (c) micropillars. *Comp+* micropillars can reduce the value of stress maximum and shift the stress maximum toward the central region.

(d) Fraction of the detachment curve after the pull-off point on *Comp+* and PDMS micropillar arrays.



Conclusion & Perspective

The composite micropillar inspired by the toe pad of tree frog shows enhanced adhesion and friction. The proposed method is generic and flexible, and can be extended to other surface designs and material combinations.

References

1. Hybrid Surface Patterns Mimicking the Design of the Adhesive Toe Pad of Tree Frog. *ACS Nano* **2017**; DOI: 10.1021/acsnano.7b04994
2. Torrent Frog-Inspired Adhesives: Attachment to Flooded Surfaces. *Adv. Funct. Mater.* **2015**, 25, 1499–1505