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3D Printing of Energy-free Liquid Transport Microchips with Bioinspired Hierarchical Structures

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1. Introduction

Traditional liquid transport requires regulation and energy, and the Nepenthes alata plant has a unique mechanism of energy-free liquid transport, which can be incorporated into human-made designs to achieve controllable water transport across microfluid chips. The water transport is ascribed to hierarchical grooves which are difficult to mimic using conventional manufacturing; hence, additive manufacturing is beneficial in fabricating these microgrooves.

2. Abstract

Energy-free liquid transport has become an attractive research topic for a variety of industries due to its simplicity and its effectiveness. Traditional liquid transport is not ideal since it requires a lot of energy and regulation which limits the advancement of mechanical designs. This proposed research is motivated to address the barrier of creating multiscale Nepenthes alata inspired structures. In this project, the peristome architecture of nepenthes inspired structures will be designed and printed for the study of directional water transport.

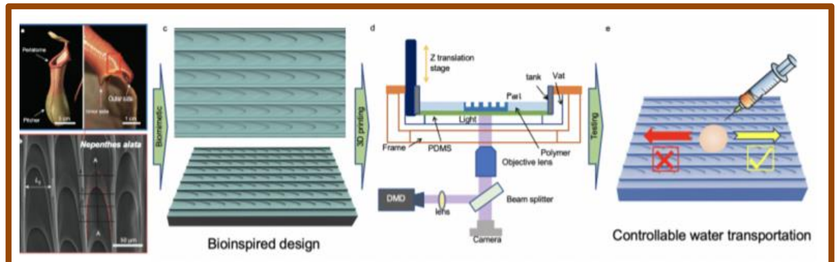
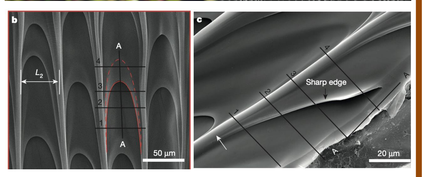


Figure1

3. Design of Bioinspired Structures

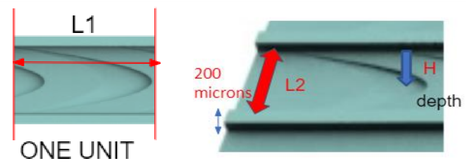
Overview of the Nepenthes alata Structures

The Nepenthes alata plant is in a shape of a pitcher that carries water. The plant has hierarchical grooves that transport water throughout the plant without the use of energy. The design of these grooves makes it difficult to mimic them using ordinary manufacturing methods; hence, using additive manufacturing, mimicking this design will be possible.



The Design for Controllable Water Transportation

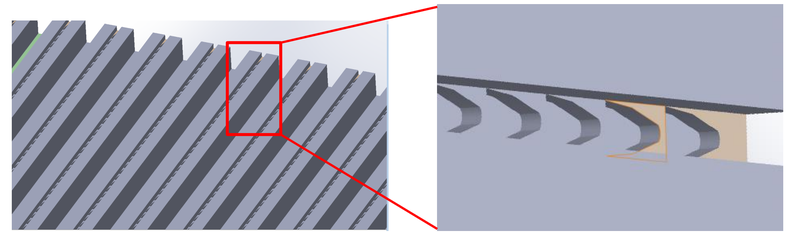
Design the Nepenthes inspired multiscale structures using SolidWorks and design multiple CAD models with different settings of parameters of critical features such as the height, length, and width of hierarchical grooves to study the effects of morphology on the directional liquid transportation.



The distance between two units

L2	H	Angle 1	gap	L1
50um	20	90	100	125
100um	20	90	100	125
150um	20	90	100	125
200um	20	90	100	125

L2	H	Angle 1	gap	L1
100um	20	90	100	125
100um	30	90	100	125
100um	40	90	100	125
100um	50	90	100	125



4. Future work

1. Investigate the printing process to accurately reproduce the designed models by using mask video projection based stereolithography.
2. Test the water transport performance of the 3D printed microchips

Acknowledgments

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Reference:Chen, H., Zhang, P., Zhang, L., Liu, H., Jiang, Y., Zhang, D., Han, Z. and Jiang, L., 2016. Continuous directional water transport on the peristome surface of Nepenthes alata. Nature, 532(7597), pp.85-89.
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