



INTERNATIONAL SOCIETY OF
BIONIC ENGINEERING

Bionic anti-adhesion and deicing surface inspired from Nepenthes



From Nepenthes to functional surfaces



Anti-adhesion of medical devices

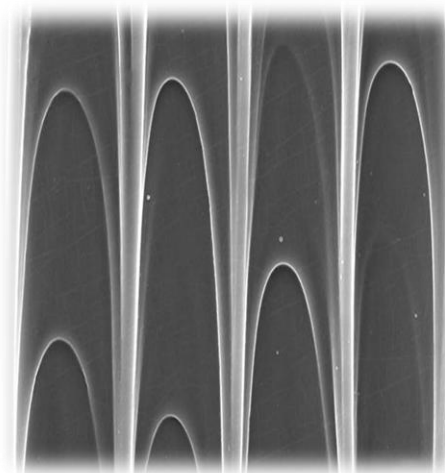
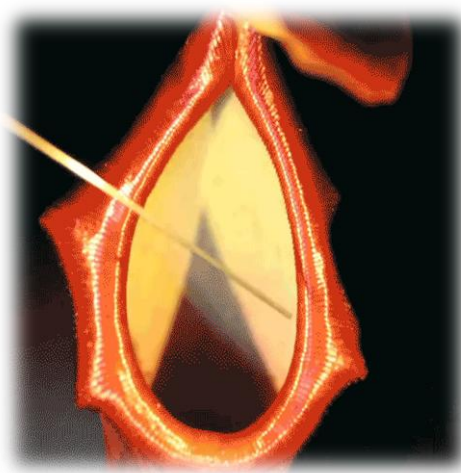


Deicing of aircraft

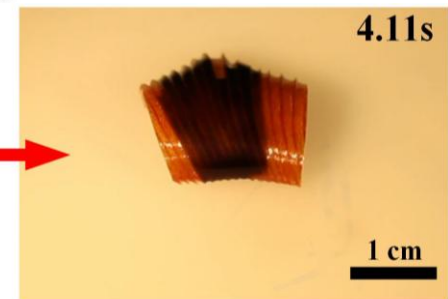
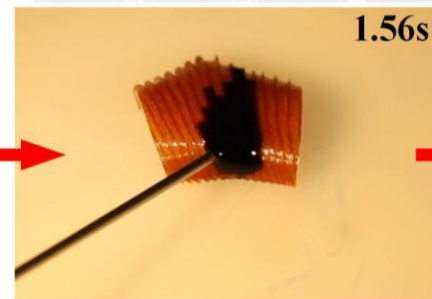
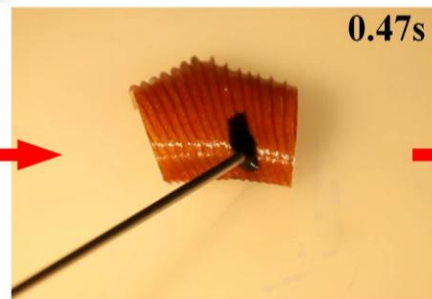
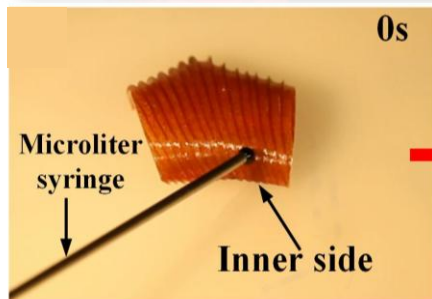
The case was provided by the
Individual Member of ISBE (PM283)

1. Biological Prototype

➤ Biological model: *Nepenthes* peristome with hierarchical microstructure

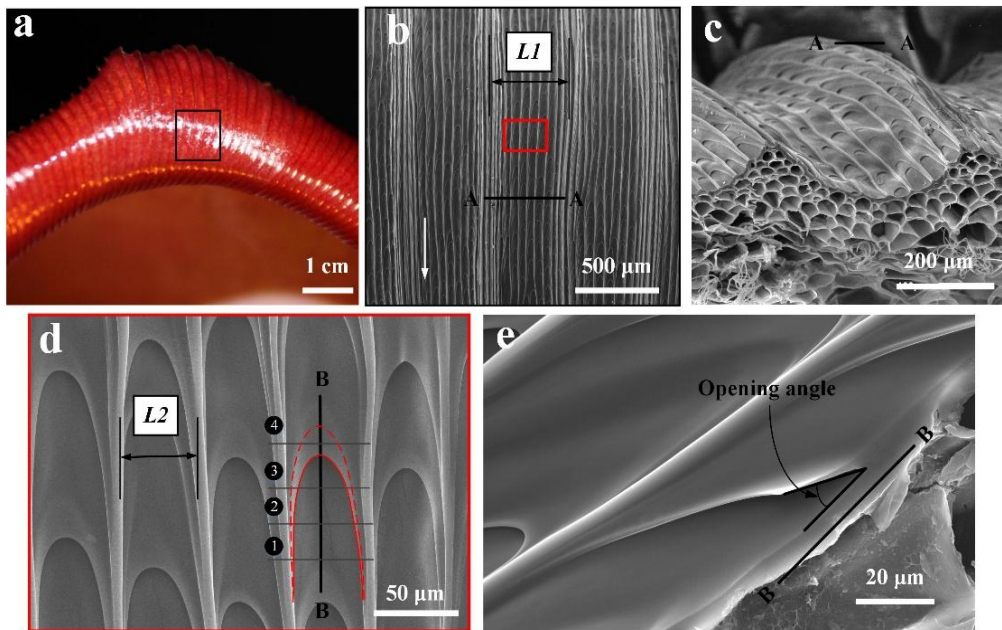


- Hierarchical microstructure
- Directional liquid transport



Unidirectional liquid transport was found on the *Nepenthes* peristome to form uniform liquid film for enhancement of wet slipping function. The contact model is changed from solid-solid to soli-liquid-solid, which can provide inspiration for creative design of anti-adhesion and deicing surface.

2. Bionic Study

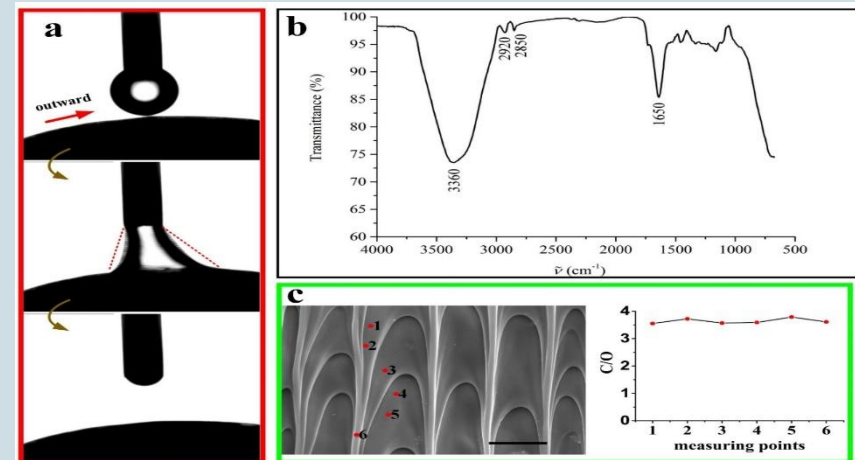


Unique Structure characteristics:

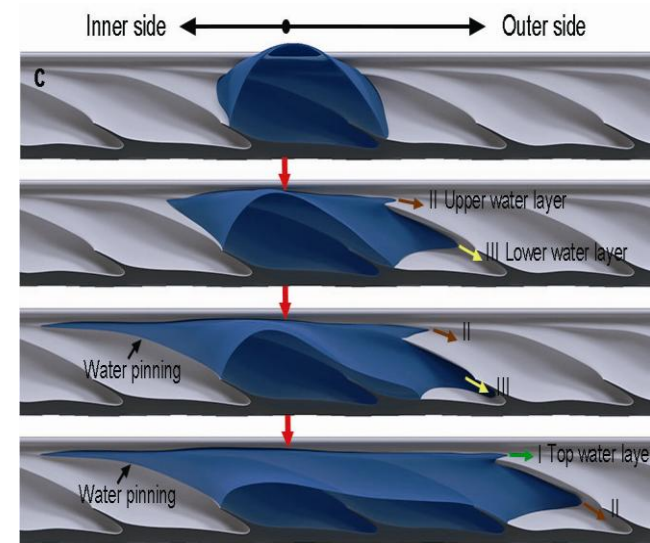
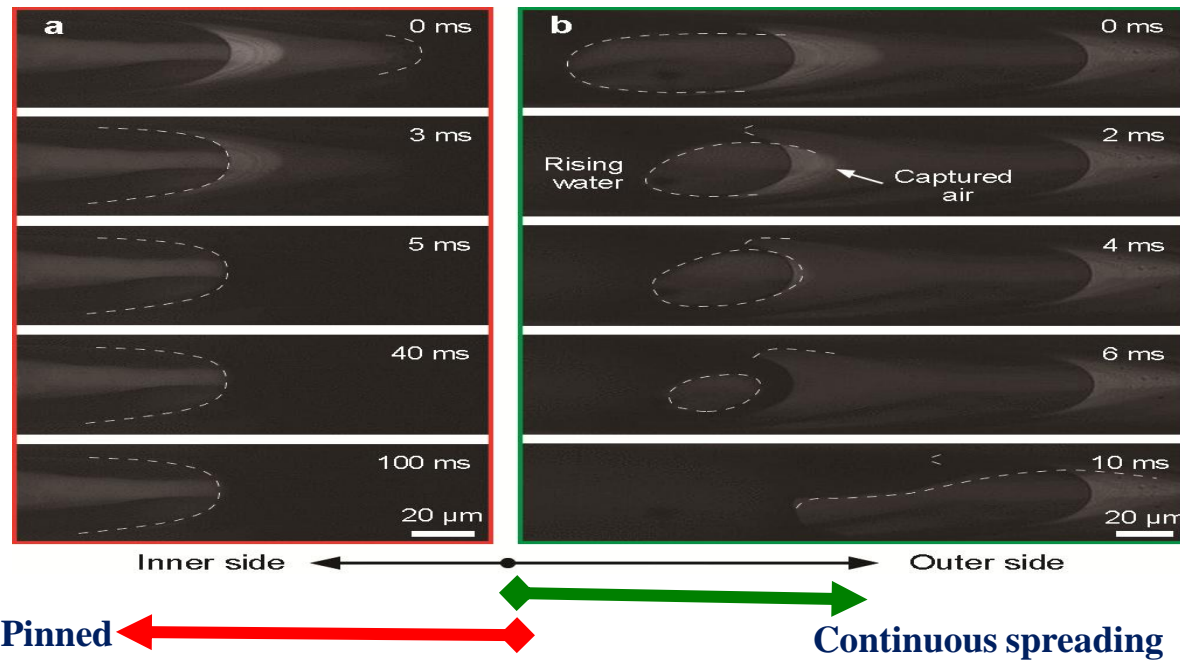
- ◆ Two-order parallel hierarchical **microgrooves**
- ◆ **Duck-billed micro-cavities** distributed along the second-order.
- ◆ The outline of the micro-cavity edge approximately **arch-shaped**

Surface Material Characteristics:

- ◆ ATR-FTIR: Super-hydrophilic



2. Bionic Study

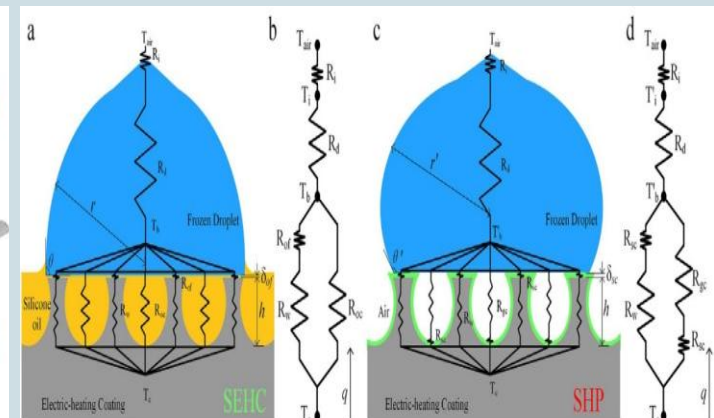
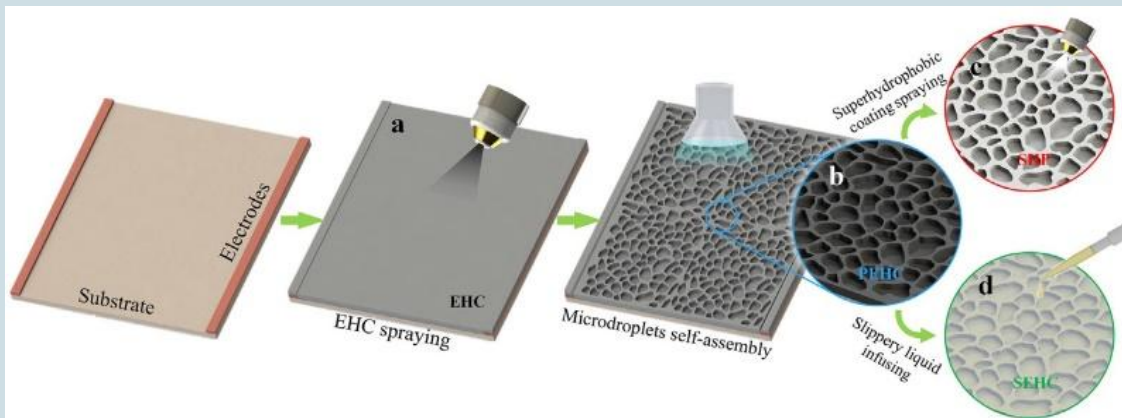
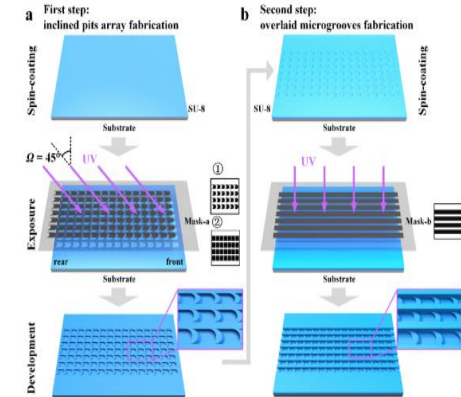
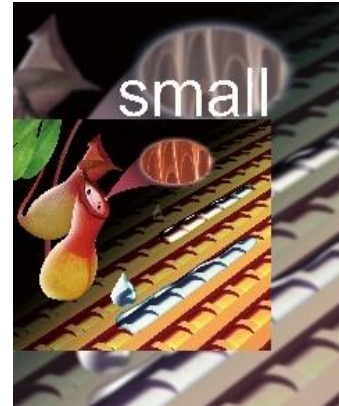
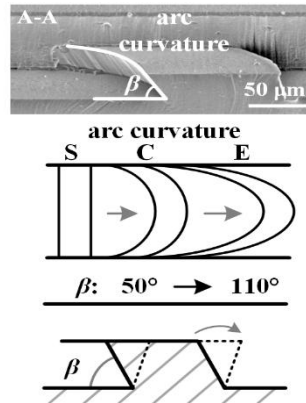
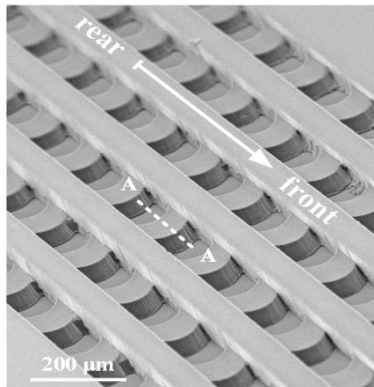


Cooperative effect of Hierarchical structure on unidirectional liquid transport

- ◆ Gradient structure induced Taylor rise promotes spreading from inner side to outer side
- ◆ Pinned in reverse direction

3. Design and Processing

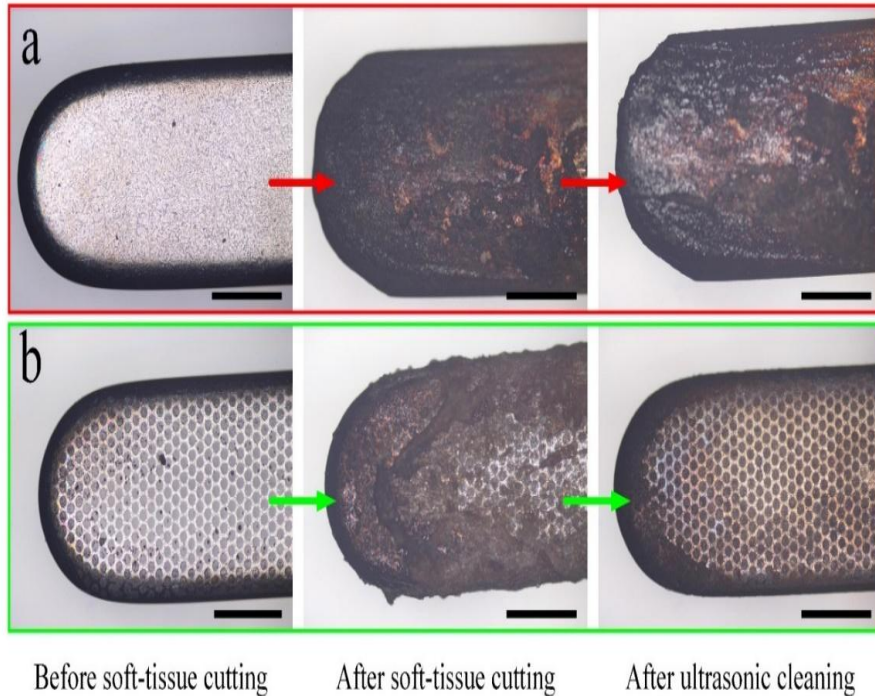
Bio-inspired hierarchical structure were proposed and fabricated by multi-steps etching, 3D-printing, self-assembly and other approaches.



Lage-area coating method for easy-fabrication of hierarchical surface

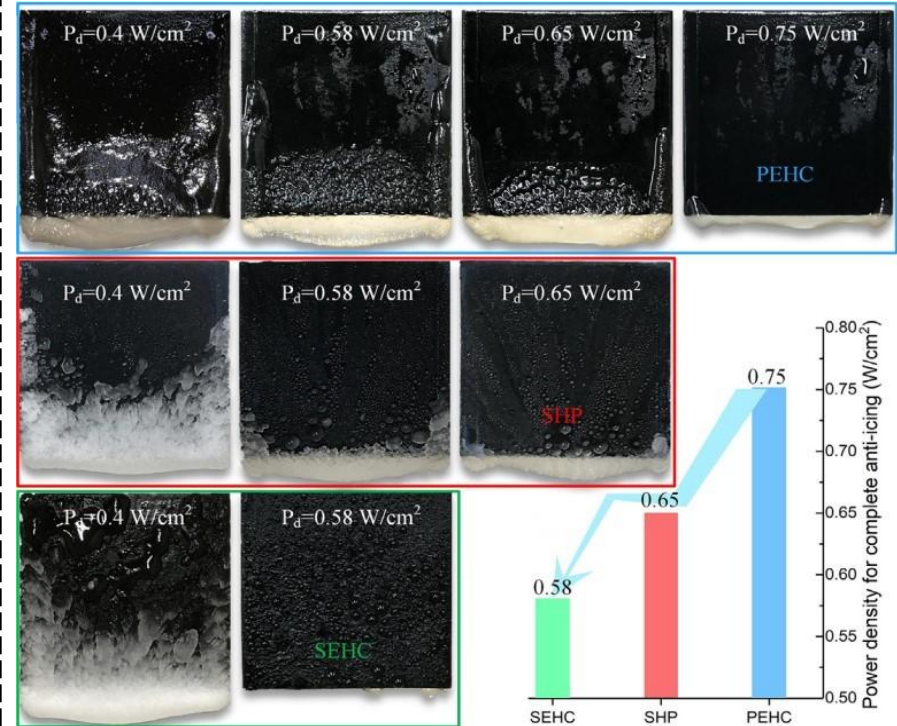
4. Achievements and Application

Anti-adhesion of soft tissue



- Adhesion force reduced by 80%
- Adhesion mass reduced by 88%
- Long durability

Deicing of aircrafts



- Static test: energy consumption reduced by 83%
- Dynamic test: energy consumption reduced by 75%



INTERNATIONAL SOCIETY OF
BIONIC ENGINEERING



***The self slippery anti-adhesion technique
has been applied in minimal invasive
surgery and deicing area.***