
Role of mucus of Fish-Scale wettability

Biomimicry Alberta Workshop Summer Series

interfacial Science and Surface Engineering Lab (iSSELab)

Department of Mechanical Engineering,

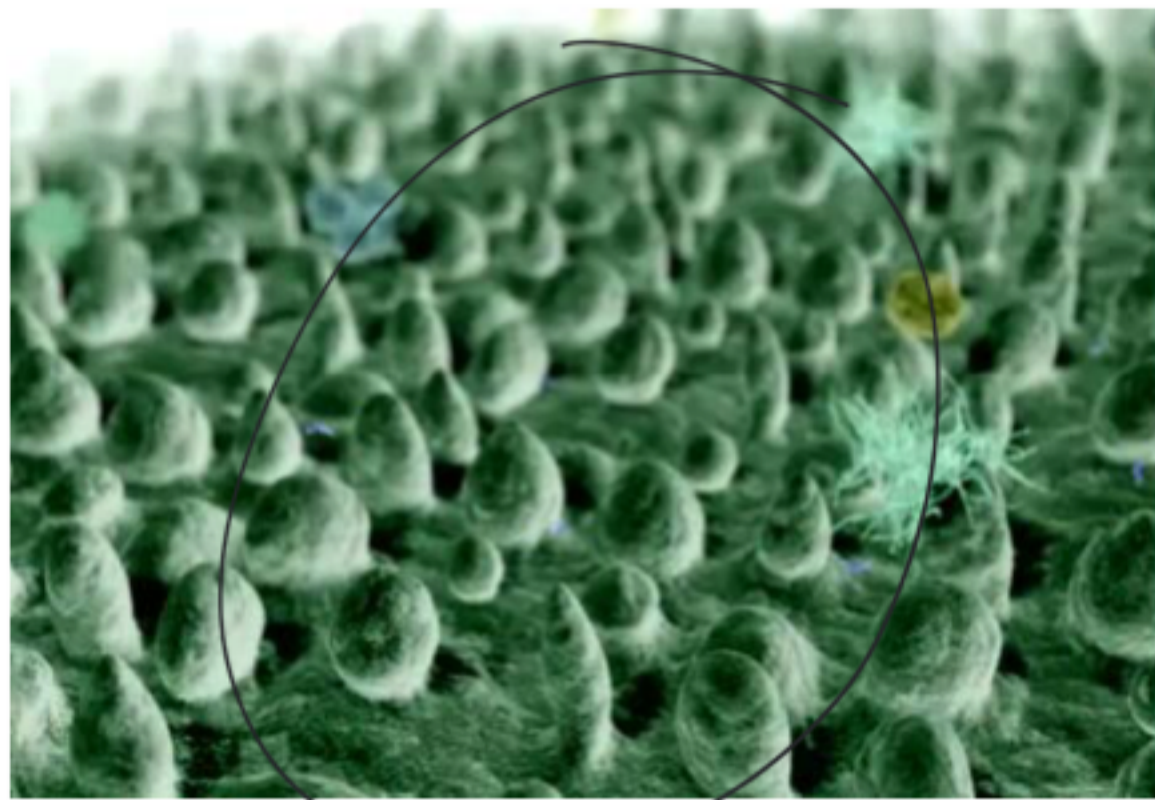
University of Alberta,

Edmonton, Alberta, Canada

June 25, 2017



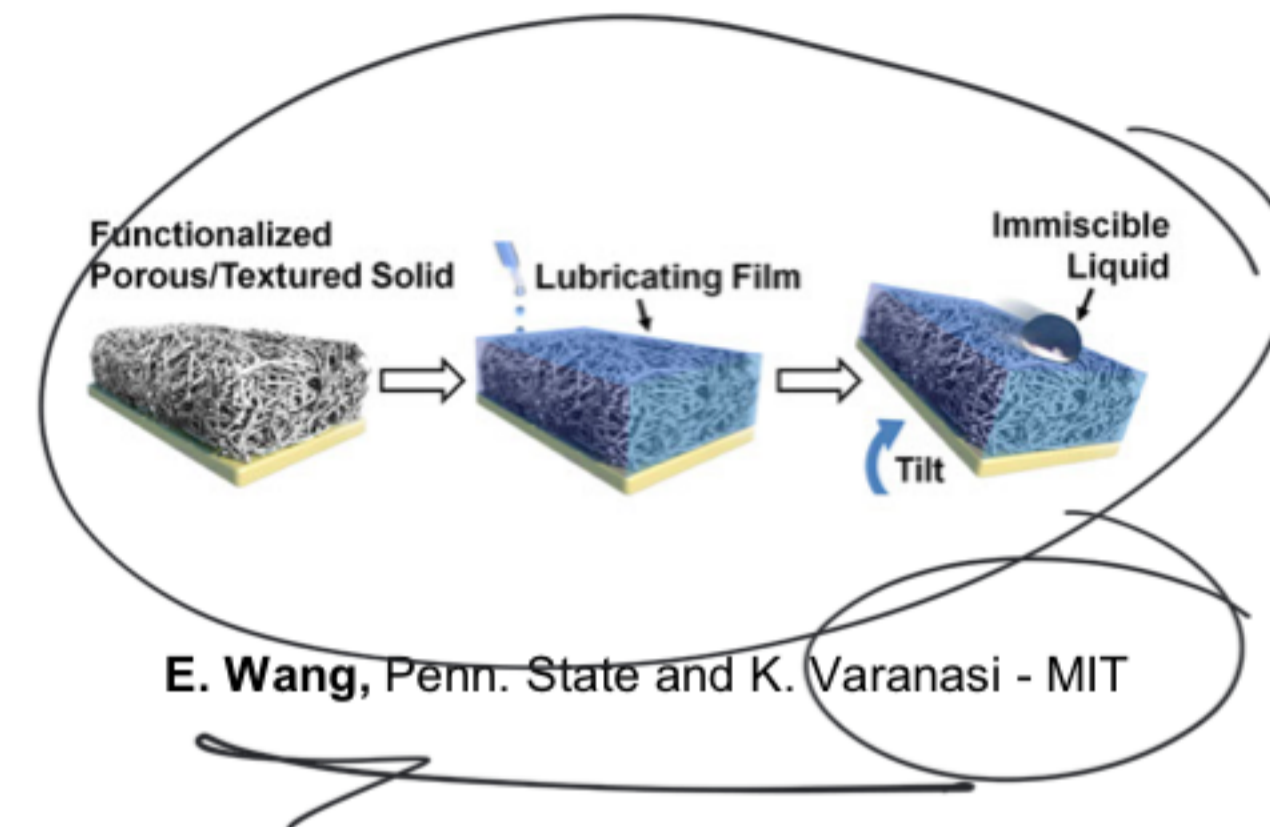
Wettability and nature



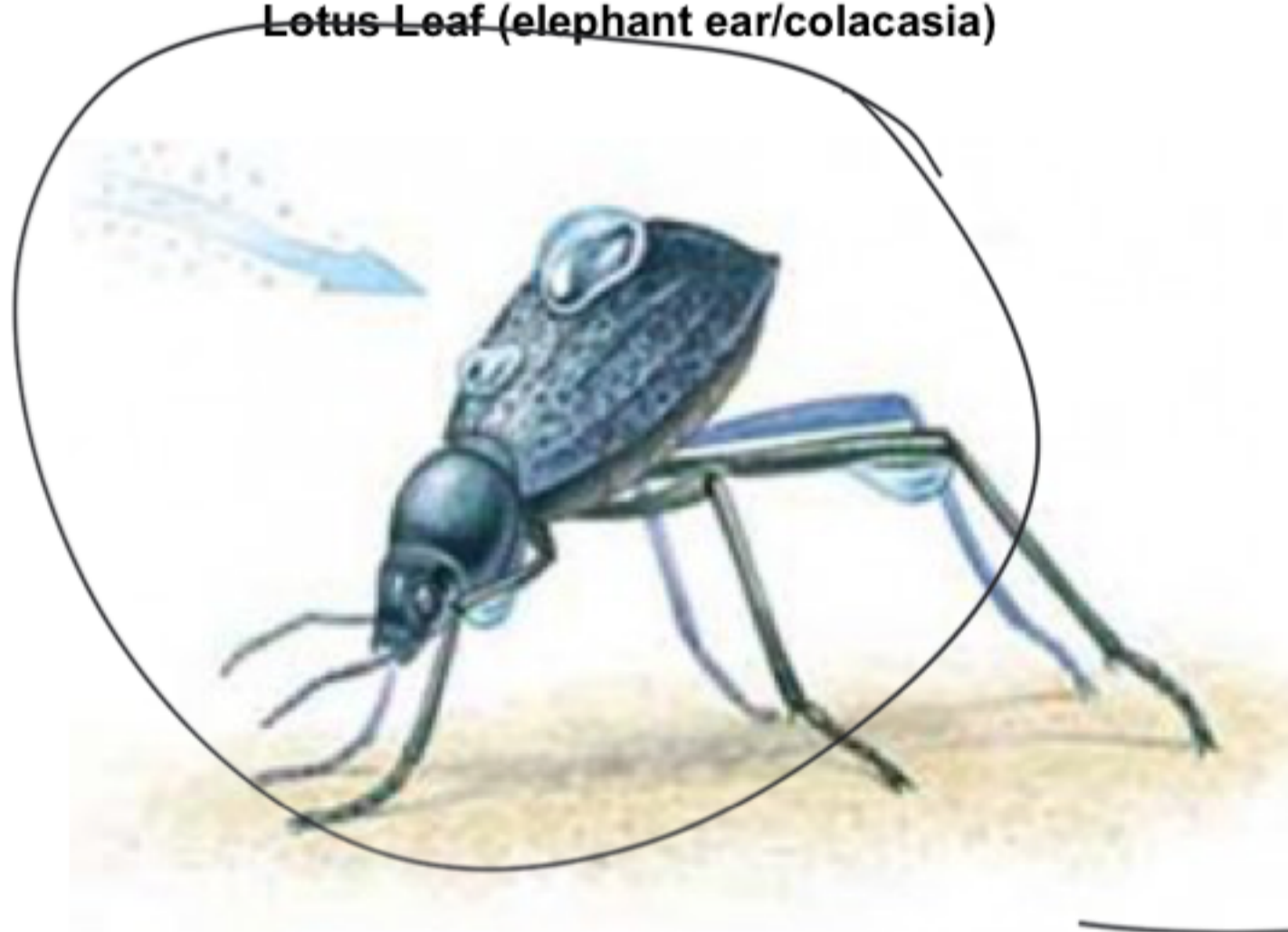
Lotus Leaf (elephant ear/colacasia)



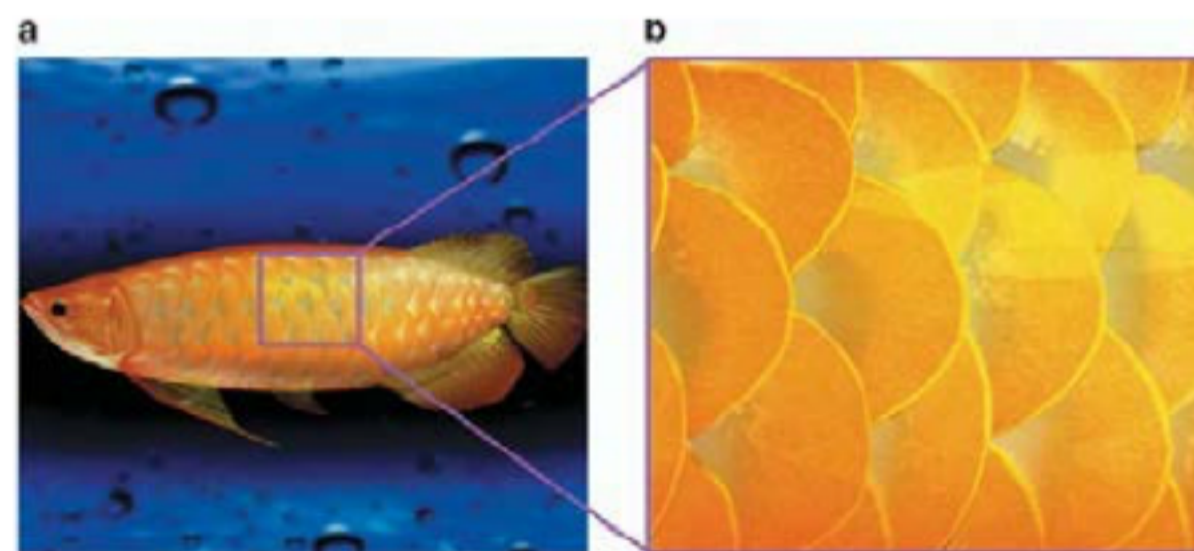
Monkey cups (Nepenthes pitcher plant)



E. Wang, Penn. State and K. Varanasi - MIT



Namib Desert Beetle (Natural History)



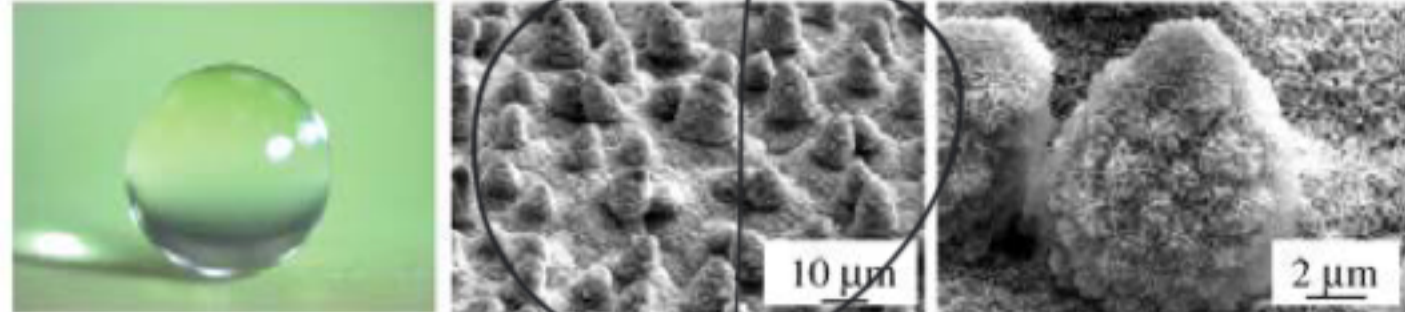
Fish scale (NPG Asia Materials 7(12))



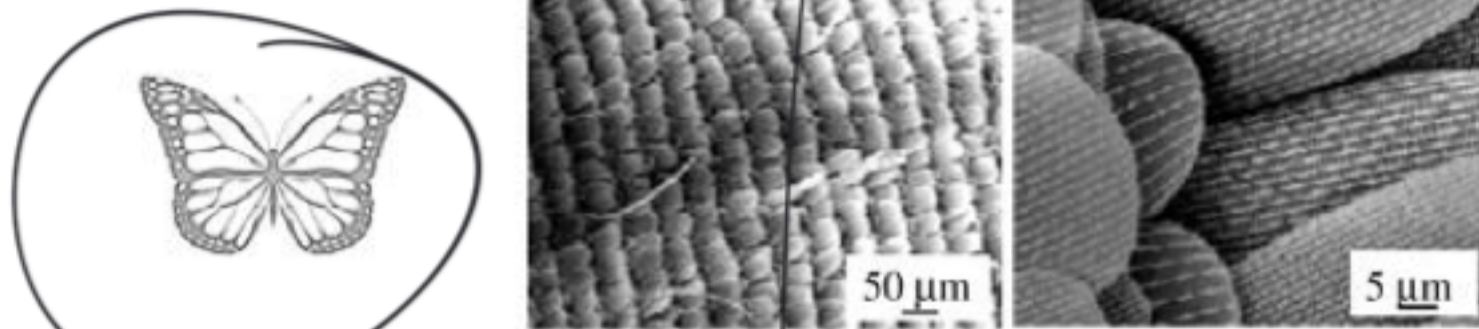
Acc. Chem. Res. 2009 Vol. 42, No. 1

Wettability and nature

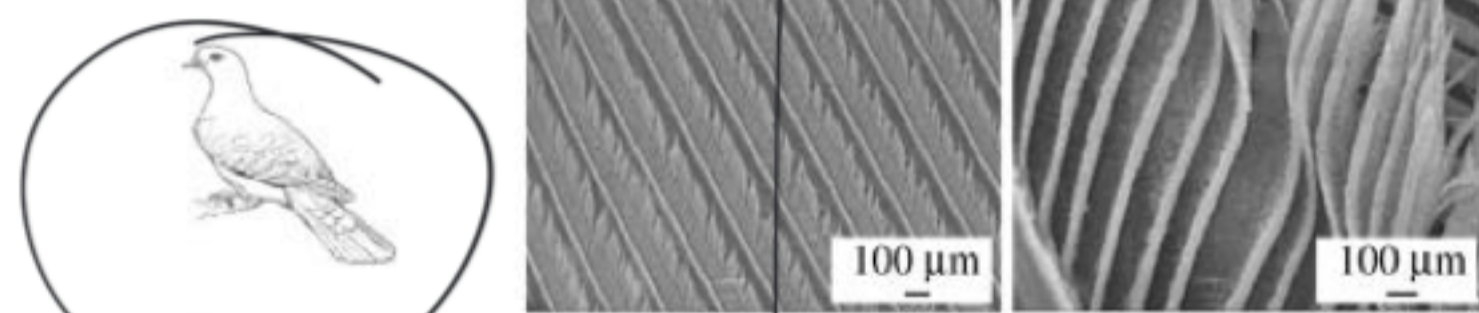
examples of self-cleaning surfaces



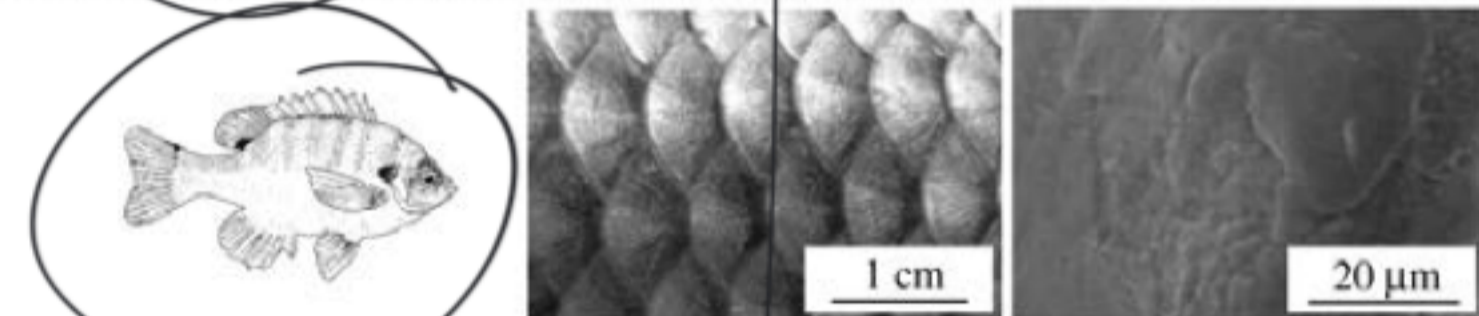
superhydrophobic lotus (*N. nucifera*) leaf (reproduced with permission from Bhushan *et al.* [5])



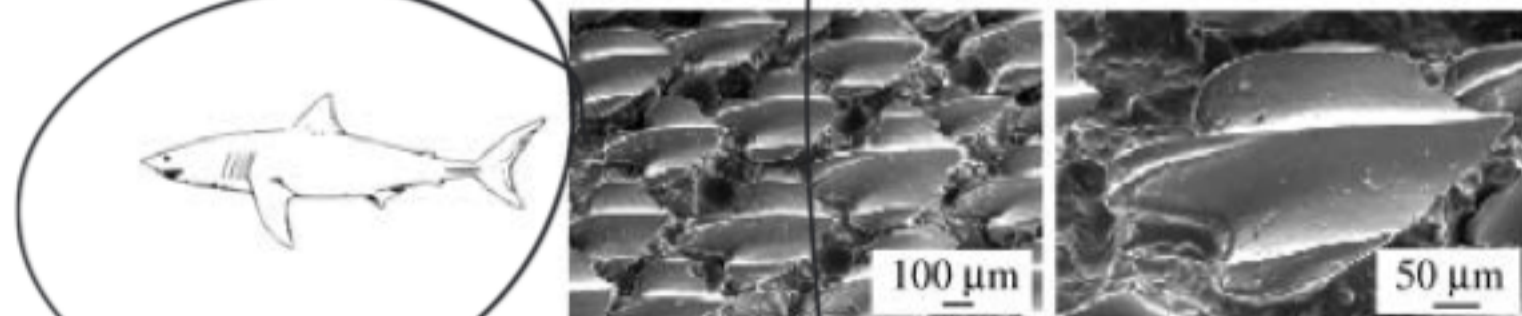
superhydrophobic butterfly (*P. leucus*) wings (adapted from W. Barthlott)



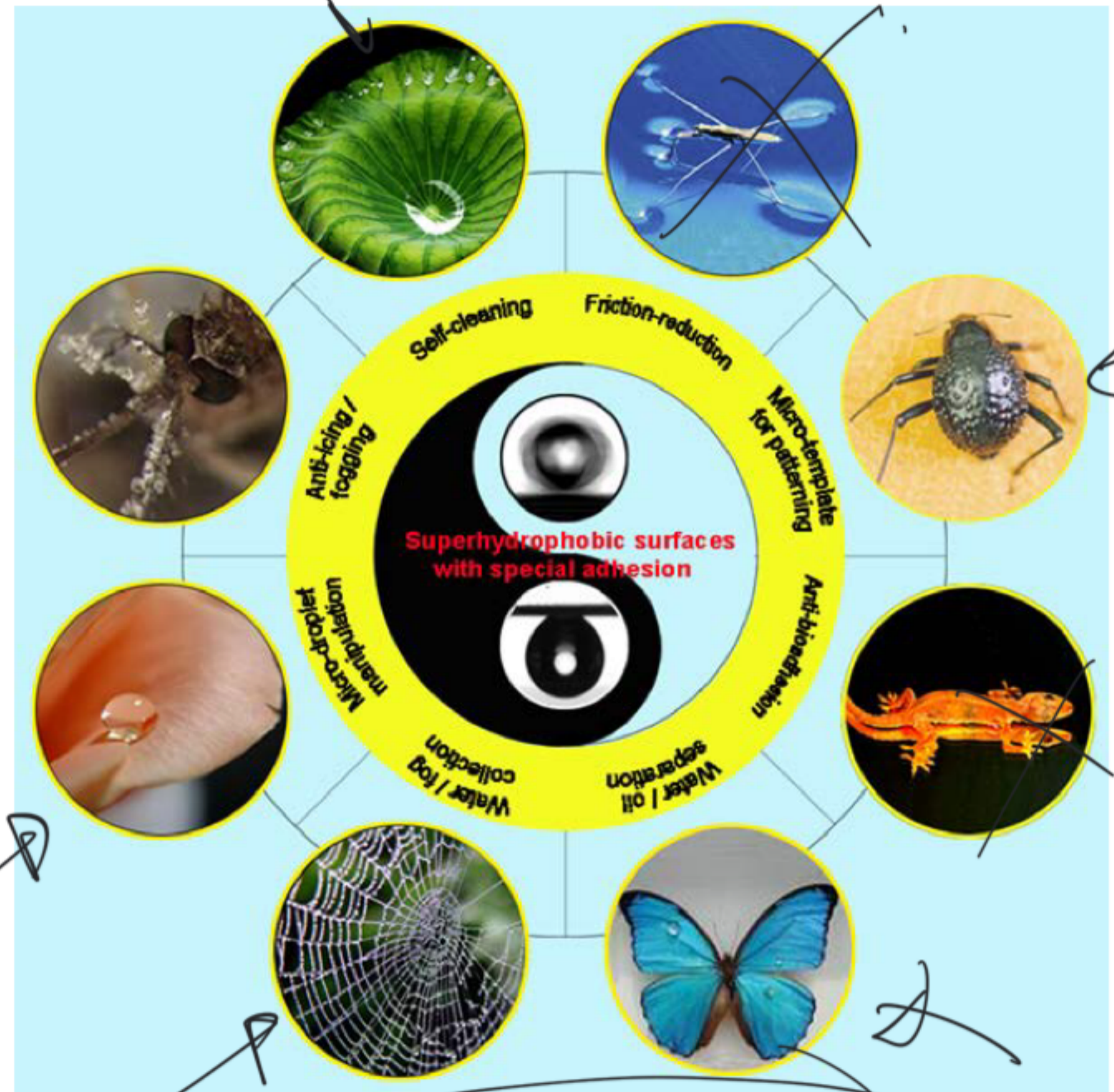
superhydrophobic pigeon (*Columba*) feathers (reproduced with permission from Bormashenko *et al.* [115])



superoleophobic fish (*Micropterus*) scales (reproduced with permission from Liu *et al.* [114])

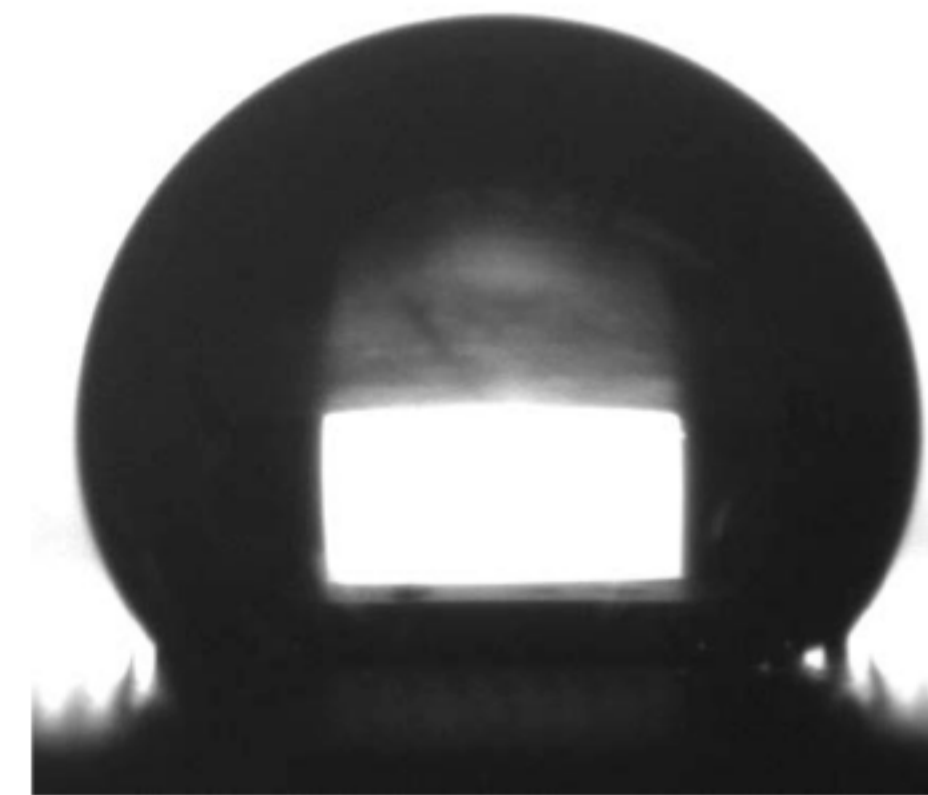
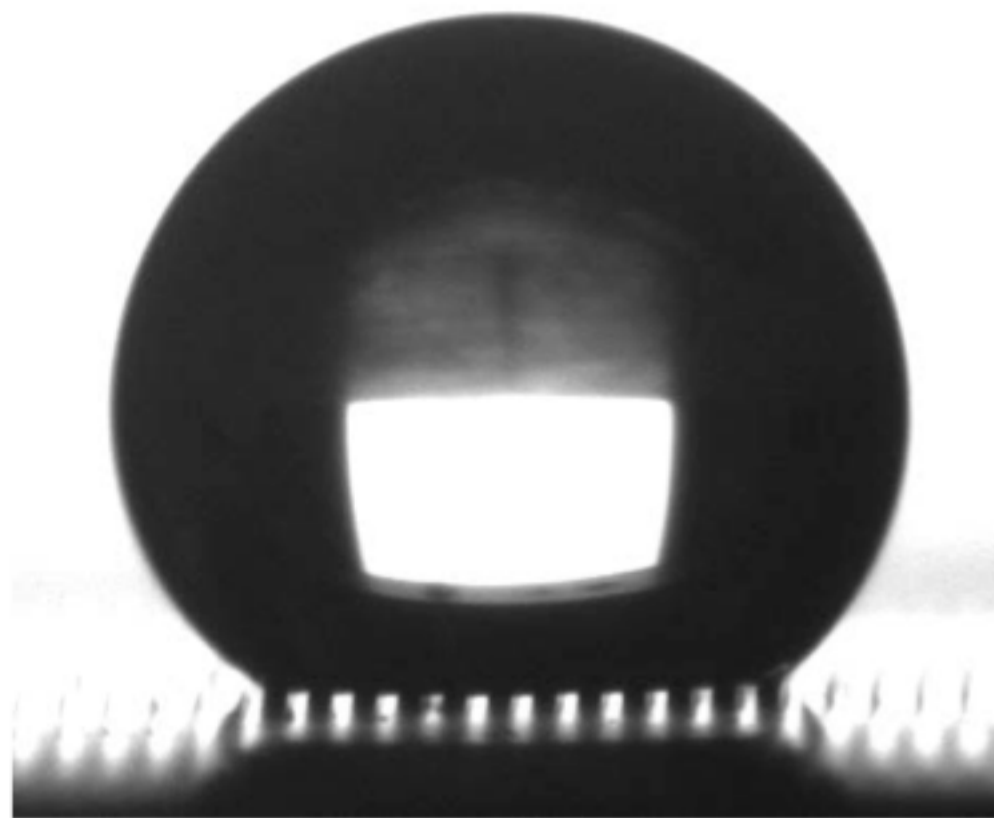
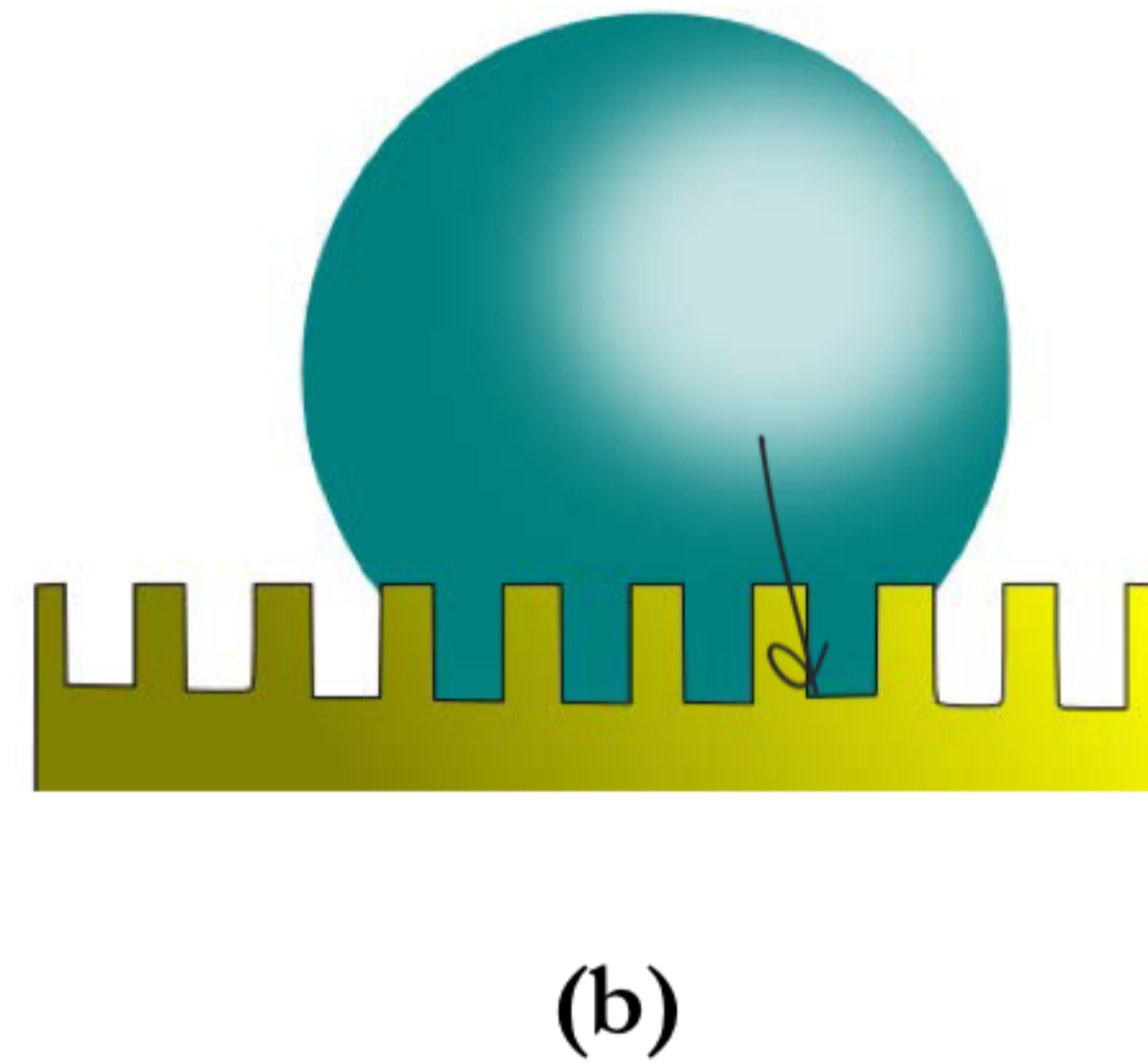
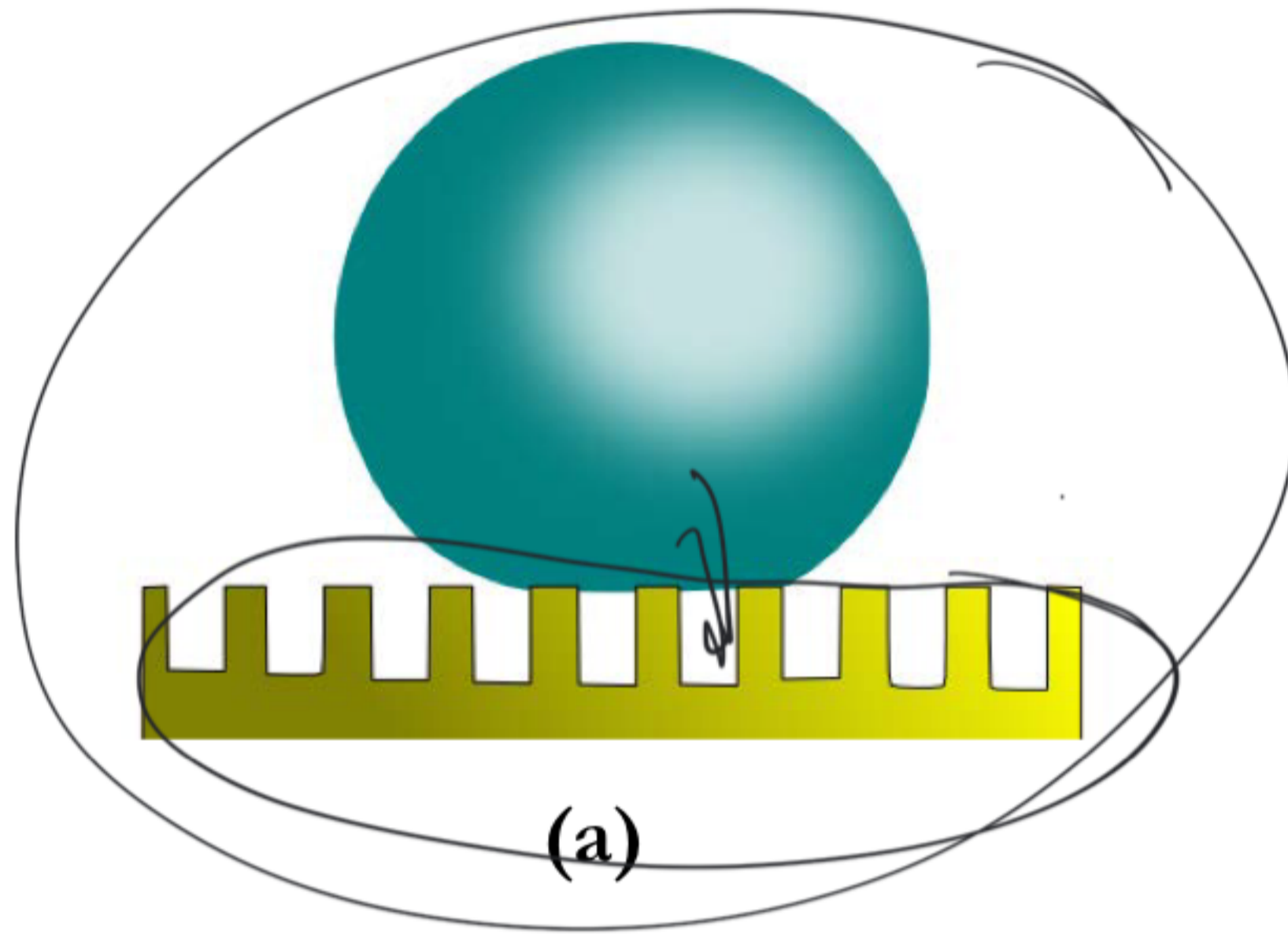


low-drag shark (*S. acanthias*) skin (reproduced with permission from Jung & Bhushan [95])

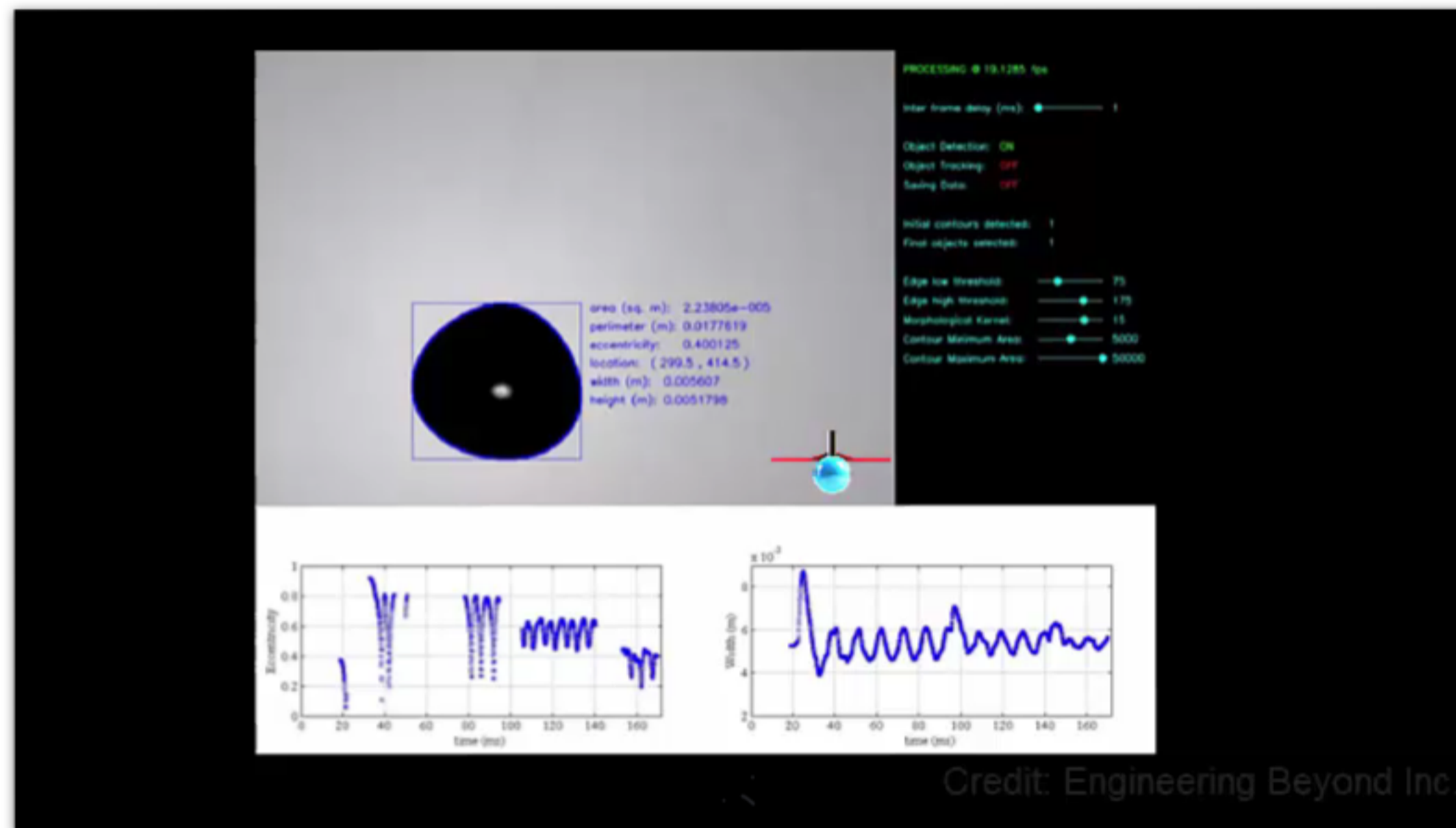


Wetting and Wettability – Book Ch. 3

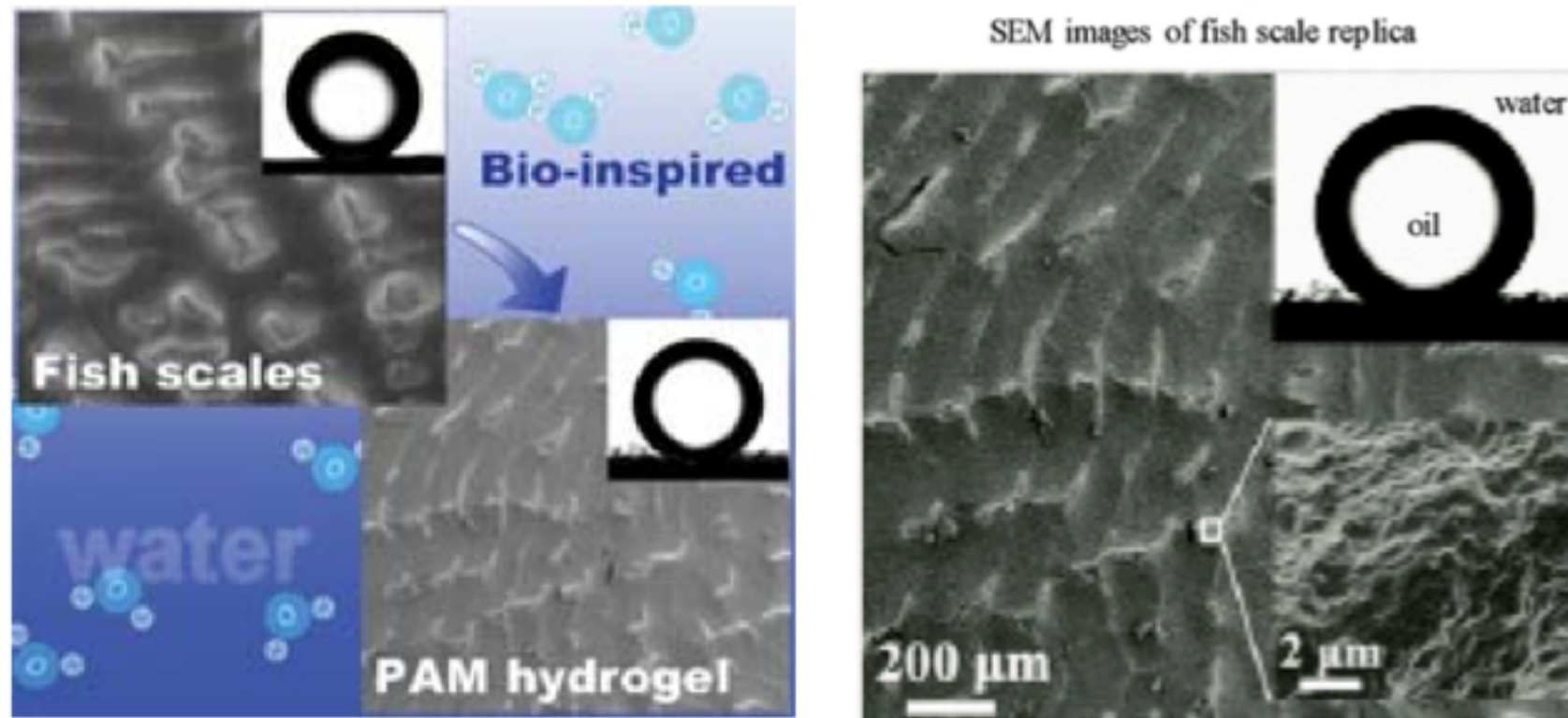
Role of surface roughness and wettability



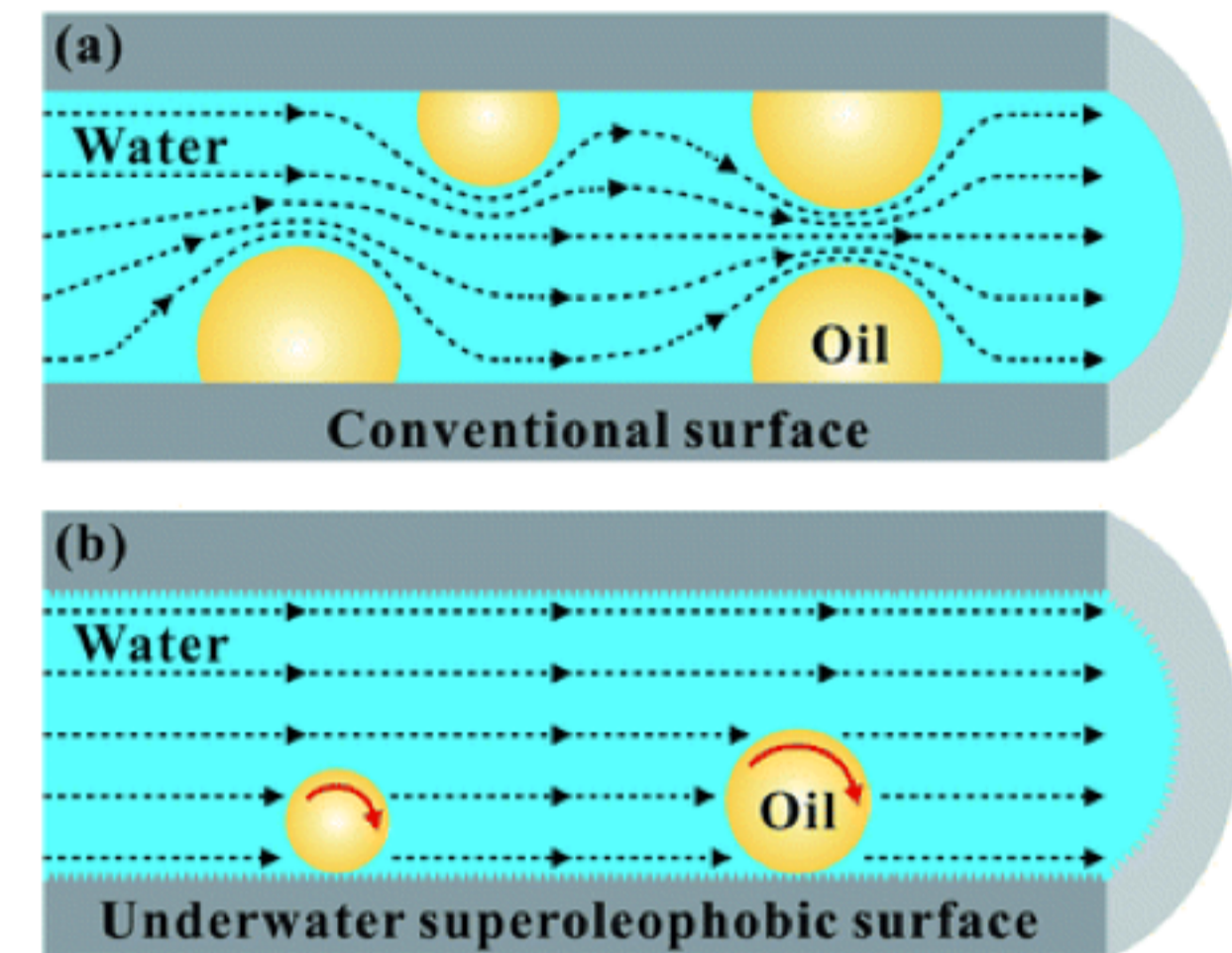
Role of surface roughness and wettability



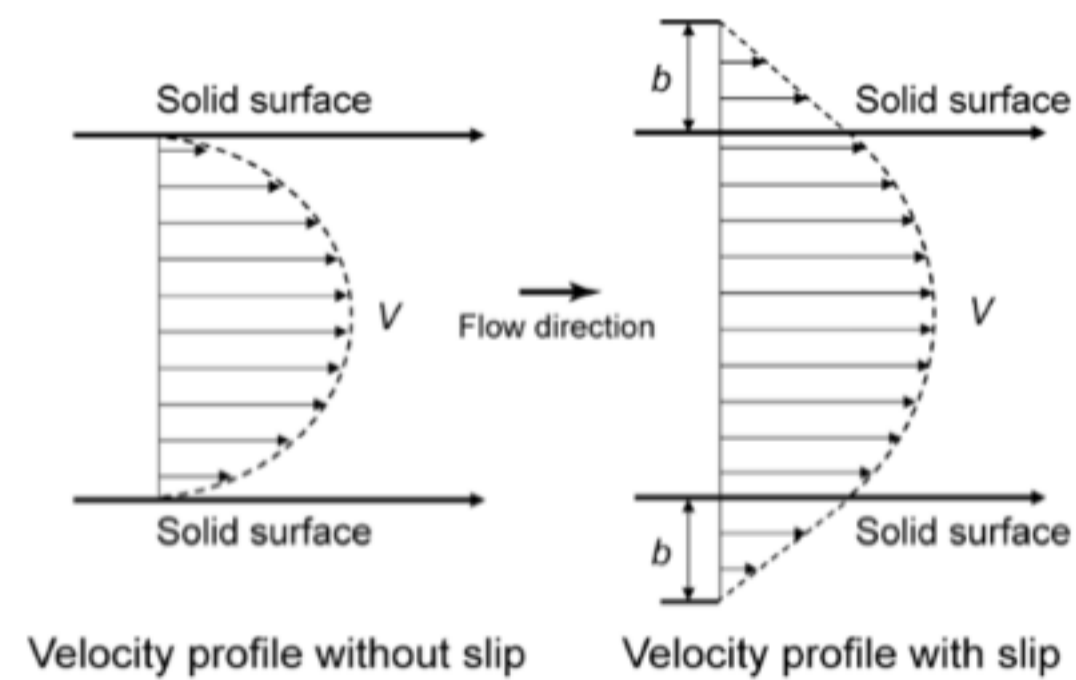
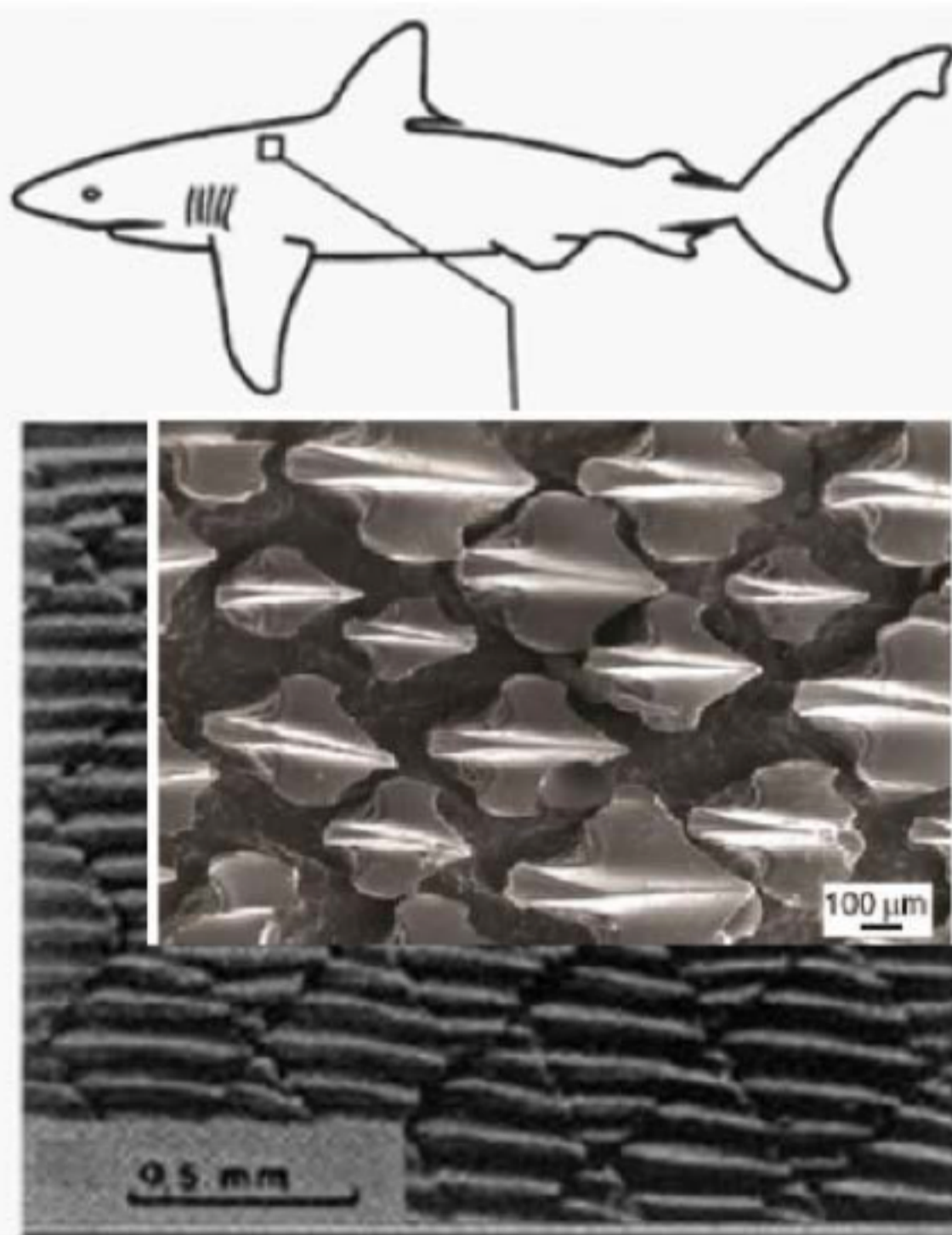
Fish scale wettability



Liu et al., *Adv. Mat.*, 2009



Yong et al., *J. Mater. Chem. A.*, 2014

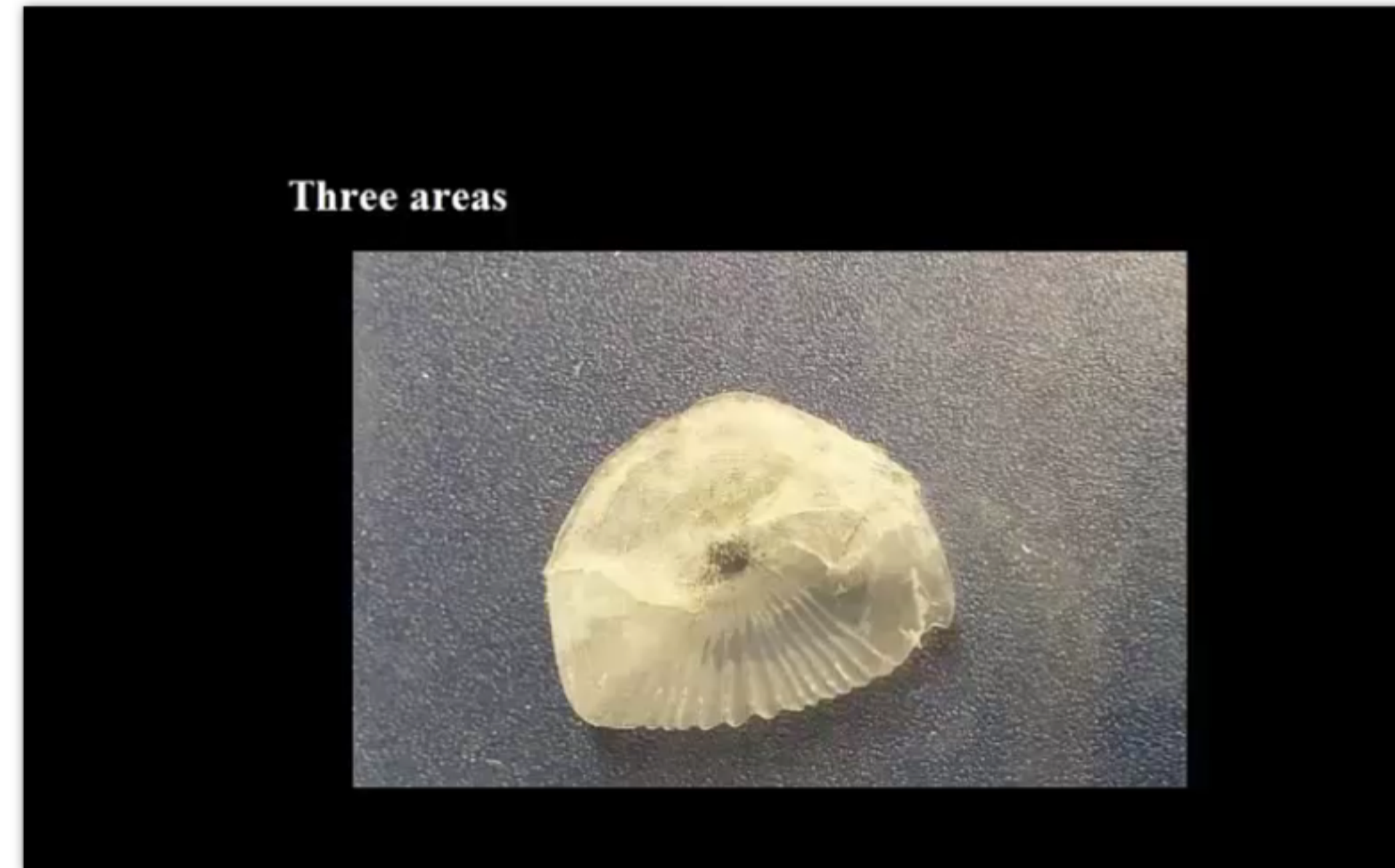
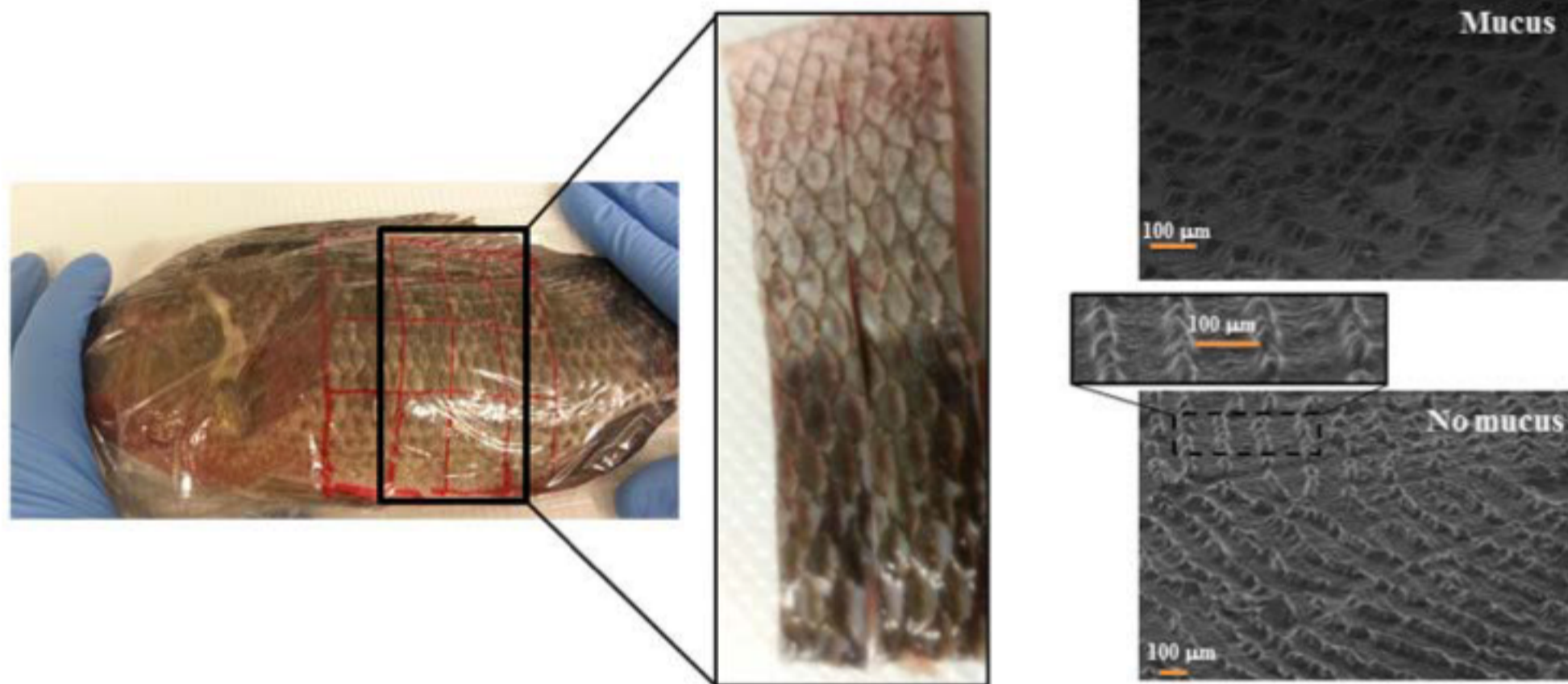


B. Ghushan, *Beilstein J. Nanotechnol.*, 2011

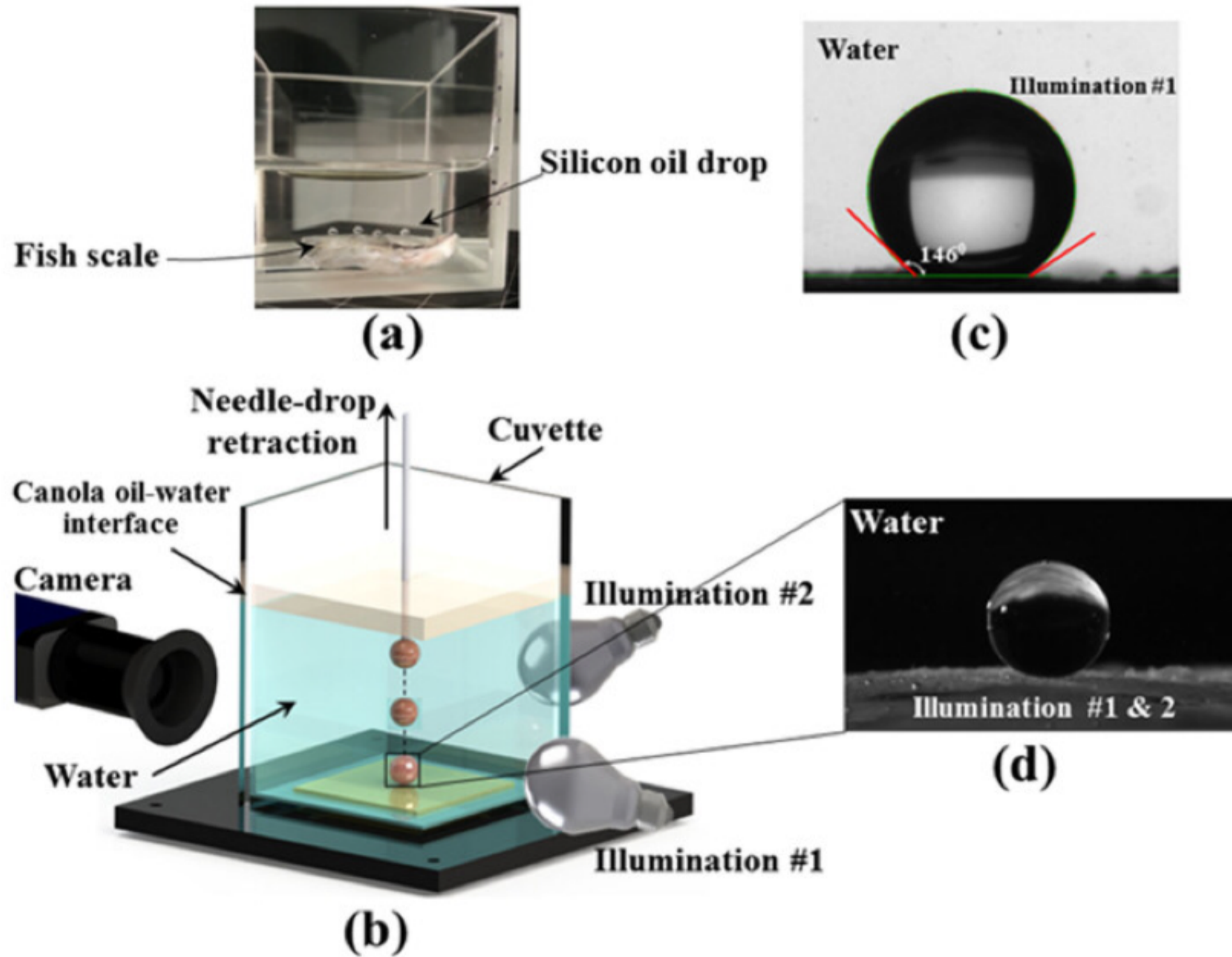


<http://www.mnn.com/earth-matters/wilderness-resources/photos/7-amazing-examples-of-biomimicry/copying-mother-nature>

Fish scale wettability



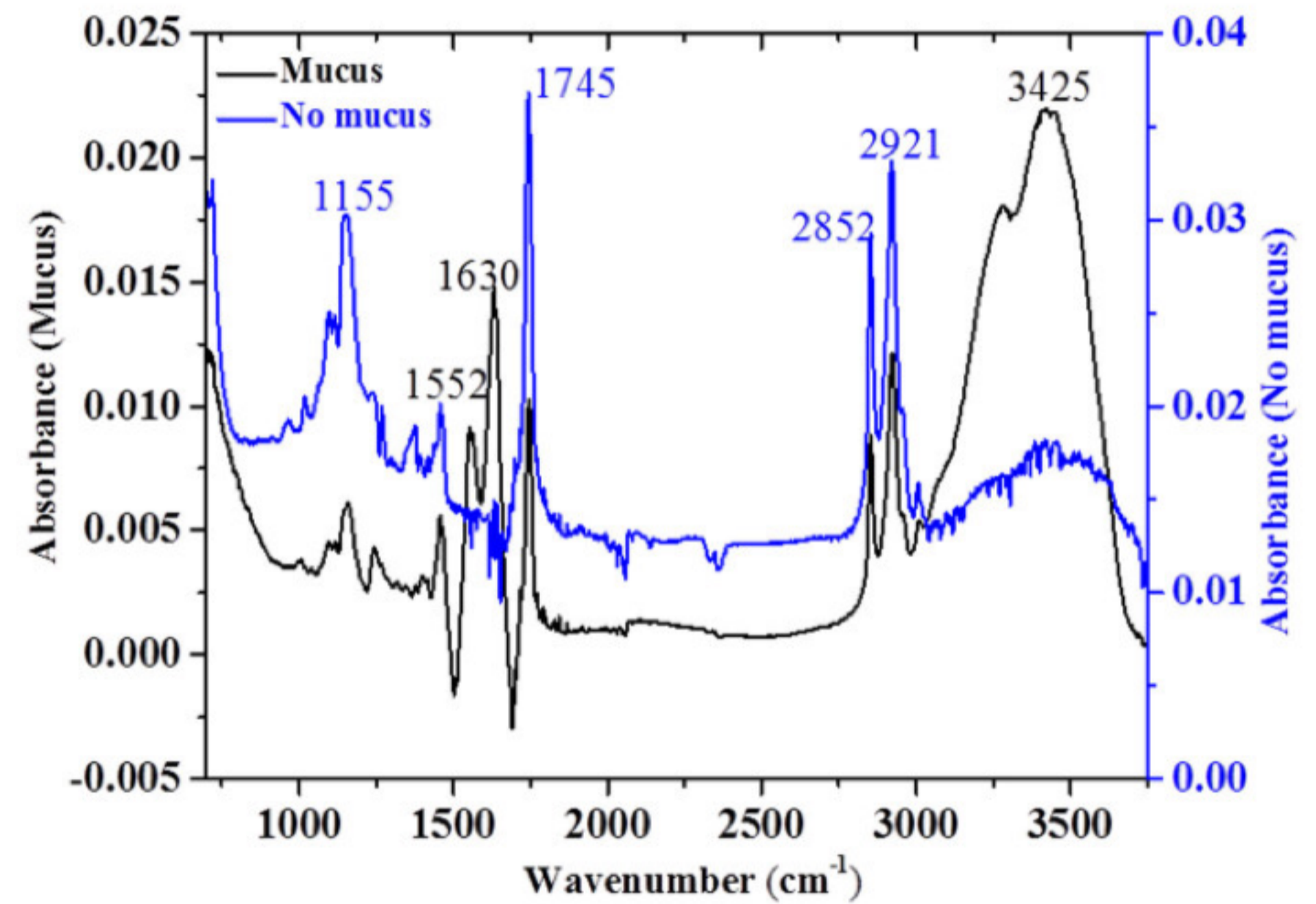
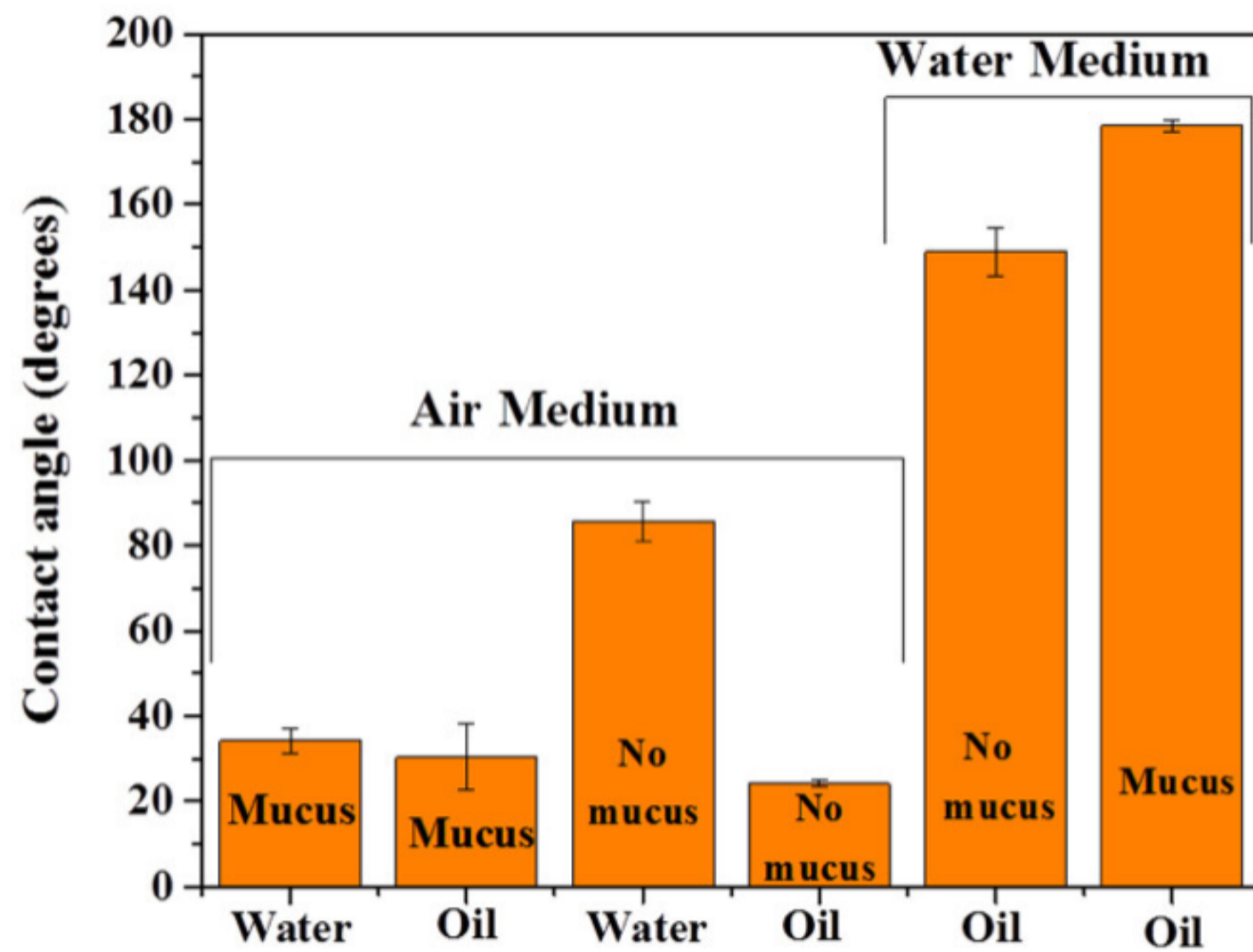
Fish scale wettability



Under-water superoleophobicity of fish scales

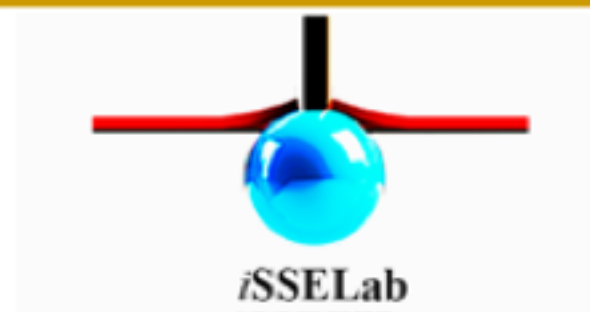
Video S2: Contact angle measurements on fish scale with mucus

Fish scale wettability



Role of mucus

- The uniformity of the mucus layer and its attachment to the surface is a primary concern in this study
- Mucus is slippery on the (glass) surface
- Better option: Mucus layer on a PDMS surface
 - Mucus layer can attach to PDMS surface more effectively.
 - Importantly, we can replicate the fish scale features on the PDMS and mimic the ideal fish skin scenario – fish skin features – with and without mucus.



Biomimicry: ongoing studies (iSSELab)

- Particle separation with lotus leaf
- Water harvesting
- Banana leaf – role of wax

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NINT 6-065, National Institute for Nanotechnology

