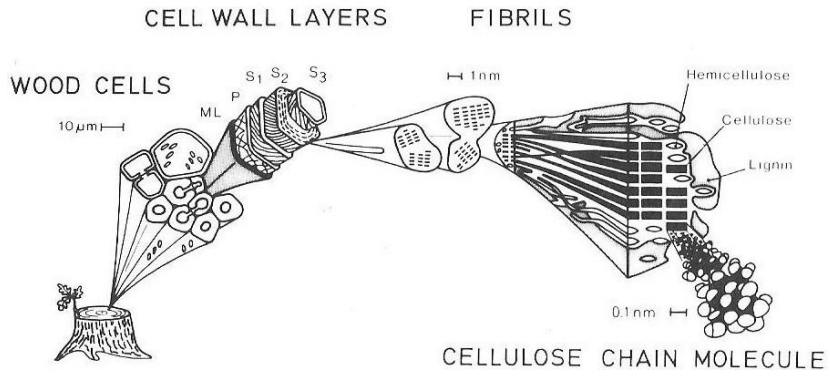
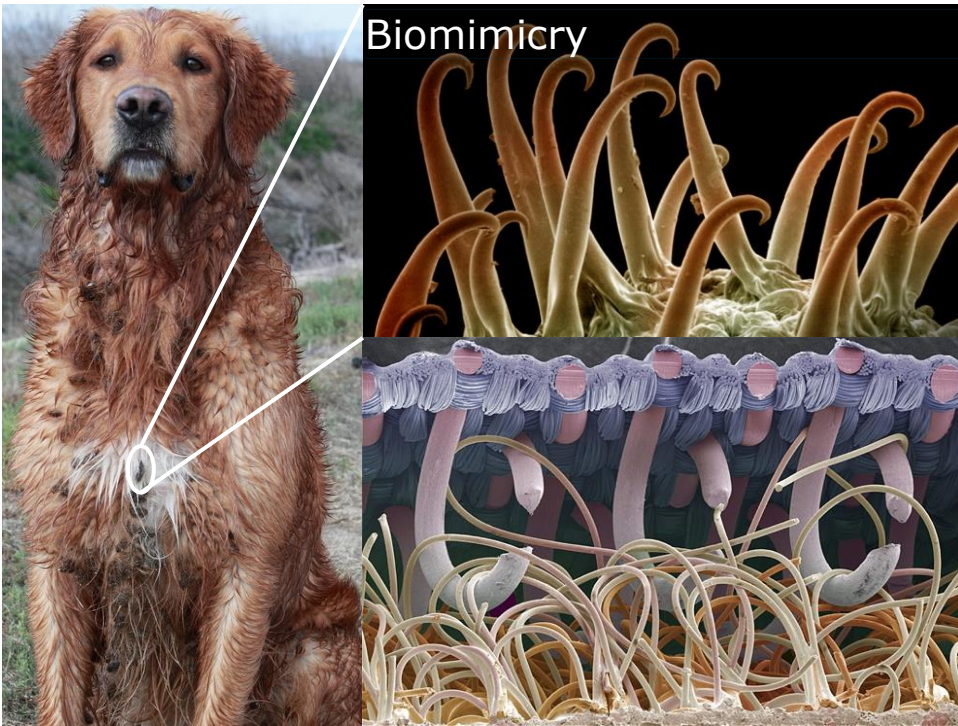

Materials inspired by geckos, mussels and sandcastle worms

Marleen Kamperman,
Physical Chemistry and Soft Matter

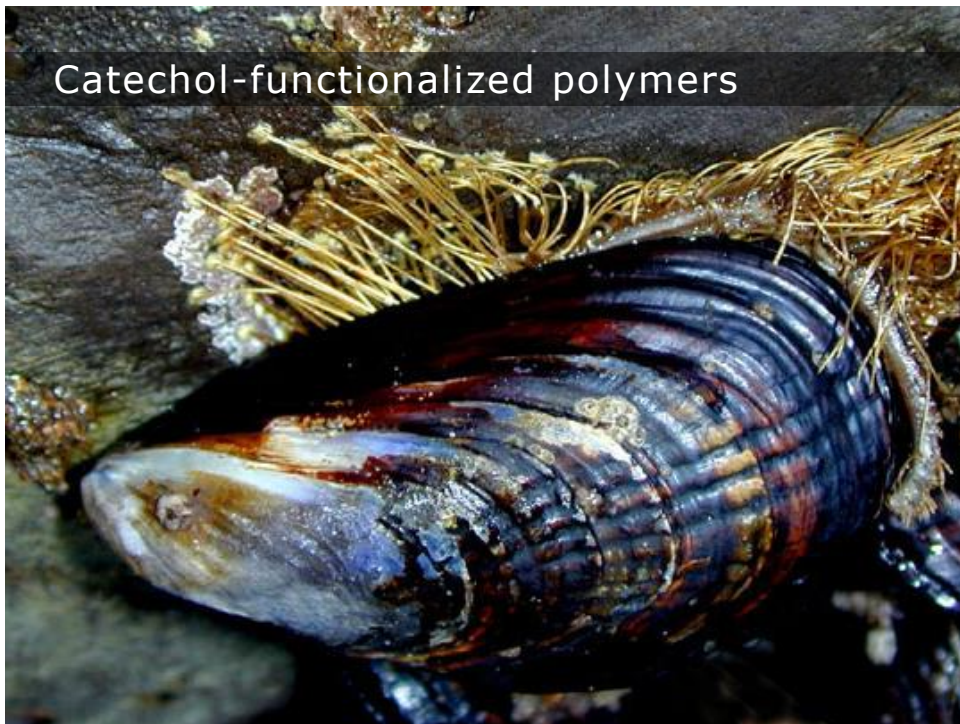






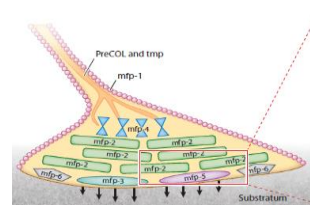
Thomas Eisner 1929 – 2011
"father of chemical ecology"



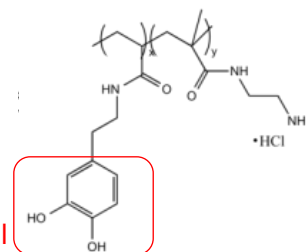


Catechol-functionalized polymers

- Five mussel foot proteins (mfp) contribute to the plaque formation.
- One characteristic of mfps: L-3,4-dihydroxyphenylalanine (DOPA)
 - Versatile binding ability
 - Inorganic substrates: TiO_2 , SiO_2 , Fe(III), alumina
 - Organic substrates: TEFLON, PDMS



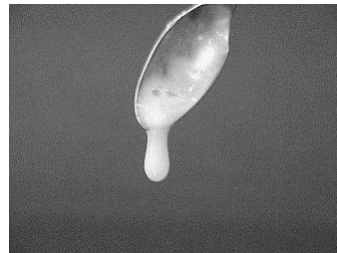
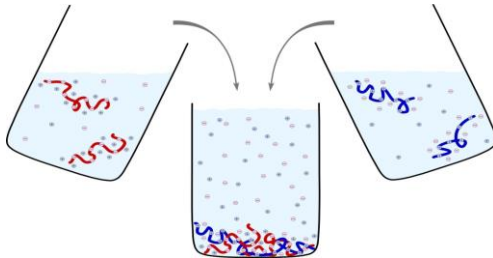
Lee et al. *Annu. Rev. Mater. Res.* **2011**



catechol



Complex coacervates

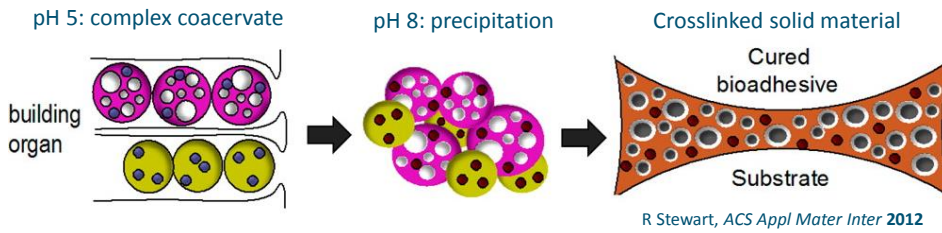


Why use complex coacervation?

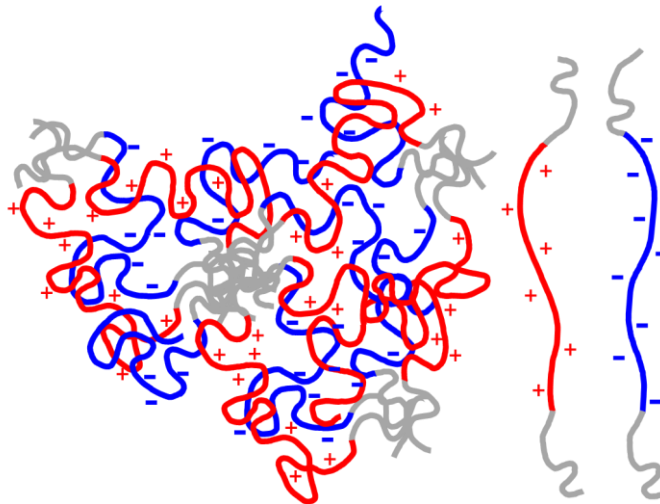
Complex coacervation provides advantages for underwater adhesion:

1. Immiscible with water
2. Readily wets surface
3. Relative high density provides high concentration of functional groups at surface

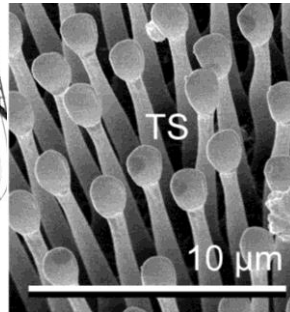
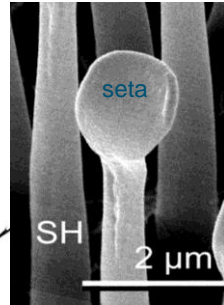
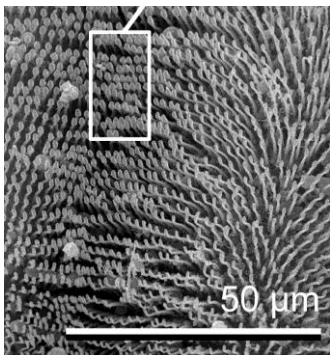
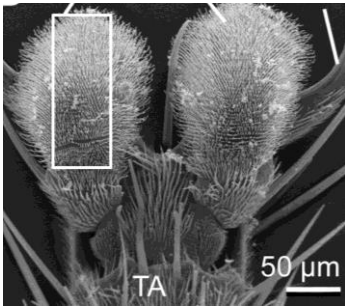
Sandcastle worms



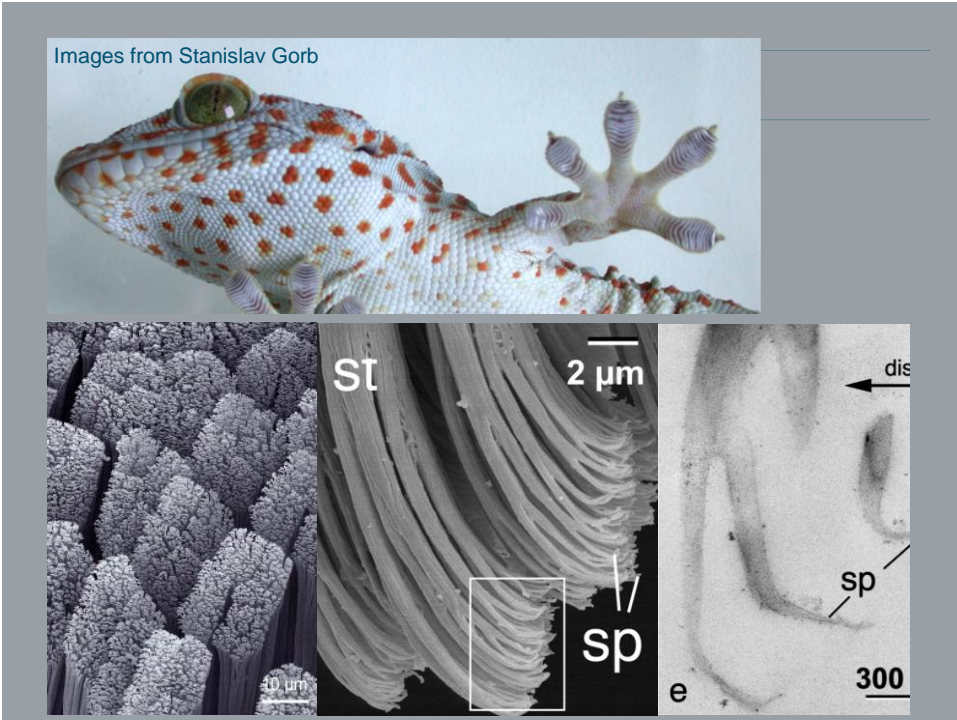
Electrostatic and hydrophobic interactions



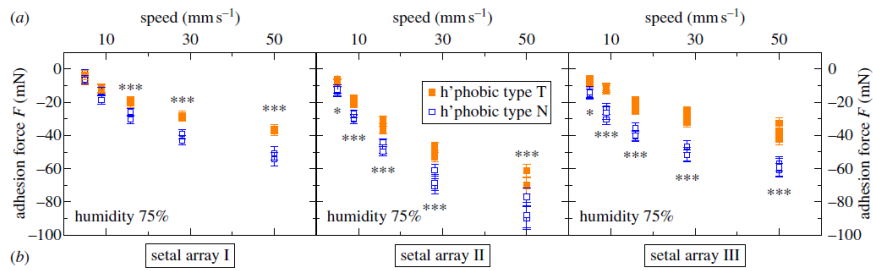
Structured Adhesives



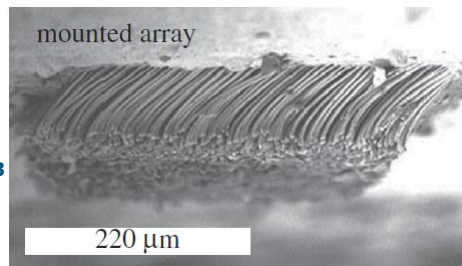
Images from Stanislav Gorb



van der Waals adhesion

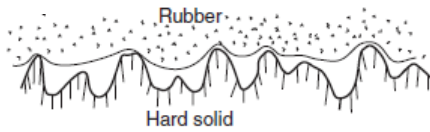


Jacobs, Autumn, *Royal Society Interface*, 2013



Area of contact

Two solids in contact:

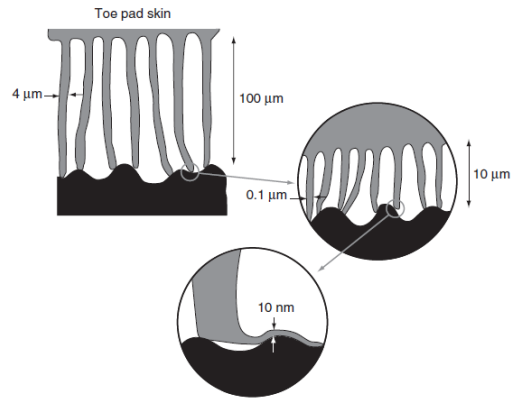


Area of real contact is very small and the adhesion negligible.

Persson, *MRS Bulletin*, 2007



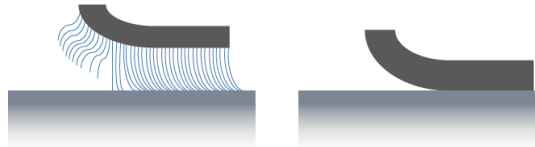
Hierarchical fibrillar system:



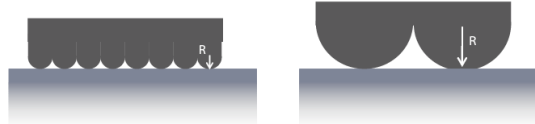
Area of real contact is high!

Principle of Contact Splitting

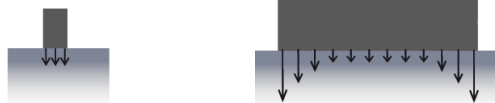
Extrinsic contribution to the work of adhesion



Size effect due to surface-to-volume ratio



Uniform stress distribution



Defect control and adhesion redundancy

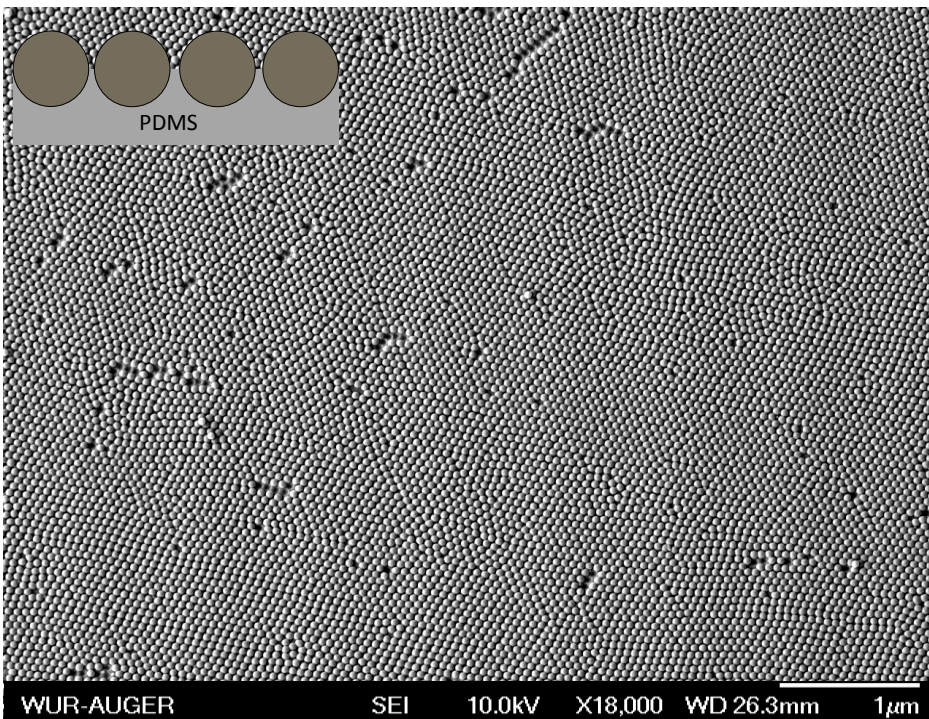


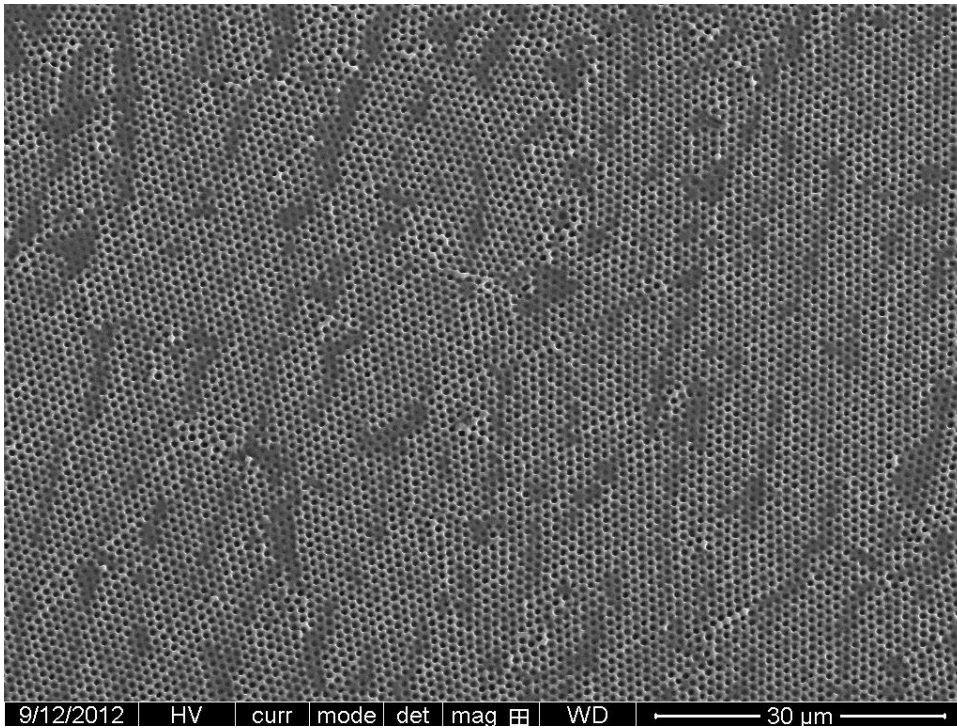
Kamperman, *Arzt, Adv Eng Mater* 2010

Colloidal Self-Assembly

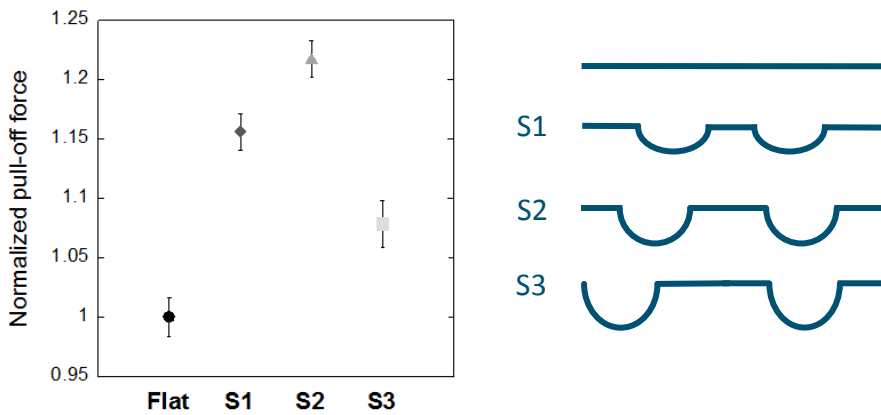


- Alternative way to create nanostructured patterns
- No expensive photolithography techniques needed
- Small feature sized possible
- Robust structures

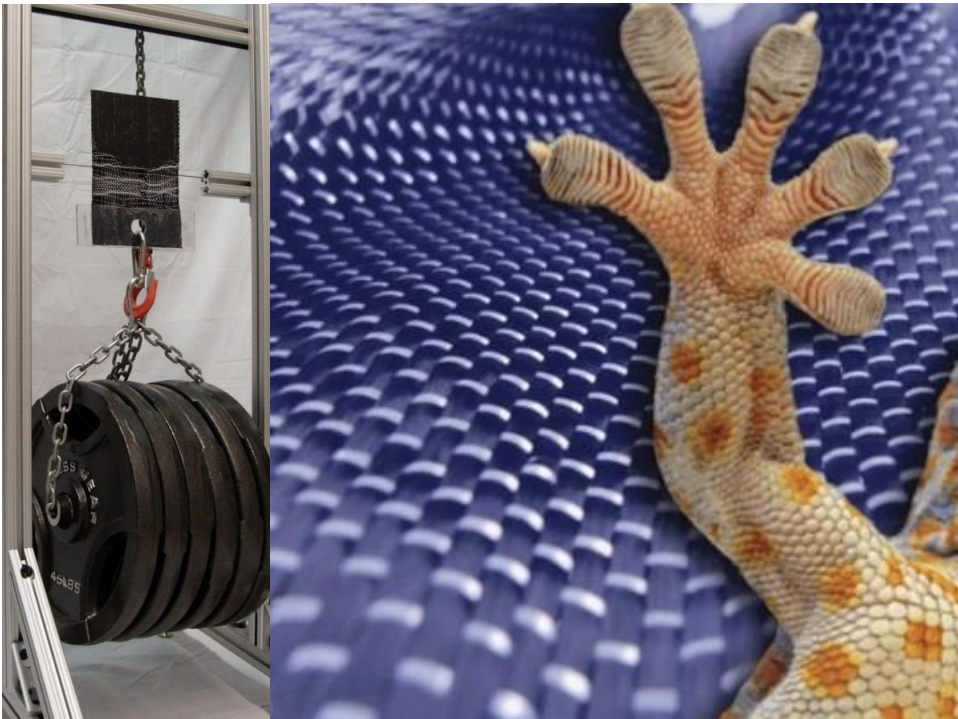
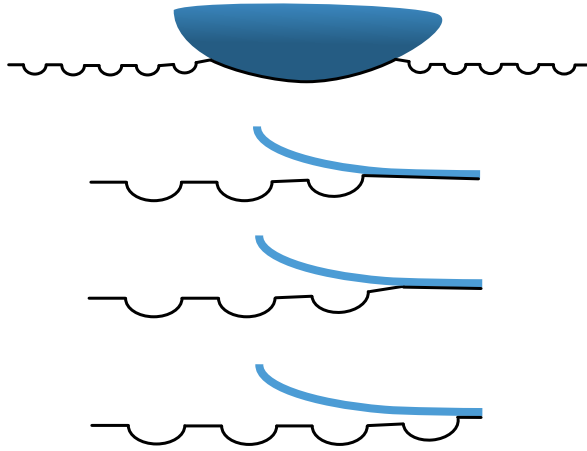




Dimple depth and density



Crack trapping mechanism



“Somewhere, something incredible is waiting to be known.”
Carl Sagan

