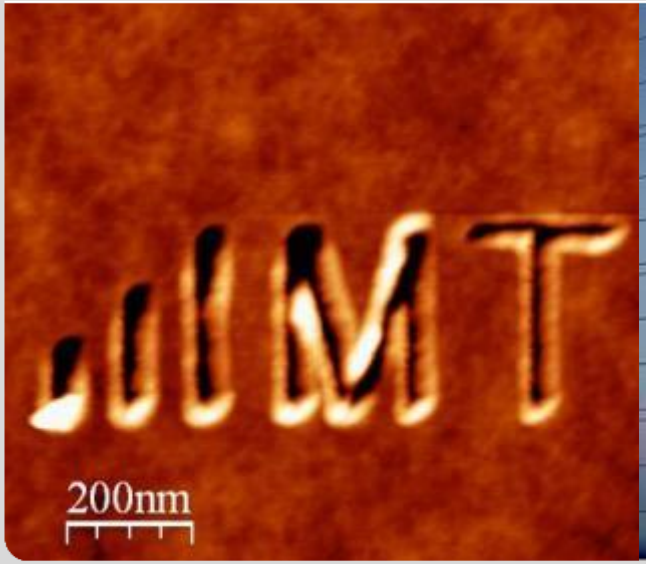
Karlsruher Institut für Technologie

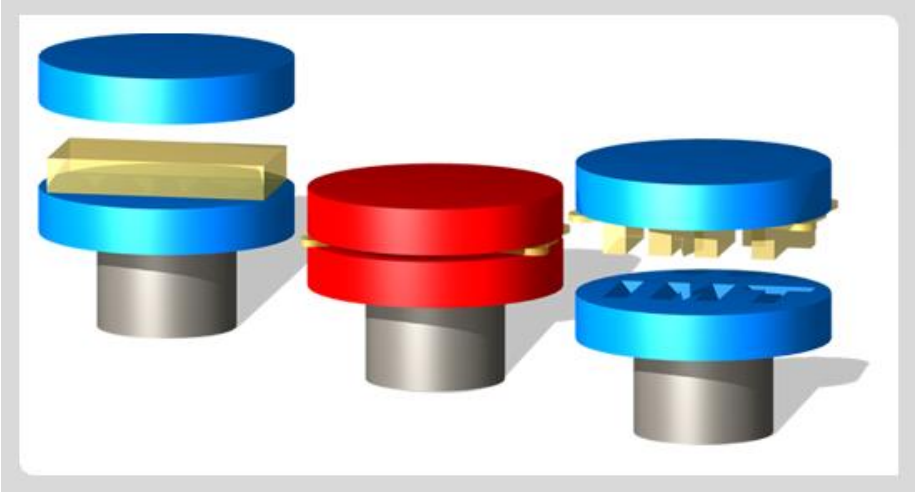
Nanofur for Biomimetic Applications

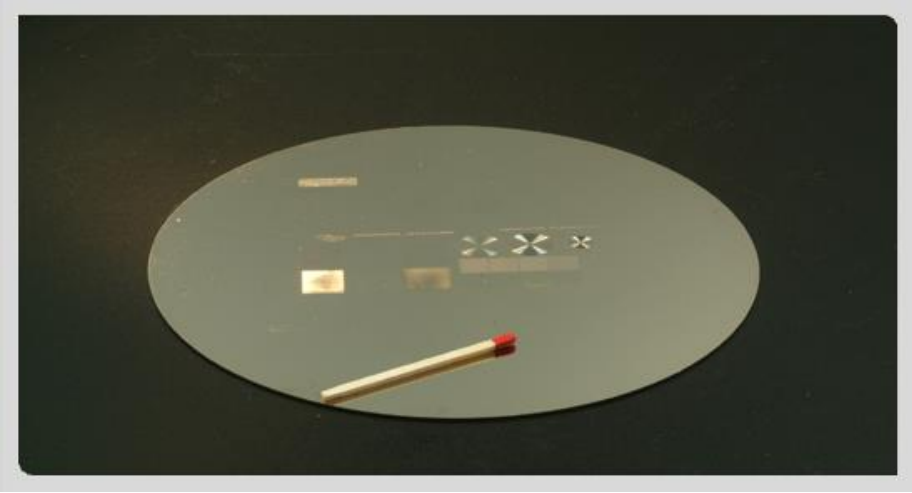
Hendrik Hölscher

Institute of Microstructure Technology (IMT)



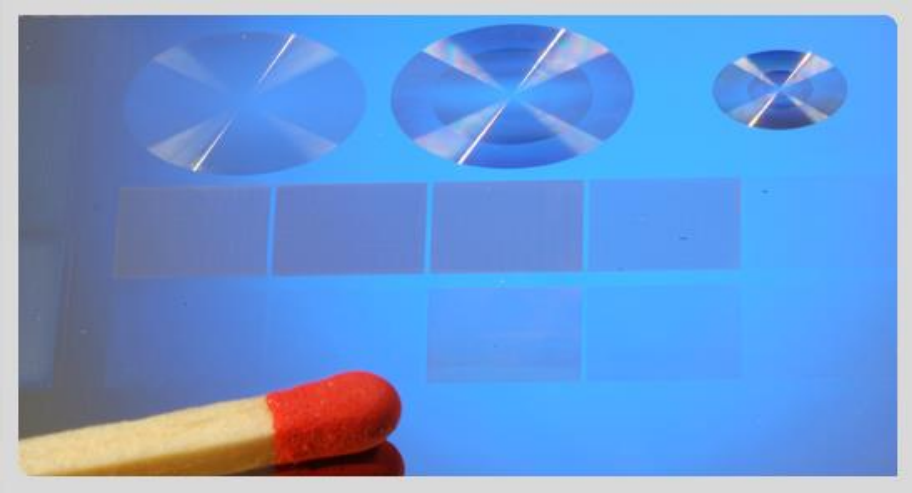
Hot Embossing and Hot Pulling – Large-Area Fabrication of Gecko Structures



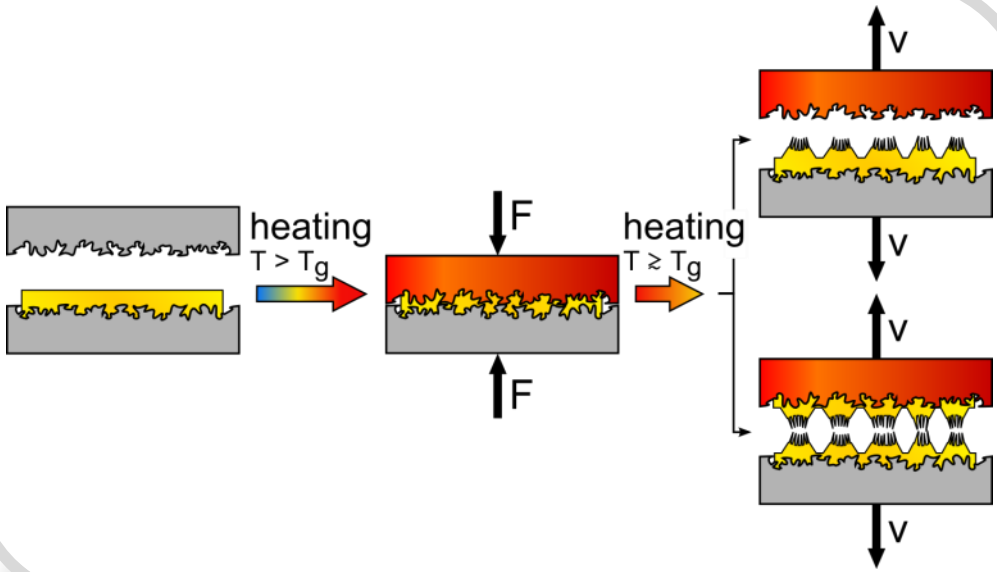


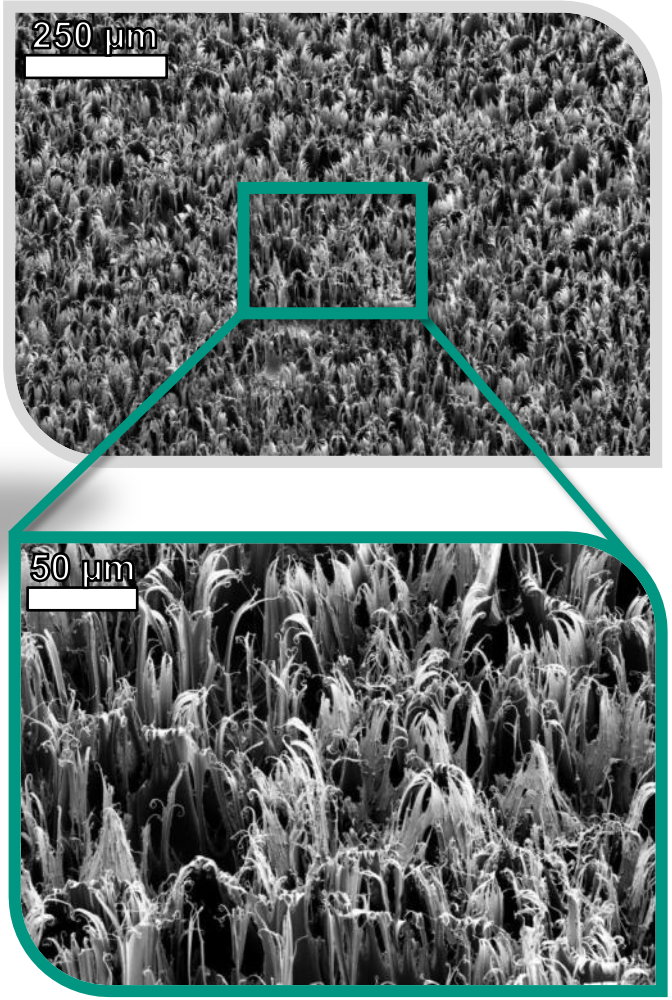
- **Characteristics:**
  - $2^1/_2$ D submicron structures
  - materials: thermoplastic polymers
  - mold insert required
  - maximum area: Ø 8’’

M. Worgull: Hot Embossing, Elsevier (2009)



Large Area Fabrication by Hot Pulling

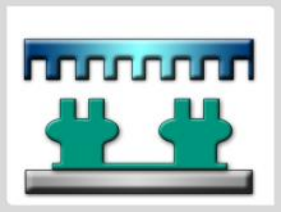


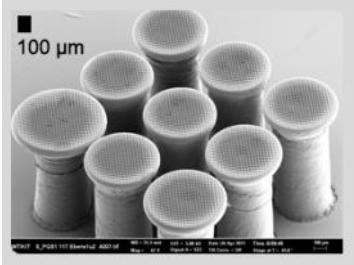


M. Röhrig (IMT, KIT)

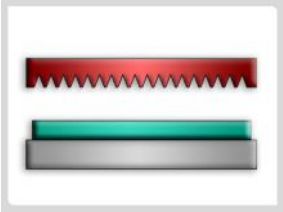
Hot Embossing and Hot Pulling

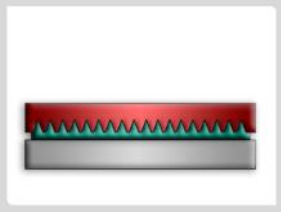
- Hierarchical Hot Embossing

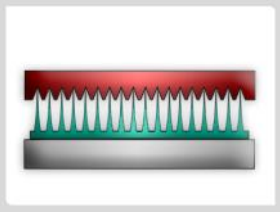


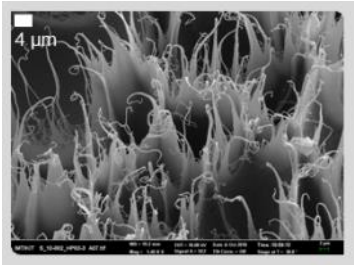


- Hot Pulling
  Patent WO 2010 /049081

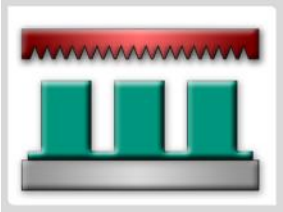


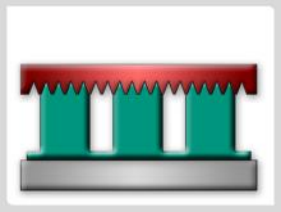


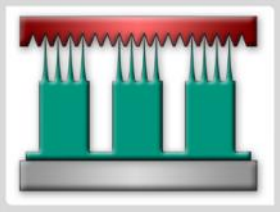


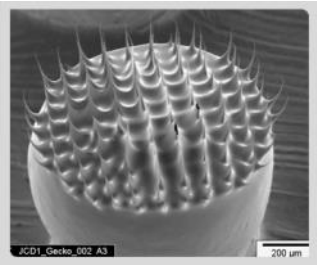


- Hot Embossing and Hot Pulling





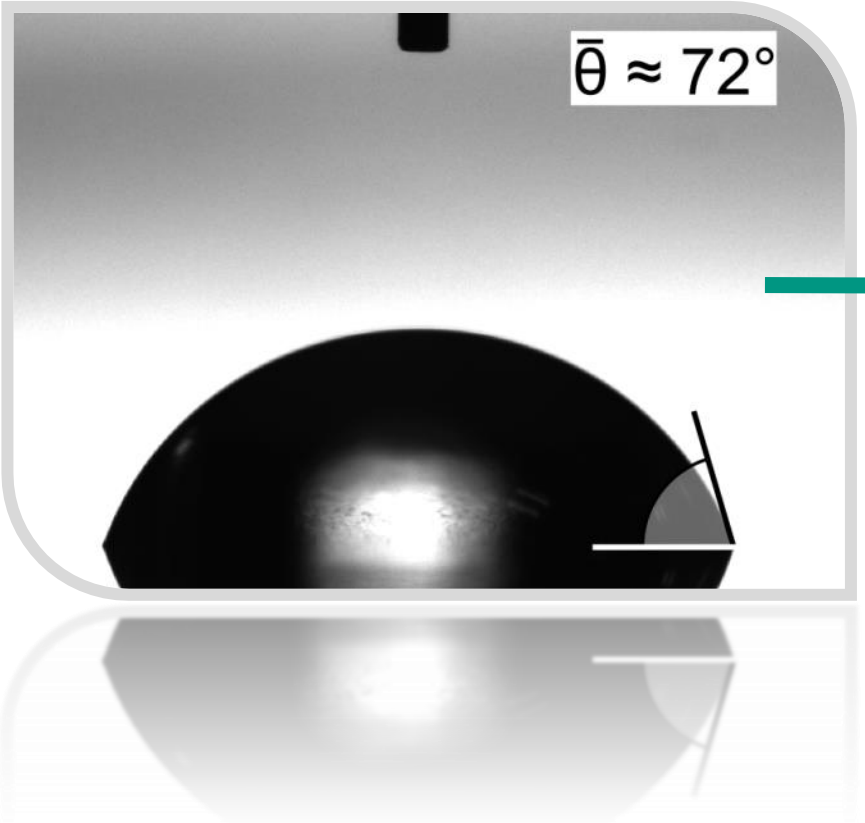




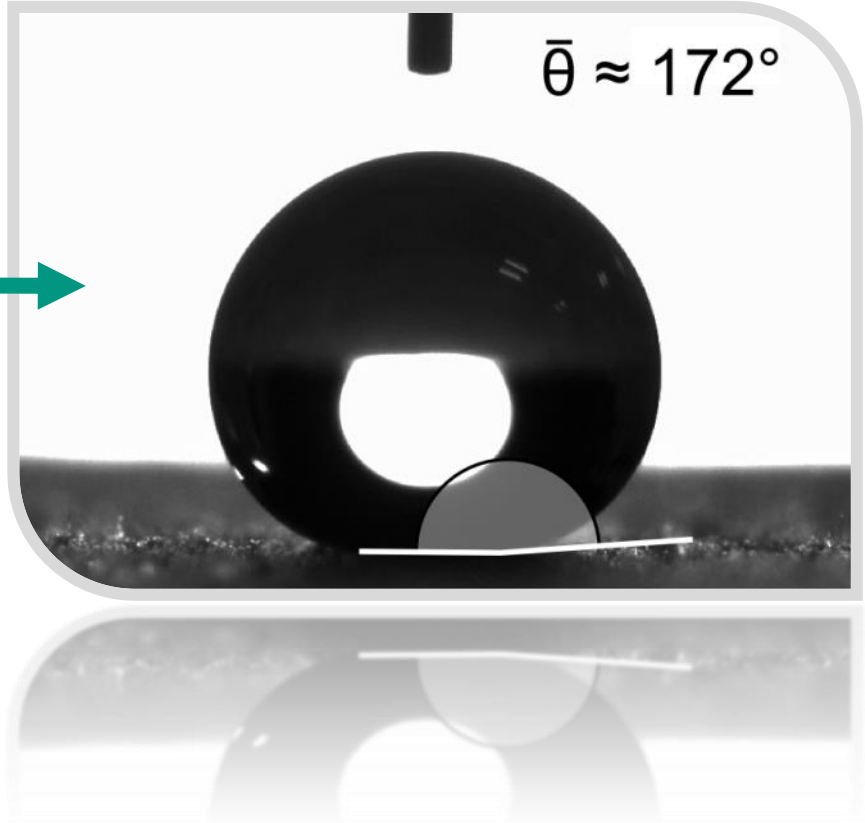
F. Oulhadj, F. Pfannes, G. Etienne, M. Schneider, M. Röhrig (IMT, KIT)

Structural Super-hydrophobicity on Hairy Polycarbonate

Flat Polycarbonate



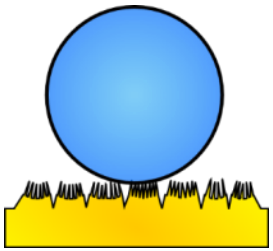
Hairy Polycarbonate

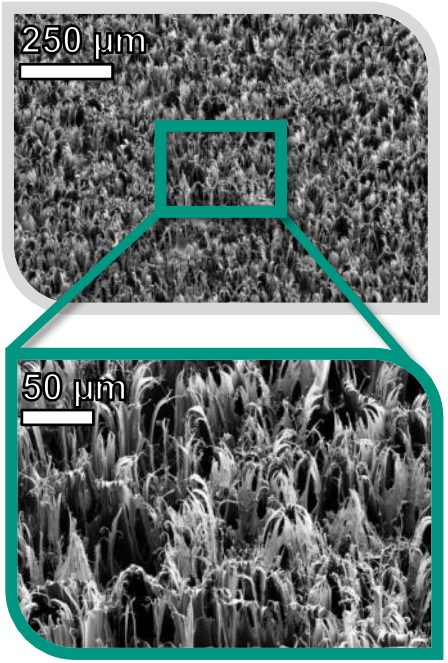


M. Röhrig (IMT, KIT)

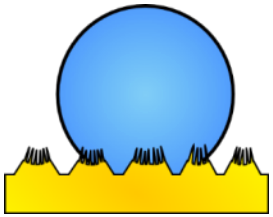
Structural Super-hydrophobicity – Cassie or Wenzel – depending on the parameters

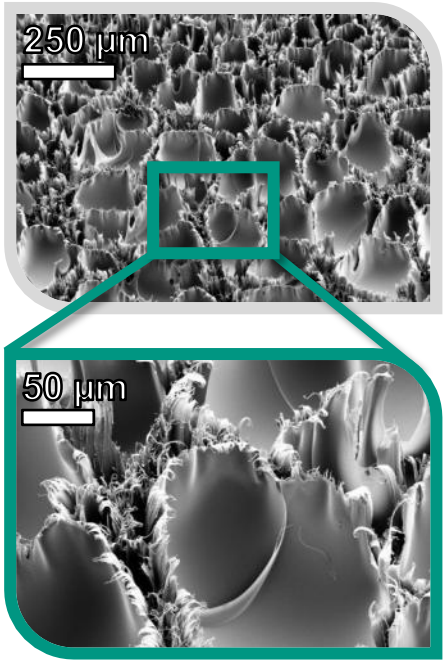
- **Cassie (Fakir) State**
  - Water rolls off easily
  - Typical for Lotus-Effect





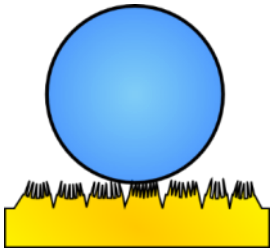
- **Wenzel State**
  - Water adheres
  - Typical for Rose-Petal-Effect



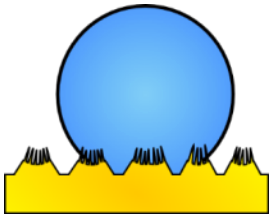


M. Röhrig (IMT, KIT)

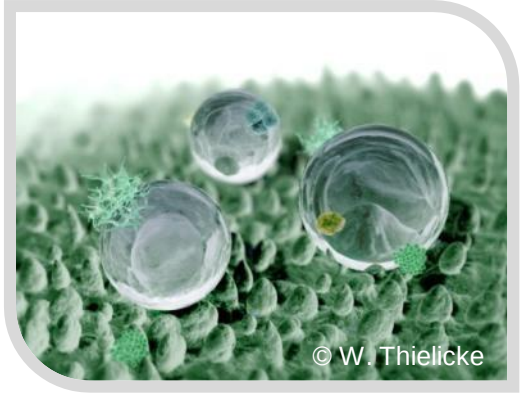
Cassie or Wenzel State – depending on the parameters

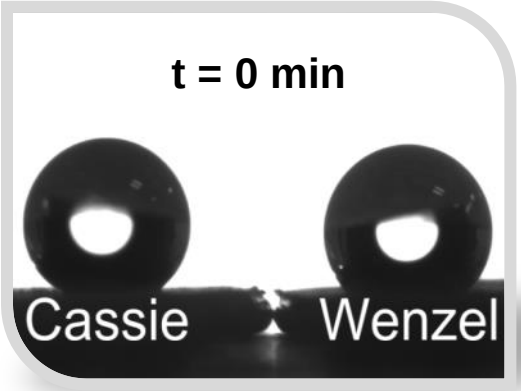


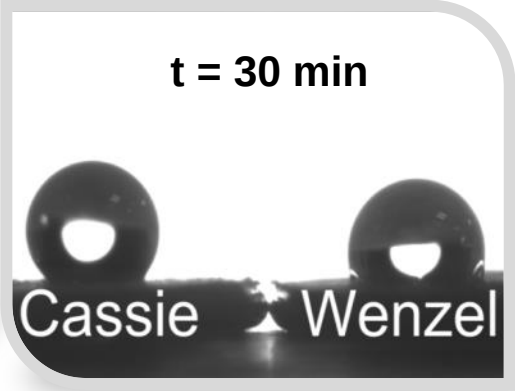
- **Cassie (Fakir) State**
- Water rolls off easily
- Typical for Lotus effect®

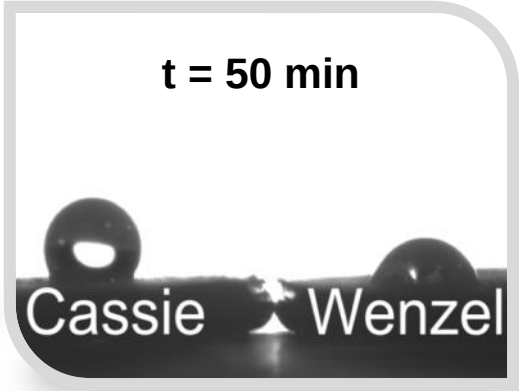


- **Wenzel State**
- Water droplets adhere
- Typical for Rose petal effect





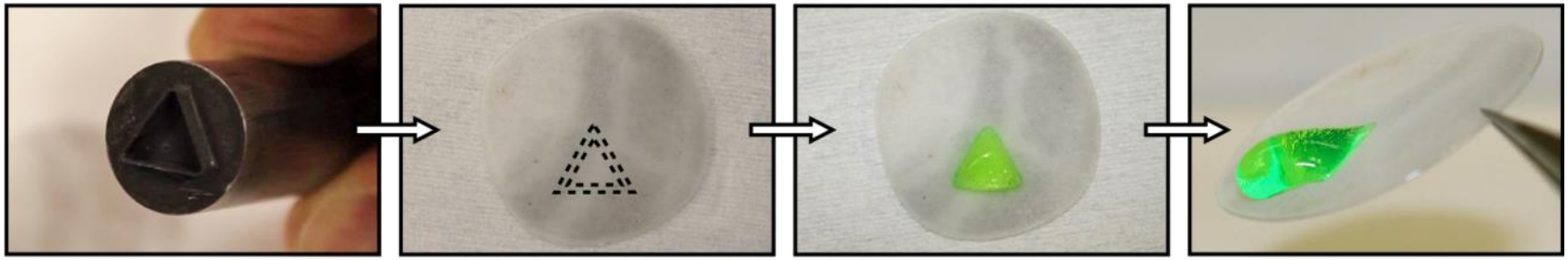




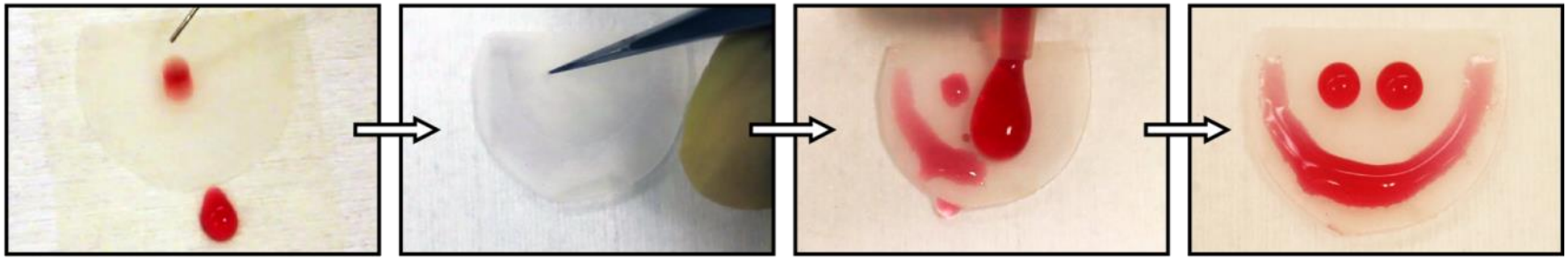
M. Röhrig (IMT, KIT)

Fluidic Applications of Nanofur

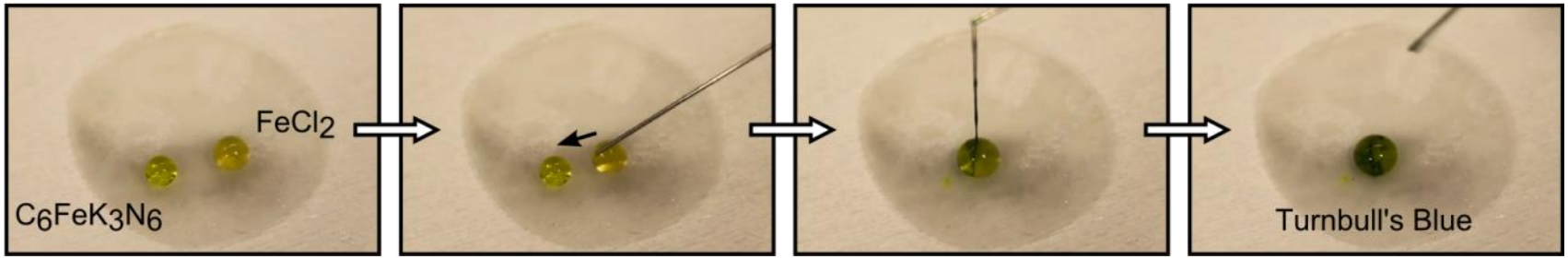
a Liquid trap



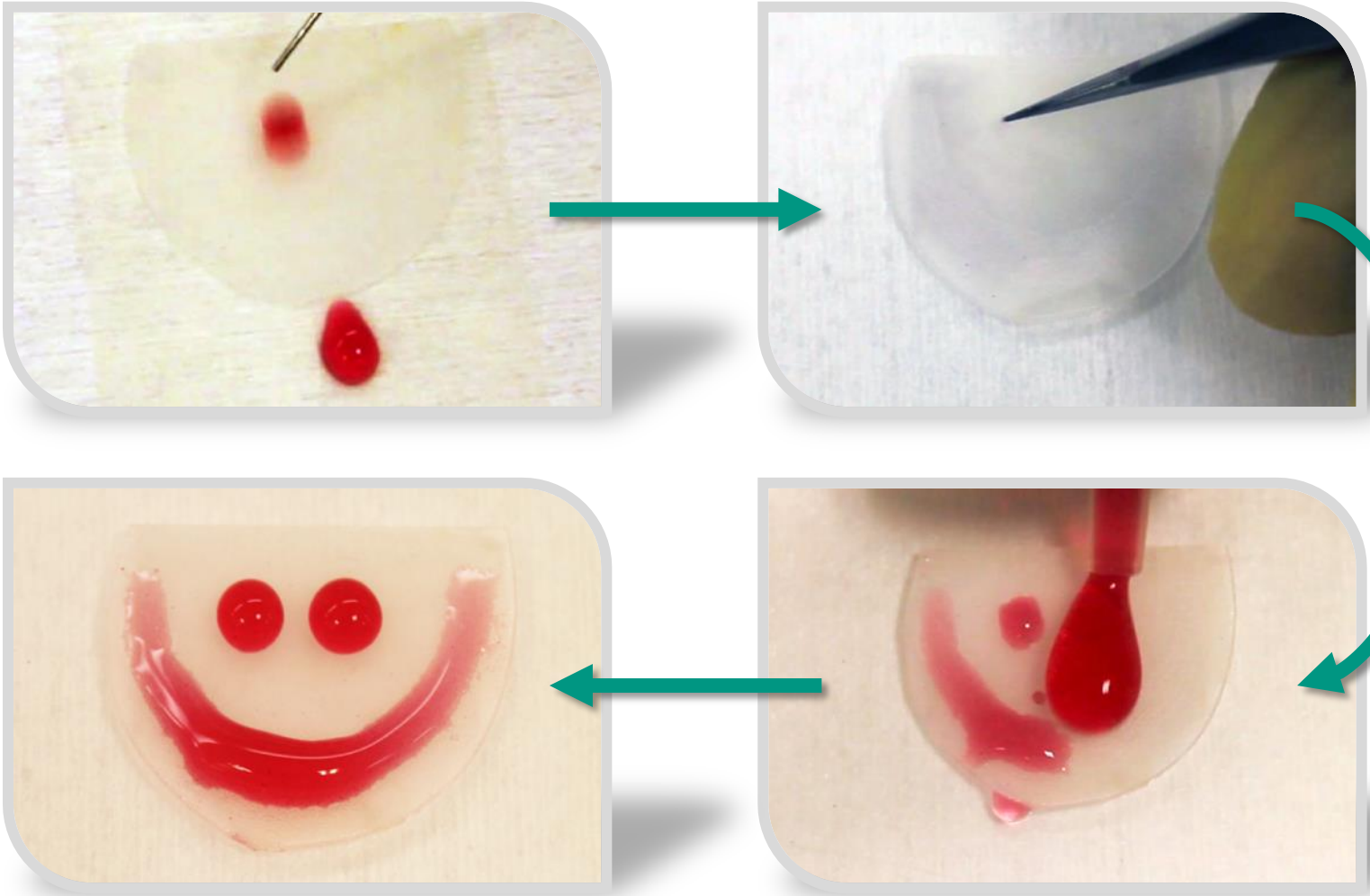
b Reservoir for liquids



c Substrate for experiments with liquids

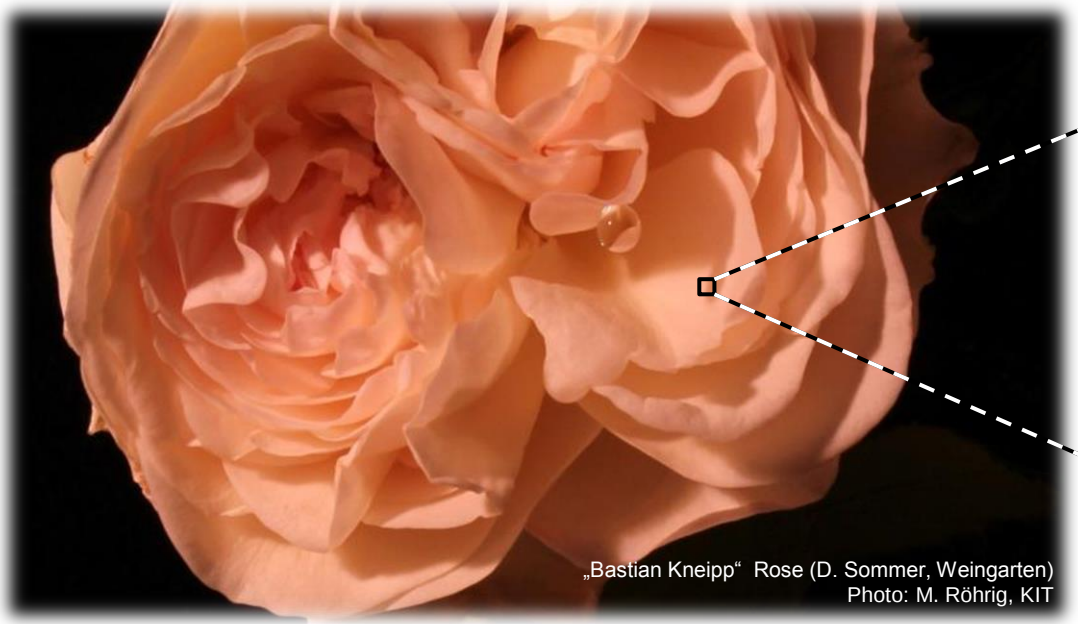


Preparation of Super-hydrophobic/Hydrophilic Areas

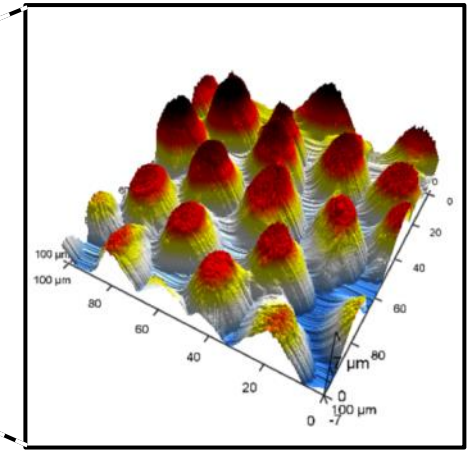


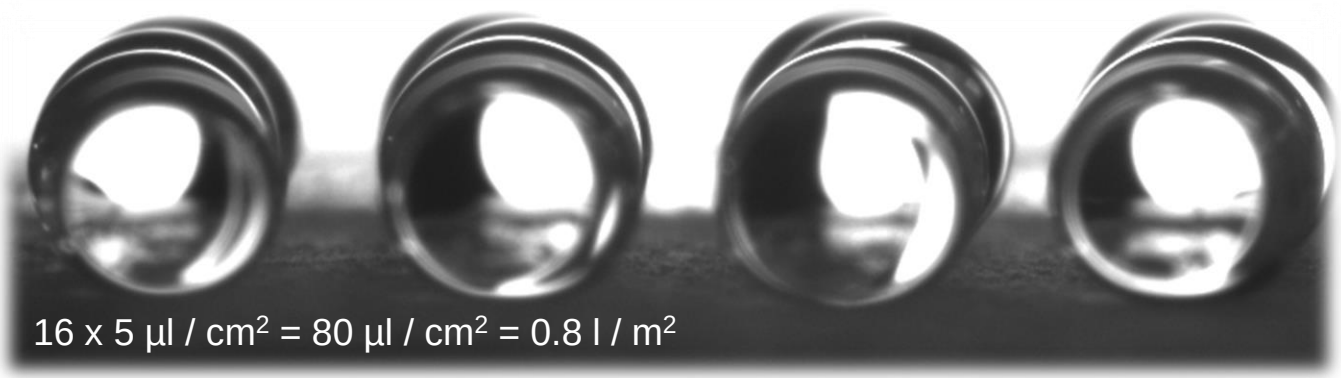
M. Röhrig (IMT, KIT)

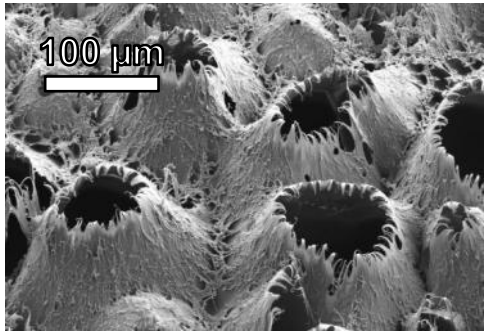
Rose Petal Effect:
Super-Hydrophobic Wenzel State



„Bastian Kneipp“ Rose (D. Sommer, Weingarten)
Photo: M. Röhrig, KIT

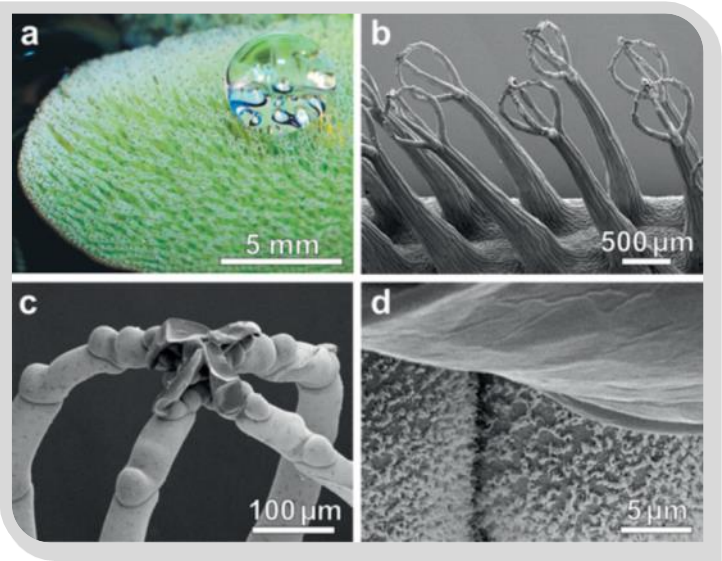


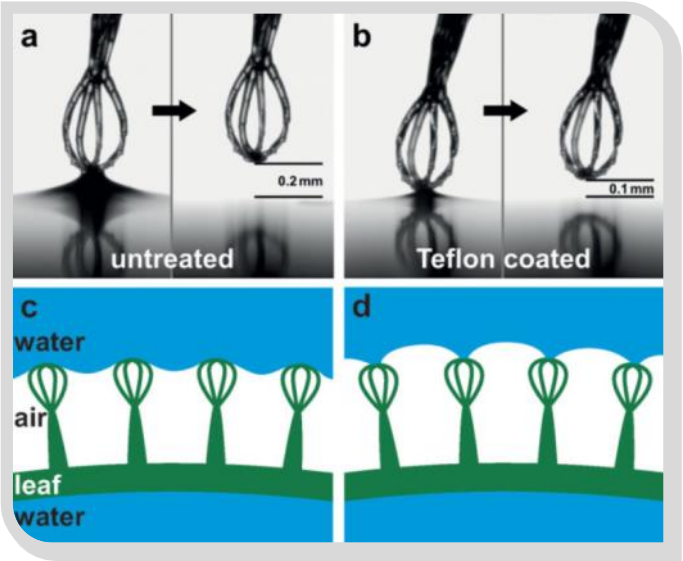




H. Louvin, T. Meier, M. Röhrig (IMT, KIT)

Hairy Structures Show Salvinia Effect

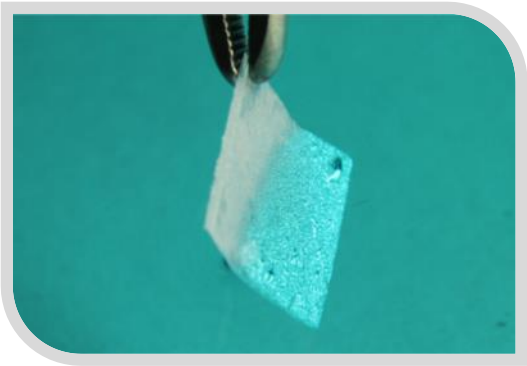




Barthlott et al., *Adv. Mat.*. **22**, 2325 (2010)

Salvinia plant

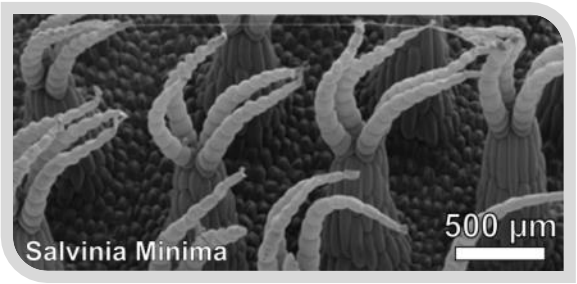
Structured PC

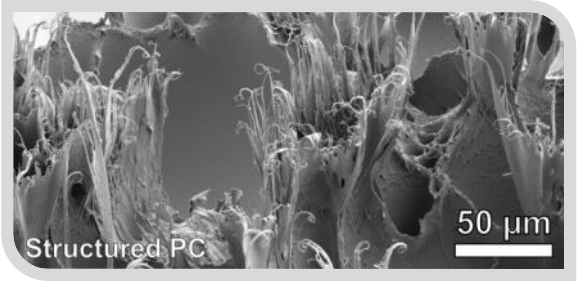


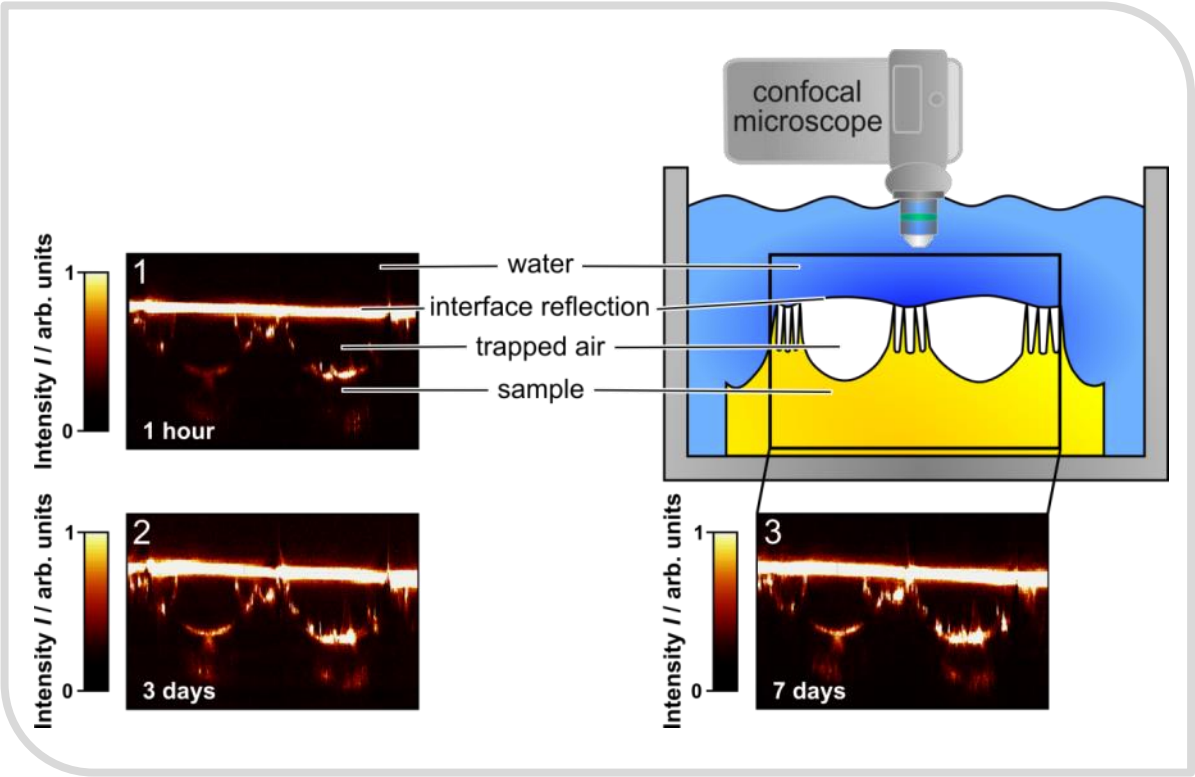
Flat PC

M. Mail (INT, KIT), M. Röhrig (IMT, KIT)

Structural Super-hydrophobicity – Special Feature: Salvinia Effect



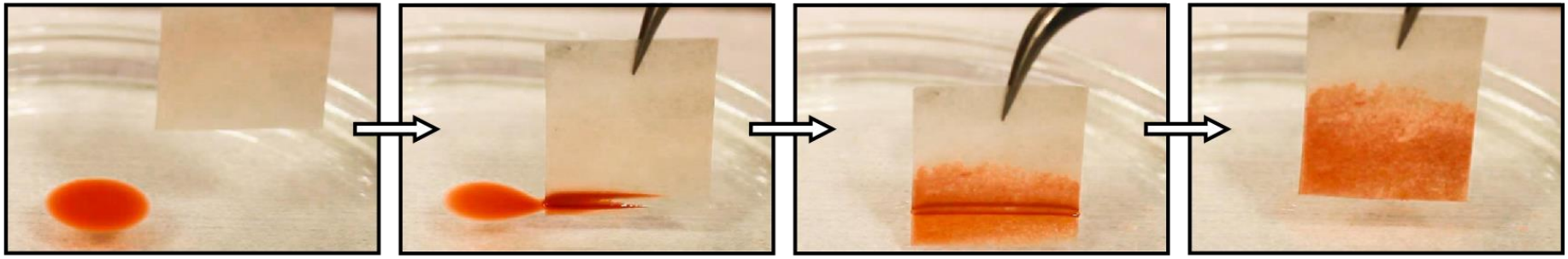




M. Mail (INT), M. Röhrig (IMT)

Seperation of Oil and Water

a Oil spill clean up

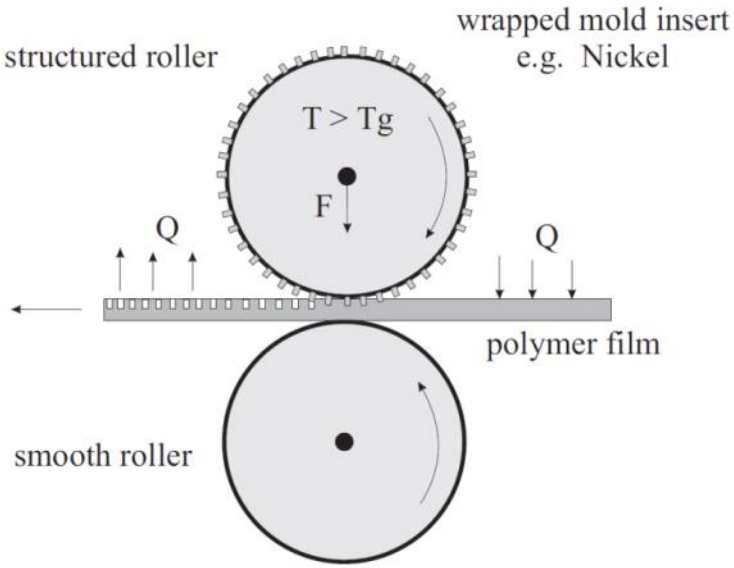


b Filtration of oil/water emulsion

Flat polycarbonate

Nanofur

Long-term Vision: Role-to-role Embossing



Role-to-role embossing

Matthias Worgull (IMT)