Mass-fabrication of microfluidic systems applicable for medical diagnostics

Jan Kafka, September 2021

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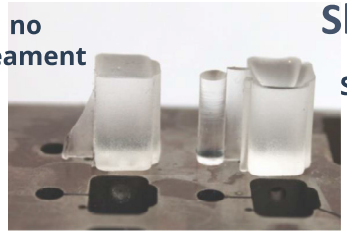
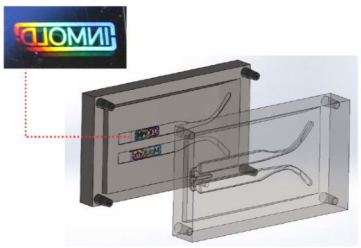


ShapeAid

ShapeAid™ treament

MoldGfrx



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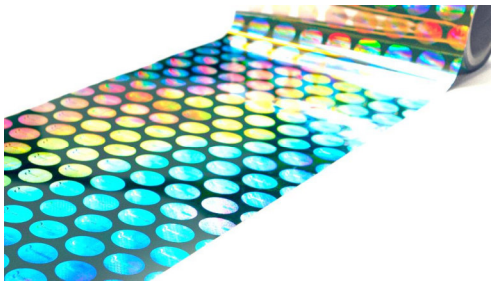
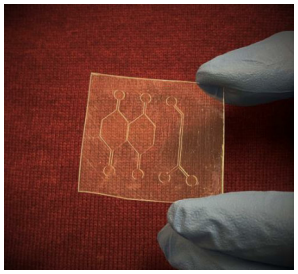
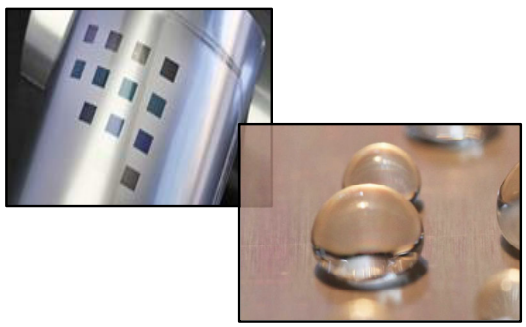
Decorative films



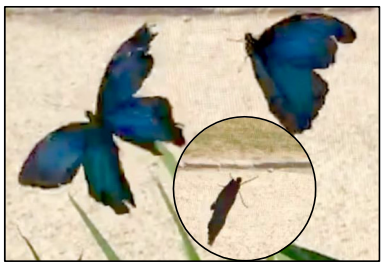
Microfluidic films

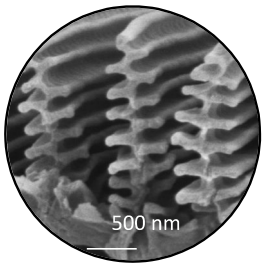


Functional films



Our Starting Point: Biomimetics – intelligent designs from nature





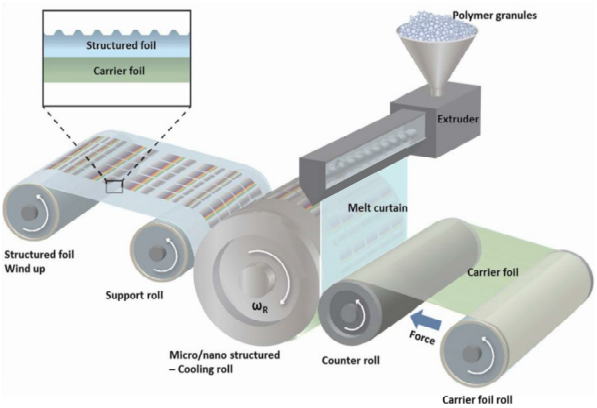
African *Morpho* butterfly, structural color

Lotus flower, self-cleaning

Changing the properties purely by changing the surface structure

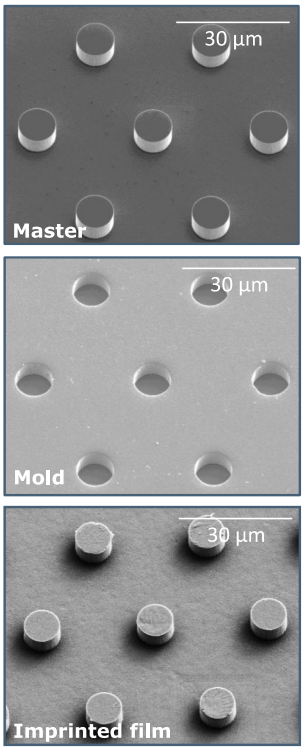
Photo of a gecko (Credit: Shutterstock/Papa Bravo), SEM image of gecko setae measured by Gorb&Autumn, SEM image of Morpho Sulkowskyi scales measured by Potyralio et.al., Photo of Nelumbo nucifera (Photo credit: Denis Tcherniak) SEM image of Nelumbo nucifera by Barthlott&Neinhuis

Roll-to-Roll mass-production

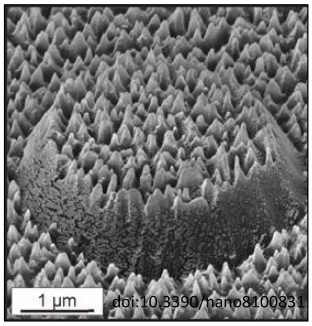


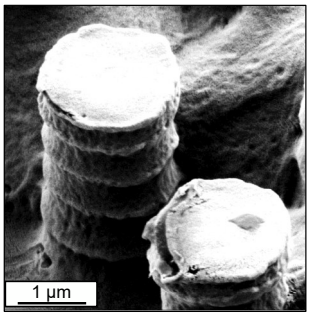
- Commercially established process for flexible packaging
- Replication of patterns in thermoplastic polymers
- Aspect ratio: commonly 1:1 (up to 1:3 depending on the structure and polymer)
- Layer thickness: 50 - 500 µm

Imprinting structures using roll-to-roll extrusion coating



- Up to aspect ratio 1:1 most of the structure types and sizes can be formed in common thermoplastic polymers
- Results above aspect ratio 1:3 have been achieved in PP for nano- and low micro-sizes, the limitation is the layer thickness
- Undercut structures can be achieved
- Hierarchical structure replication possible





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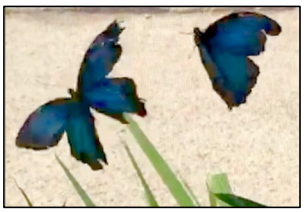
Functional films

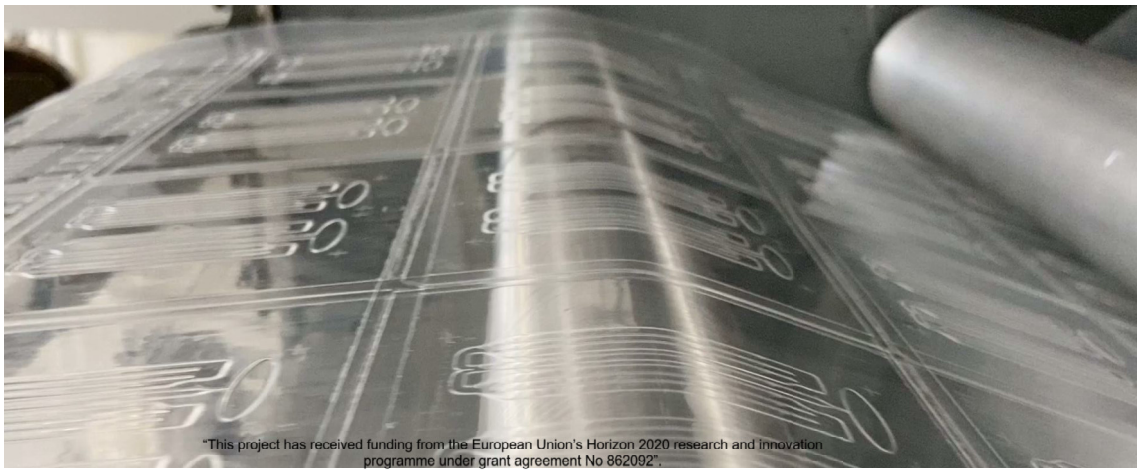


Plasmonic colors

Superhydrophobic structures

- structural colors
- optical diffractive elements
- anti-reflective structuring
- liquid guiding surfaces
- superhydrophobic structures on films and plastic parts
- light manipulating surfaces and optical elements

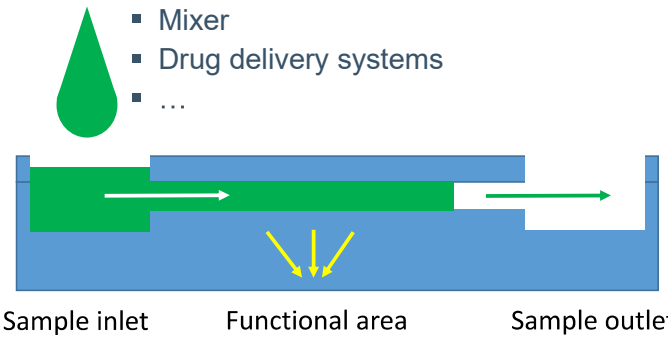
Mass-fabrication of substrates applicable for biomedical devices

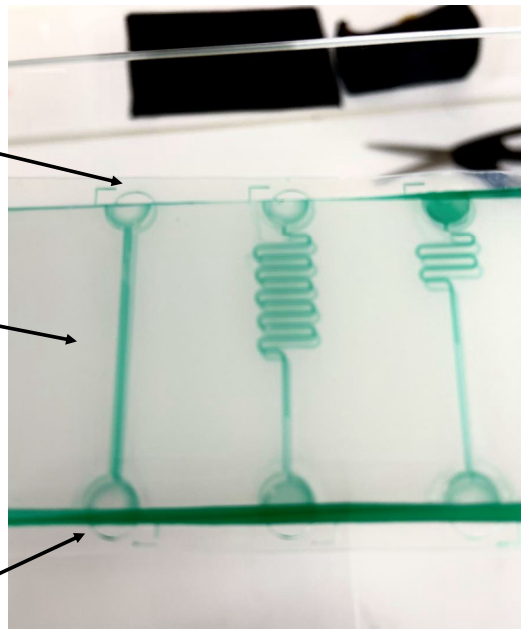


"This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 862092".

Microfluidic devices on a roll

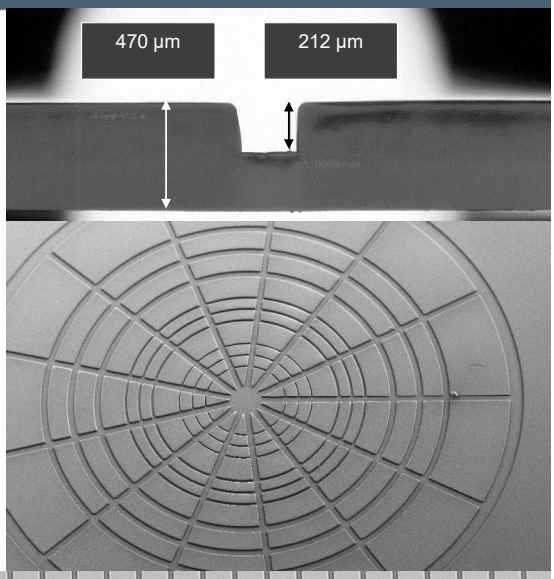
- Capability to mass-produce biomedical devices for life sciences
- Possible applications:
  - Filter
  - Sensors
  - Mixer
  - Drug delivery systems
  - …

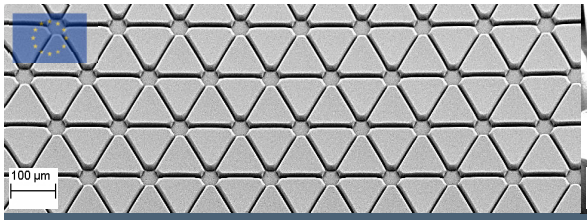


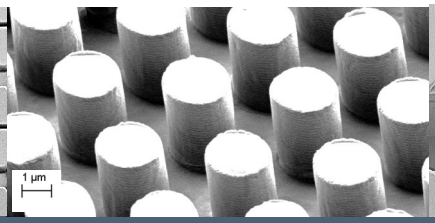


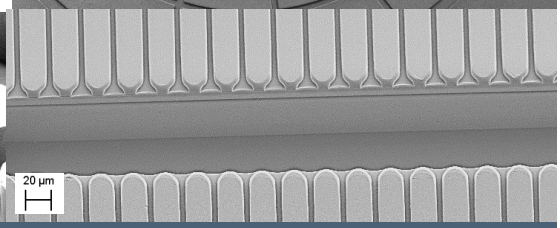
Repliciation of complex systems

- Substrate thicknesses up to 500 µm possible depending on polymer type and structure density
- For low aspect ratio structures up to 1, large directional freedom in respect to replication
- Integration of functional features as e.g. nano roughness, micro pillars or pits into channel possible
- Multiple level structures applicable for multichannel networks or energy directors









Replication test package

- Characterisation of provided master design in Silicon
- Fabrication of production tools (shims) for extrusion coating replication
- Extrusion coating replication test using a selected polymer
- Analysis of best replicated samples
- Report with summary of analysis results
- Delivery of scissor cut arcs for further inspection at customer site

Mass-fabrication steps for biomedical devices:

1. Pattern origination
2. Pattern replication
3. Biofunctionalization
4. Application of a lid for closed systems
5. Cutting out in- and out-lets
6. Connecting to a flow system

NextGen Microfluidics

"This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 862092".

Open Innovation Test Bed: NextGenMicrofluidics

NextGen Microfluidics
DT-NMPB-03-2019
GA no. 862092

- Open European test bed with 21 partners from 8 EU countries
- Project lead by JOANNEUM RESEARCH and BioNanoNet
- Covers the entire value chain from design to manufacturing of microfluidic devices

Design & Simulation
BIONIC SURFACE TECHNOLOGIES

Materials
condensia
micro resist technology

Electronics manufacturer
Infineon

Bioprocess
NST

Process development
scienion ENABLING LIFE SCIENCE
INMOLD
temicon micronano solutions
RESCOLL Société de Recherche

Microfluidics development & manufacturing
bi.FLOW systems biofluidic integration
micronit microtechnologies

Medical senors
Erba Technologies Austria GmbH
Erba Mannheim
GENSPEED BIOTECH

Cell culture solutions
ibidi cells in focus
Innoprot Speeding up drug discovery

Research
tecnalia Inspiring Business
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BRFAA
BNN
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Open Innovation Test Bed: NextGenMicrofluidics

NextGen Microfluidics
DT-NMPB-03-2019
GA no. 862092

Open for broad range of applications

DEMO CASE 1
Biosensors for Food Safety Monitoring and Medical Diagnostics

DEMO CASE 2
Sars-CoV-2 antibody detection

DEMO CASE 3
Smart Phone Enabled Home Diagnostics for Potassium in Blood

DEMO CASE 4
Cell Culture Devices for Pharmaceutical Testing

DEMO CASE 5
Sensors for Bio-Process Monitoring

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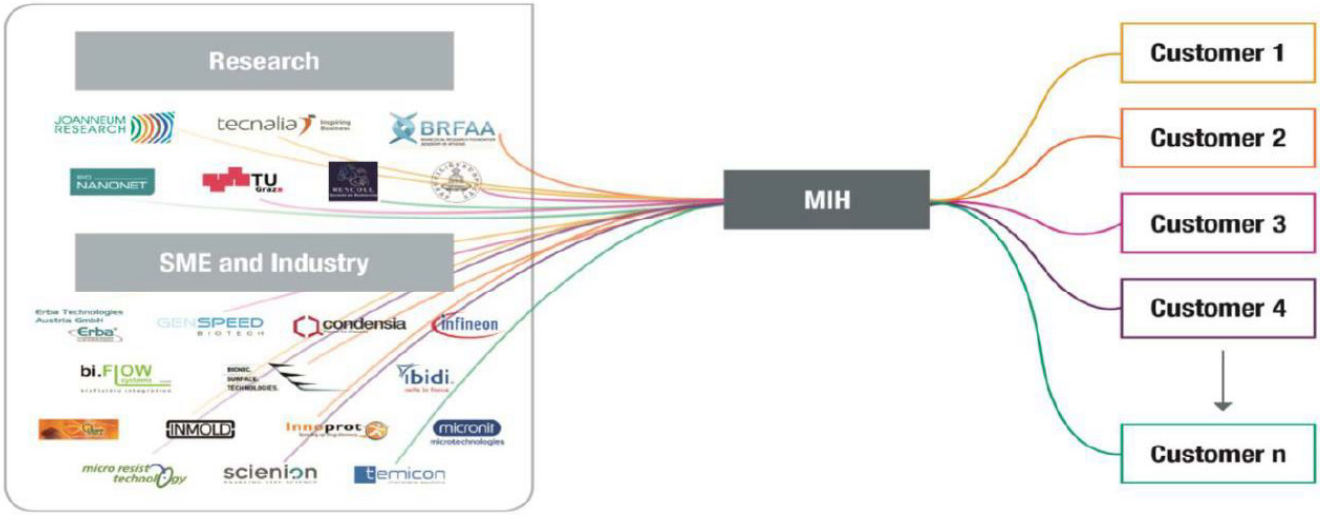
Microfluidics Innovation Hub (MIH):

- single entry point to a wide range of existing cutting edge microfluidic technologies



Get in touch: https://www.nextgenmicrofluidics.eu/microfluidics-innovation-hub/

R&D company, founded in 2007
Located north of Copenhagen
Focus: surface coatings and patterning services for injection molding and R2R processes

Cleanroom mastering techniques

- Lithography (UV, DUV, e-beam)
- Wet and dry etching processes
- Thin layer deposition
- Backend processes
- Laser machining
- Electroforming

Mold manufacturing and services

- Manufacturing of molds for R2R and micro-/nano-imprint
- Mold coatings for hardening and anti-stiction

Roll-to-roll extrusion coating

- Imprint in thermoplastics like PP, PE, PS, COC
- Wavelength-selective structures, hydrophobic, oleophobic surfaces, DOE's, liquid controlling, anti-reflective, microfluidics