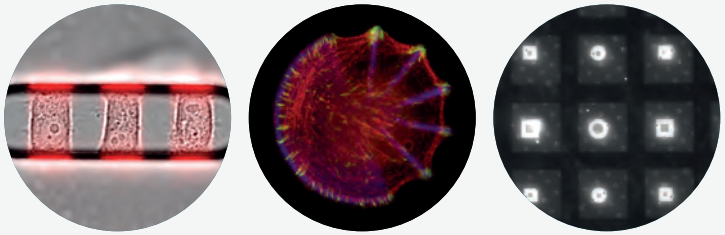
PRIMO

Better cell sample preparation
for cell biology & cryo-ET

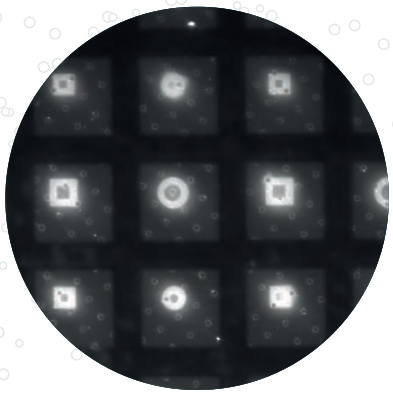


alvéole

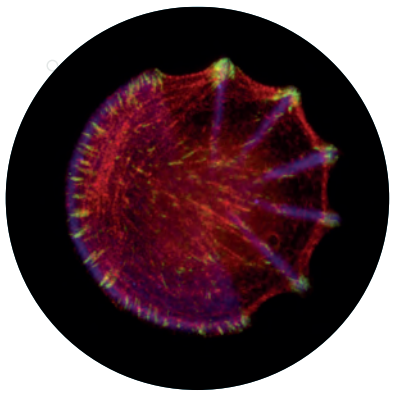
Better cell sample preparation, Better *in vitro* cell models.

One of the challenges confronting cell biologists *in vitro* is to work with **controlled and reproducible microenvironments** to more efficiently study living cells and model diseases.

PRIMO 2 contactless and maskless photopatterning platform allows to engineer custom *in vitro* microenvironments and **fine-tune their mechanical and biochemical properties**, at the micrometer scale with high flexibility and reproducibility.



ECM protein micropatterns on holey carbon EM grids (200 mesh gold grid bars) done with PRIMO maskless photopatterning for controlling the cell adhesion location. L. Engel et al., JMM, 2019



Embryonic fibroblasts from vimentin knockout mice on fibronectin + fibrinogen-A647 (blue) micropattern, actin (red) and focal adhesions (green). Courtesy of A.J. Jimenez and B. Vianay, Physics of cytoskeleton & Morphogenesis lab

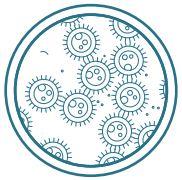
Benefits

Time saving & independence

Rapidly optimize your experimental conditions yourself.

High Flexibility

Download any images you want to structure and/or functionalize your substrate.



Versatility

Use your regular cell culture substrates: stiff or soft, flat or microstructured.

My interest is to understand the role of biophysical and topological properties of tissue microenvironments, such as stem cell niches, in modulating cell fate. Thus, the ability to precisely tune and control extracellular cell/organelle shape and geometry in 2D and 3D, is of critical importance. PRIMO has been incredibly useful in this regard!

Yekaterina A. Miroshnikova
Human Frontiers Postdoctoral Fellow
University of Helsinki, Helsinki Institute of Life Science & Max Planck Institute for Biology of Ageing, Wickström Lab

Micropatterning made easy

Cell culture substrate

Anti-fouling coating (PEG)

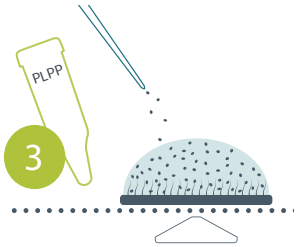


Photo-initiator

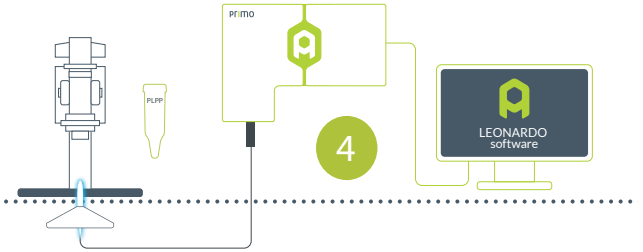
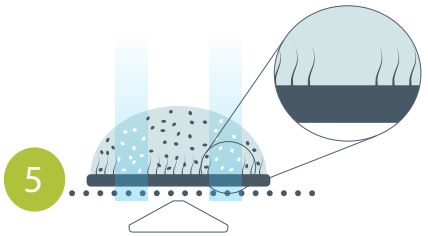
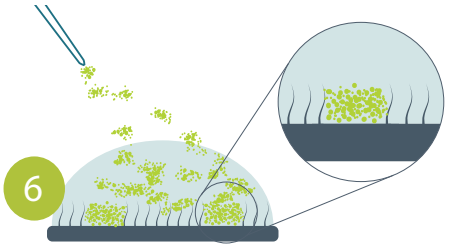


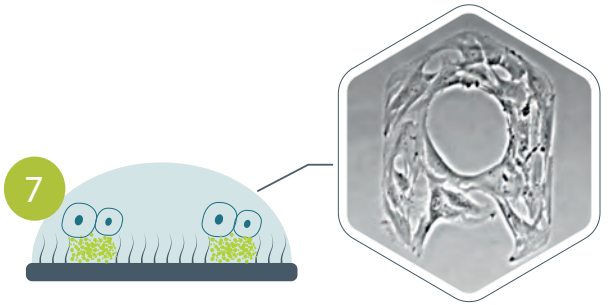
Image loading in Leonardo software and PRIMO system



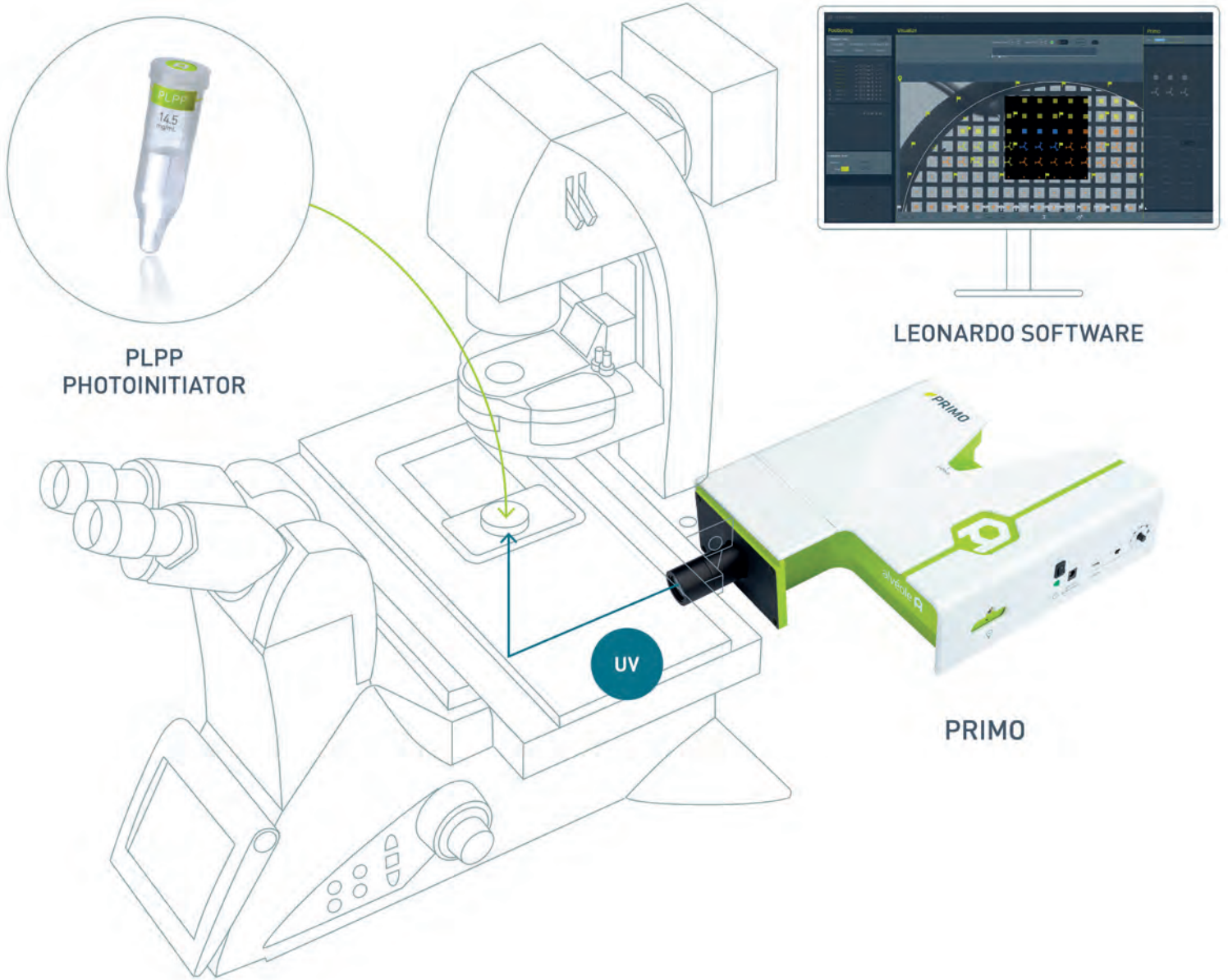
UV illumination
(λ=365nm, 0.5 to 20 sec)



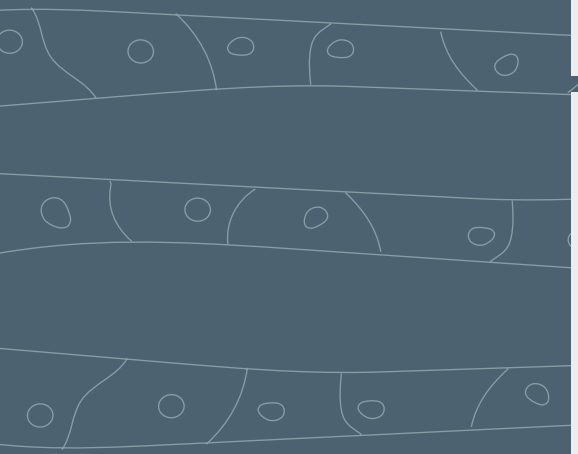
Protein micropatterning



Cell adhesion


PLPP
14.5
mg/mL
PLPP
PHOTOINITIATOR
LEONARDO SOFTWARE
PRIMO
UV
PRIMO

Unrivalled performance



GRADIENTS

256

gray levels

MULTI-PROTEIN

3

depending on experimental conditions

Range of 10+ proteins used daily by our users

HIGH RESOLUTION

1.2 µm

over the entire illuminated field*

**Approximately 500x300µm, 20x objective.*

ALIGNMENT

on microstructures* or micropatterns

**Automatic detection and patterns positioning*

COMPATIBLE

standard substrates*

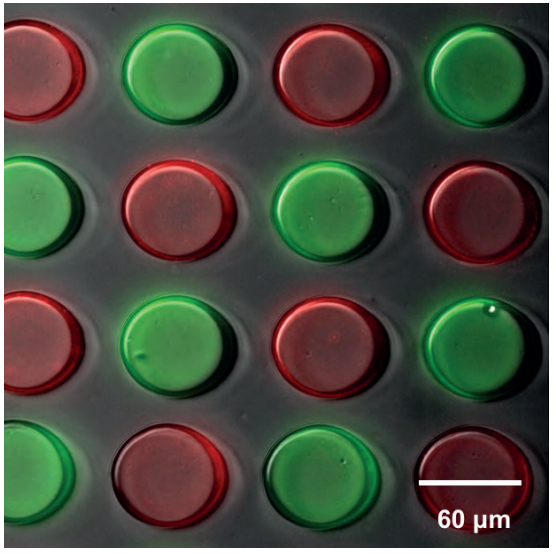
**stiff or soft, flat or microstructured.*

FAST

0.5 sec

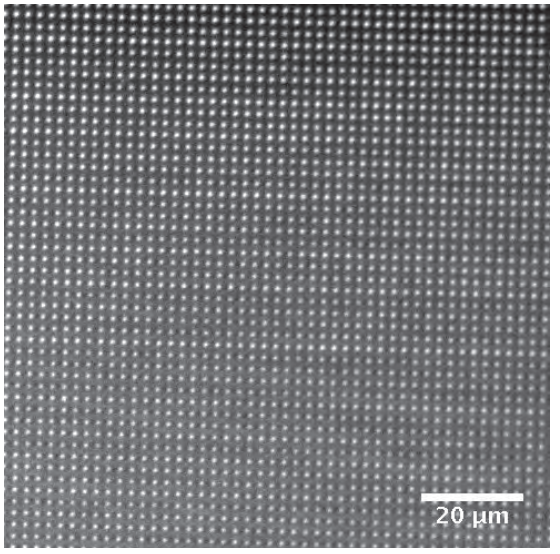
for a full field pattern*

**Approximately 500x300µm, 20x objective, with PLPP Gel.*



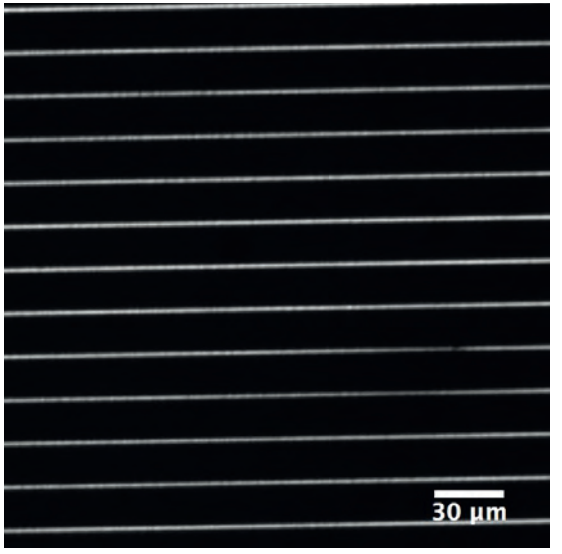
ALIGNMENT & MULTI-PROTEIN:

Sequential photopatterning of Fibrinogen -A488 in green and Protein A-A647 in red onto PDMS micropillars microfabricated with PRIMO.



HIGH RESOLUTION:

Epifluorescence microscopy image of 1,5µm dots (spaced by 1,5µm) of ProteinA-488 on PDMS.



HIGH RESOLUTION:

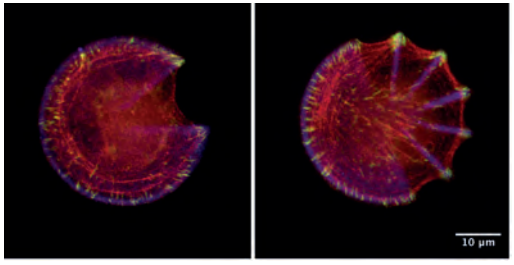
Epifluorescence microscopy image of 2 µm horizontal lines of ProteinA-488 on glass.

GRADIENTS:

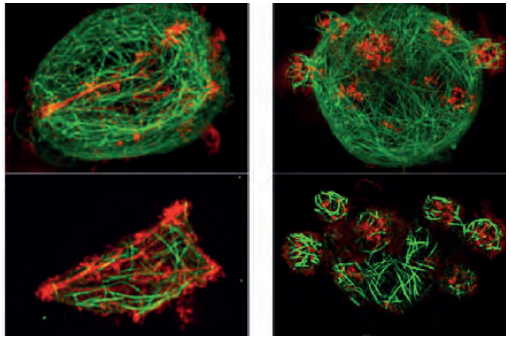
Epifluorescence microscopy image of a gradient of Fibrinogen-A488 on a glass coverslip.

Applications

Cytoskeleton studies

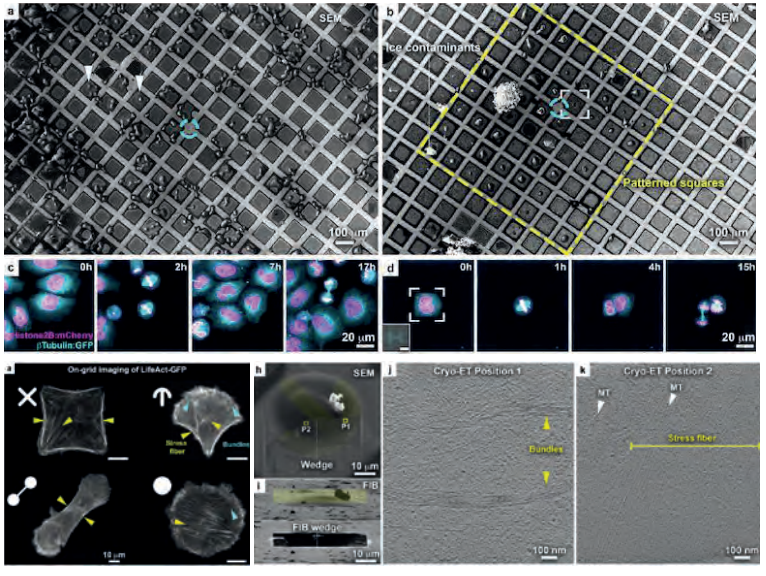


Embryonic fibroblasts from vimentin knockout mice on a fibronectin + fibrinogen pattern (blue), actin (red), focal adhesions (green). Courtesy of A.J. Jimenez and B. Vianay, Physics of cytoskeleton & Morphogenesis lab.



«A mechano-signalling network linking microtubules, myosin IIA filaments and integrin-based adhesions» N.B.M. Rafiq et al., Nat. Mat., 2019

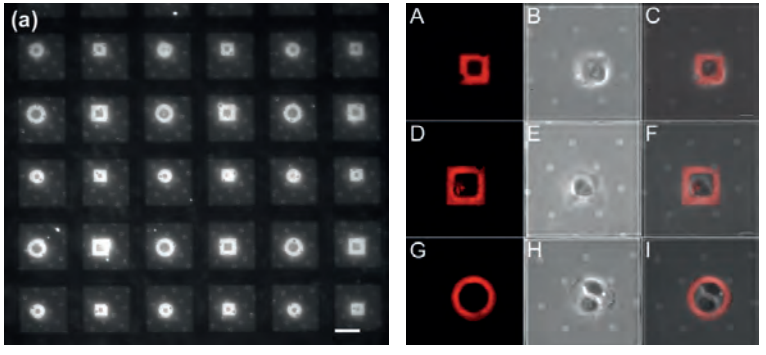
Cryo-ET cell sample preparation



(a) HeLa cells on standard gold-mesh grid SiO2 holey film. Arrowheads: cells optimally positioned for FIB-milling. (b) HeLa cells on a gold-mesh holey grid with 20 µm diameter disk fibronectin patterns. (c-d) HeLa cells seeded on a (c) control and (d) patterned (H-shaped) gold-mesh grids with SiO2 (R1/20) holey film. FOV: one single grid square.

(j-k) Tomographic slices of positions 1 and 2 indicated in (h). Actin bundles and internal stress fibers -indicated in (a)- are found in locations expected according to the actin map in a crossbow-shaped RPE1 cell.

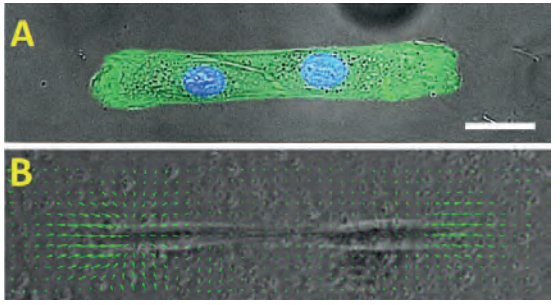
M. Toro-Nahuelpan et al., Nature Methods, 2019



Left: Gelatin hollow squares and circles patterned between the gold grid bars of 200 mesh holey carbon EM grids. Scale bar, 50 µm.
Right: PtK1 cells plated on rhodamine-fibronectin square and patterns. Scale bar, 10µm.

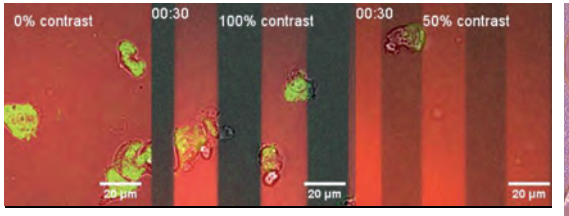
L. Engel et al., J. Micromech. Microeng., 2019

Force Measurement



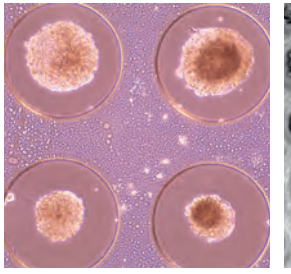
Two airway smooth muscle (ASM) cell ensemble on a rectangular gelatin micropattern (green) done with PRIMO on Nusil gel, scale bar = 25µm.
S. R. Polio et al., Scientific Reports, 2019

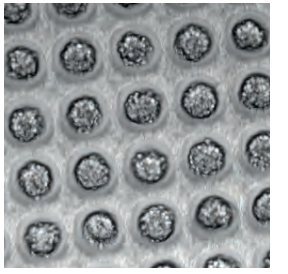
Cell Migration



Left: negative control substrate with 0% adhesion contrast; Middle: positive control substrate with 100% adhesion contrast; Right: substrate with 50% adhesion contrast.
In green: cell adhesion patch shown by RICM; In red: substrate with higher adhesion; In grey: bright-field images showing cell body.
X. Luo et al., BioRxiv, 2019

Spheroid Formation

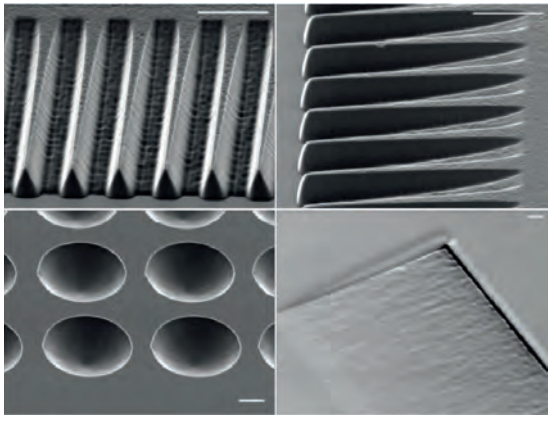




Huh-7 cells forming spheroids on micropatterns of fibrinogen-A488 (wells Ø=500 µm, micropatterns Ø=300 µm).

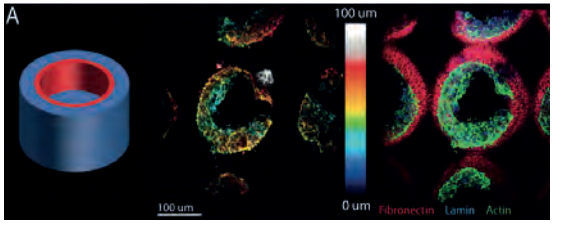
Spheroids of HEK cells in hydrogel microwells (Ø=100 µm, H=175 µm) photopolymerized with PRIMO. Courtesy of A. Pasturel and V. Studer.

Microfabrication



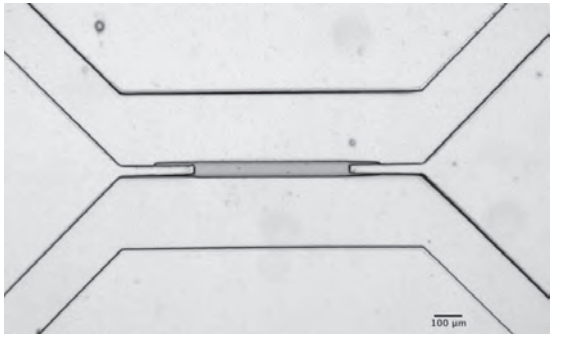
SEM images of structures microfabricated with ma-P 1275G resist and PRIMO. Scale bar = 30 µm

Hydrogel Structuration



Left panel: scheme of topographically (blue) and chemically (red) photopatterned hydrogels. Middle panel: COS-7 cells seeded on the gel (Z-scale). Right panel: patterned fibronectin (red), actin cytoskeleton (green) and nuclear envelope (blue).
A. Pasturel et al., BioRxiv, 2018.
doi.org/10.1101/370882

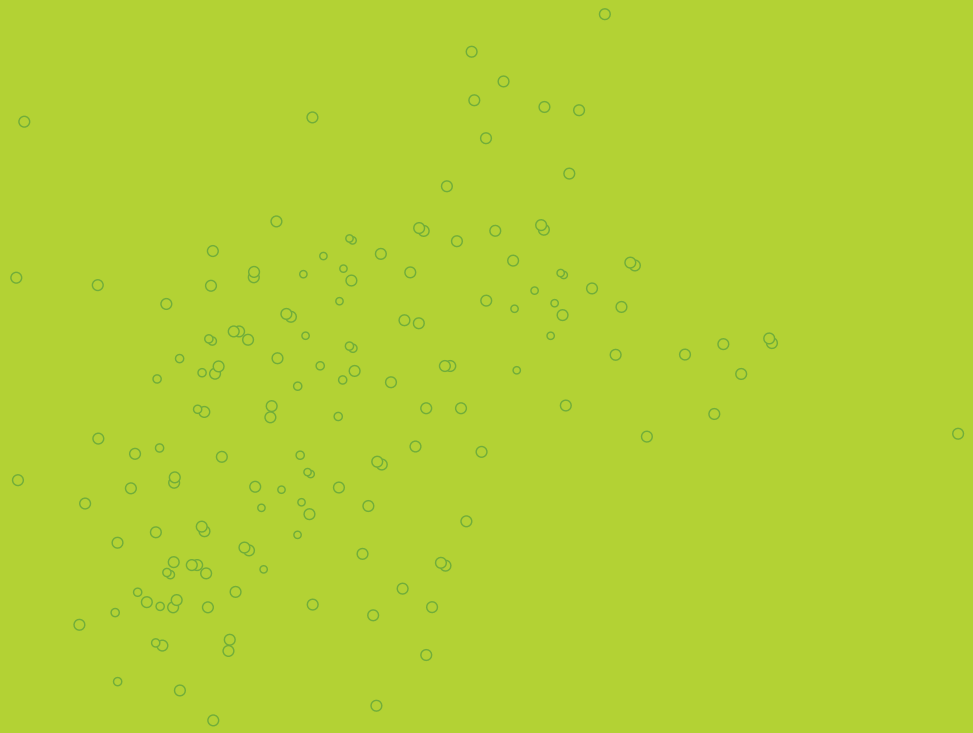
Microfluidics



Photopatterning with PRIMO system of pressure-resistant hydrogel-based permeable membrane within PEGDA microfluidic chips. Courtesy of J.-B. Salmon.

A complete bioengineering platform

We have developed complementary products to give you
optimized and personalized control over your experimental conditions.



Nomos
Automation
of Experiments

Leonardo
Photopatterning
Software

PRIMO

Stencil
Multi-Well
Solution

PLPP
Photoactivatable
Reagent

alvéole

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