Career path in STEM

Laser Bioprinting

Ioanna Zergioti

School of Applied Mathematical and Physical Sciences,
National Technical University of Athens
and acting CEO PhosPrint

NATIONAL TECHNICAL UNIVERSITY OF ATHENS

- 8 engineering schools and 1 applied mathematical and physical sciences school.
- 540 members as academic staff.
- 8500 undergraduate students and graduate students.

My career path

1988 – Bachelor in Physics University of Crete

1996 – Semester at UC Berkeley, USA

1997 – PhD, FORTH

1998 – Post-doc at MPI, Gottingen, DE

1999 – Post-doc at Philips, NL

2000 – FORTH

2003 – NTUA/School of Applied mathematics and physical Sciences Lecturer

2014 – NTUA/School of Applied mathematics and physical Sciences Associate Professor

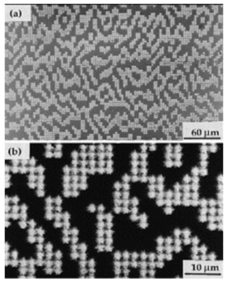
2014 – 2nd award at Industrial Technologies

2016 – 2nd Novelty award at the 3rd competition SEV&EUROBANK «Greece Innovates»

2019 – NTUA/School of Applied mathematics and physical Sciences, Professor

2019 – PhosPrint PC Spin-off company

2020 – SPIE, San Francisco, 3/2/2020 3D Printing Award



I. Zergioti *et. al.* *ASS*, **127-129**, 601 (1998)

Printing of DNA molecules on glass

I. Zergioti *et al.* APL, **86**, 163902 (2005)

Gender bias in Academia

"Gender disparity exists in higher academic positions, despite an almost equal representation across disciplines at earlier career stages"

J. Gruber et al., **The Future of Women in Psychological Science,** Perspect. Psychol. Sci., 16 (2020), pp. 483-516

Personal examples

- I was **the only female PhD student** when I joined the group (15 members) for the fall semester 1996, at the UC Berkeley
- My supervisor at the Max –Planck Institute admitted at the lab technician that **he thought I was a man** when he selected my cv for the post doctoral position back to 1998.
- I was the **only female engineer** (out of 70) when I did my post doct at Philips CFT in the NL
- **5 female Professors** in my School, at the NTUA. Naval Engineering school very recently elected **the first female professor since 1969**!

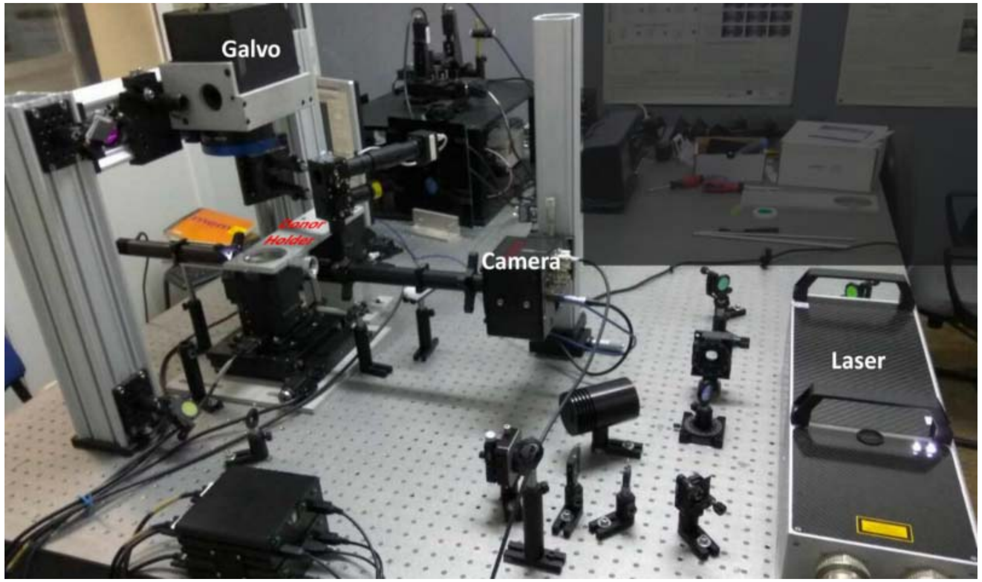
On the positive side

- The EC has a great equally opportunity policy for up to 40%
- I recently joined the EIC Women Leadership Programme 2021-2022

Laser Printing and Materials Processing Lab

1. Laser Printing Lab, for the development of flexible electronics
2. Laser Printing Lab, for tissue engineering and regenerative medicine applications

The group has > 50% gender balance



Publicity

Σάββατο 1 Δεκεμβρίου 2012 — ΕΠΙΣΤΗΜΗ - ΤΕΧΝΟΛΟΓΙΑ — Η ΚΑΘΗΜΕΡΙΝΗ • 15

«Εκτυπώνουν» ευλύγιστα φωτιστικά

Τι υπόσχεται η τεχνολογία του Μετσόβιου Πολυτεχνείου, στον κλάδο των οργανικών ηλεκτρονικών

Με τη νέα μέθοδο θα κατασκευάζονται πιο αποτελεσματικοί βιοαισθητήρες

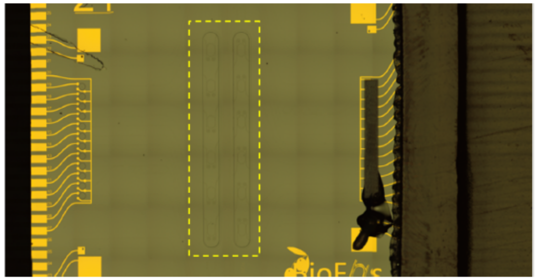
Προτάσεις

ΧΡΙΣΤΟΥΓΕΝΝΑ
Τι ήταν το αστέρι της Βηθλεέμ

ΤΕΤΡΑΗΜΕΡΟ ΦΕΣΤΙΒΑΛ
Η «γιορτή» της Επιστήμης

ΣΤΟ ΚΟΚΚΙΝΟ — Η ΑΥΓΗ

Ένα εργαστήριο μέσα σε chip για τον έλεγχο της ποιότητας τροφίμων



Ανθυγιεινοί κίνδυνοι σε υγιεινές τροφές...

Ο τομέας τροφίμων και ποτών, εκτός του ότι αποτελεί μια σημαντική διάσταση της ποιότητας ζωής, είναι και ένας σημαντικότατος πυλώνας της ευρωπαϊκής οικονομίας. Ζωτικής σημασίας είναι ο έλεγχος της ποιότητας των παραγόμενων τροφίμων όσον αφορά τυχόν μόλυνσή τους από τοξίνες και μικροοργανισμούς, ο οποίος αποκτά ακόμη μεγαλύτερη σπουδαιότητα όταν ο έλεγχος αφορά τρόφιμα πρώτης ανάγκης ή μεγάλης διατροφικής αξίας όπως τα γαλακτοκομικά και τα γεωργικά προϊόντα (φρούτα, λαχανικά και ξηροί καρποί).

Ειδικότερα στις σύγχρονες κοινωνίες υπάρχει μεγάλη ανάγκη για αποτελεσματικά μέσα παρακολούθησης της ποιότητας των παραγόμενων προϊόντων και της πιστοποίησης ασφαλούς κατανάλωσής τους. Ο λόγος είναι ότι κατά τον 20ό αιώνα η επιμόλυνση των τροφών κατέστη περισσότερο συχνή και επικίνδυνη καθώς τα κρούσματα δεν αφορούν πλέον μόνο φυσικές τοξίνες και μικροοργανισμούς, αλλά και μια πλειάδα χημικών παραγόντων όπως εντομοκτόνα, φυτοφάρμακα, αντιβιοτικά και βαρέα μέταλλα.

Από τα μεγάλα εξειδικευμένα εργαστήρια, στα εργαστήρια μέσα σε chip

Το πιο σοβαρό πρόβλημα που αντιμετωπίζει ο έλεγχος της ποιότητας των παραγόμενων τροφίμων έγκειται στο ότι οι μεθοδολογίες που υιοθετούνται για την ανίχνευση μολυσματικών παραγόντων σήμερα βασίζονται σε αναλυτικά

MIT Technology Review — Featured | Topics | Newsletters | Events | Podcasts

Uncategorized

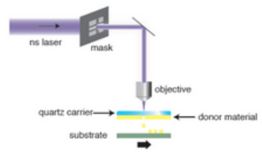
Physicists Laser Print Conducting Polymer Circuits

Solvents can cause problems in the manufacture of conducting polymer circuits. The answer is laser printing, say researchers

by **Emerging Technology from the arXiv** — November 16, 2012

Conducting polymers are plastics that carry current. This is an emerging technology that is beginning to have a significant impact on areas ranging from photovoltaics and printed circuit boards to batteries and biological sensors.

The advantages of plastic conductors are many. They are cheap, flexible and light. They are also simple to make and to shape into useful circuits. At least in theory.

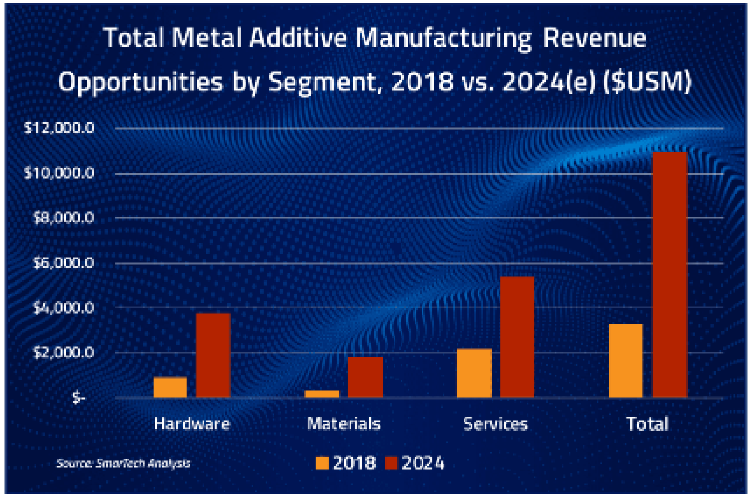


In practice, most manufacturing techniques have subtle drawbacks that are not easy to overcome. For example, these techniques generally begin with the polymer in liquid form. It is then sprayed, spun or inkjet-coated onto a substrate.

2 free stories remaining

Additive Manufacturing

"*Additive Manufacturing has the potential to revolutionize the way we make almost everything*" US President Barack Obama, 2013, at National Additive Manufacturing Innovation Institute (NAMII) in Youngstown, Ohio



Flexible Circuits

Stretchable sensors

Touch Screens

Why bioprinting?

BIOPRINTING

Man-made organs could reshape life sciences

Bioprinting enables the creation of living biological tissue and organs through the layering of living cells and supportive biomolecules.

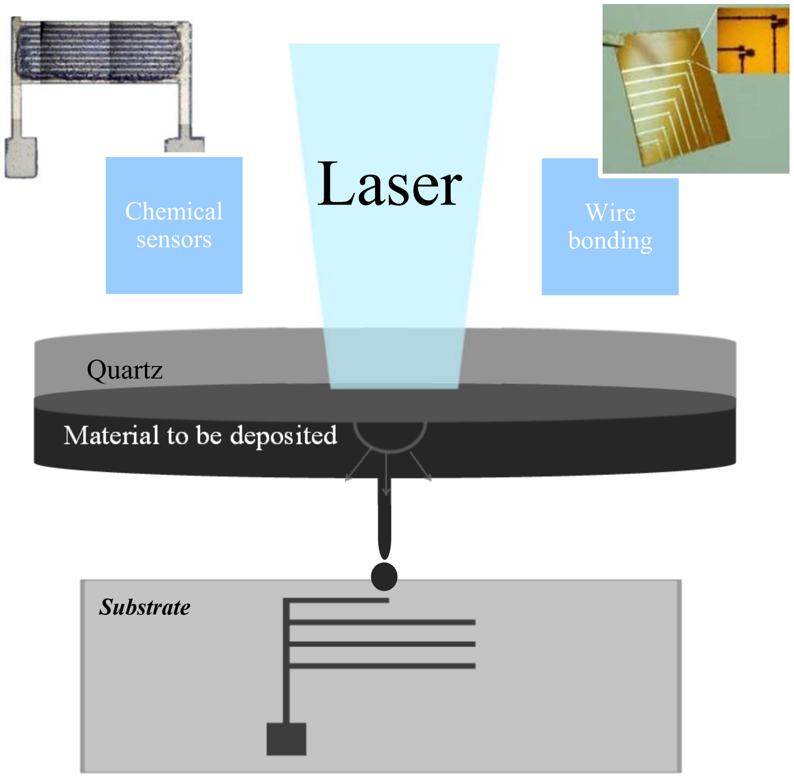
Source: CBINSIGHTS

"The 3D bioprinting industry is predicted to be valued at $1.82 billion USD by 2022"

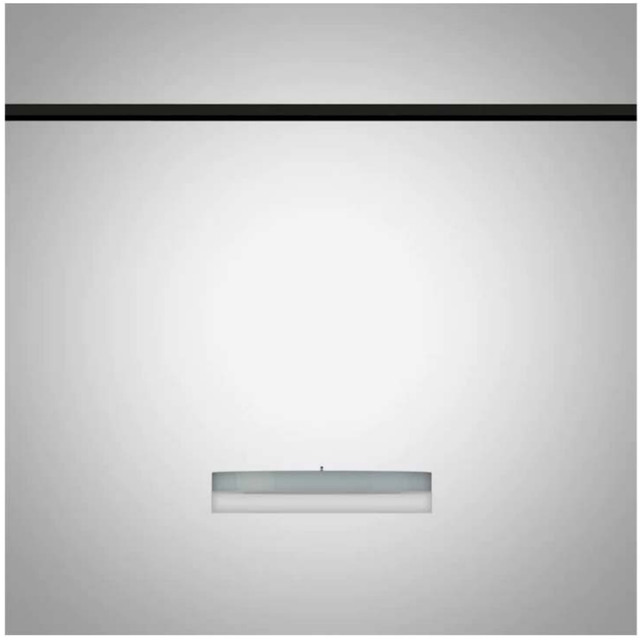
Source: Grand View Research, 2021

Source: Forbes, 2021

Laser Induced Forward Transfer



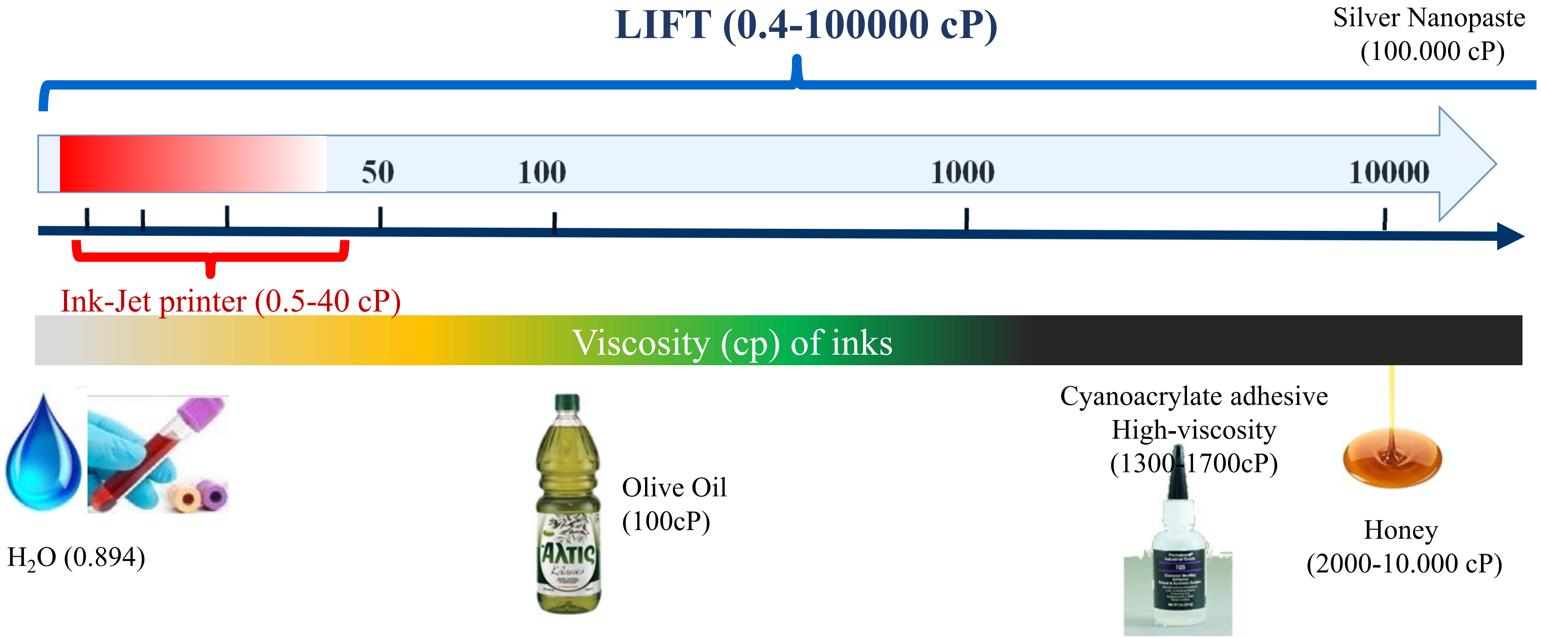
- Printing in solid and liquid phase
- Spatial resolution down to 10 μm for liquid and sub-micron for solid phase
- Printing of inorganic, organic, biological materials



LIFT advantages

- Drop-on-demand printing, non-contact printing
- Compatible with a wide range of materials
- No limitations in materials viscosity (0.4–100000cP)
- No use of nozzles, no additives
- Receiver substrate independent (flexible, polymer materials, etc.)

Inkjet printing typically handles low viscosity inks (1-15 mPa.s) and even with piezoelectric actuation, inks up to 100 mPa.s viscosity can be processed.



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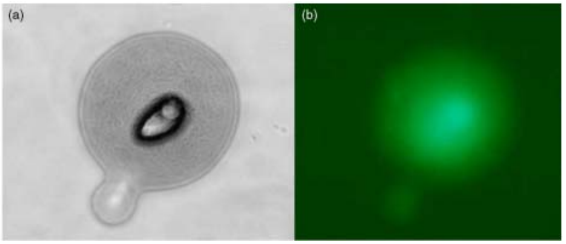
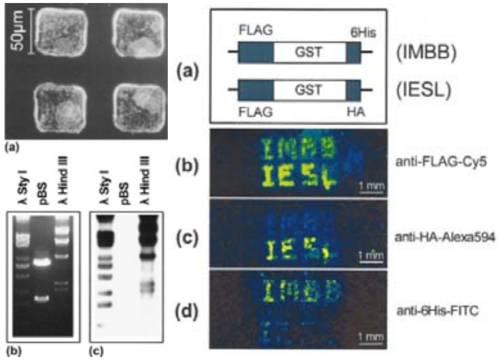
LIFT for printing of Biomaterials

BioLP™



J. Barron, et. al.
Biosensors & Bioelectronics, 20(2), 246–52, 2004.

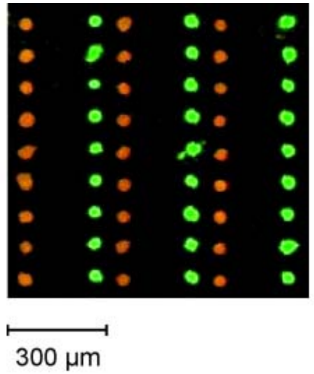
Proteins arrays



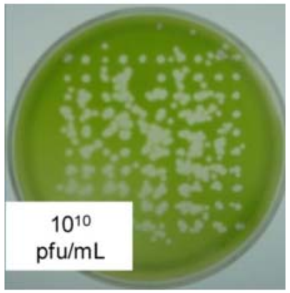
I. Zergioti et. al.
Applied Physics Letters 86(16), 163902, 2005.

DNA microarrays

Serra et al.
Applied Physics Letters ,
85 (9), 30, 2004.

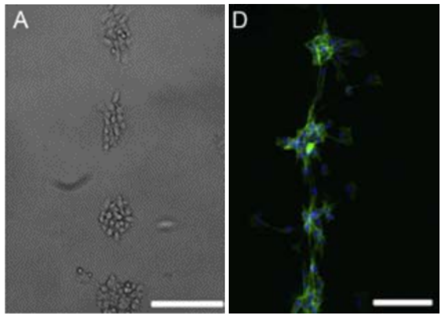


Virus



L.A. Fitzgerald et. al.,
J. Virological Methods,
167(2), 223, 2010.

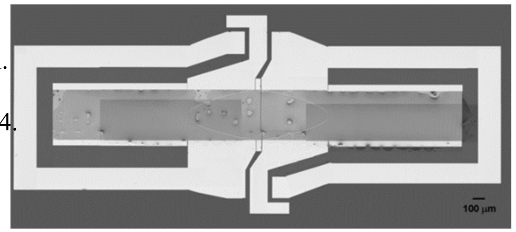
Living cells



R. Devillard et. al.
Methods in Cell Biology, 119, 159, 2014.

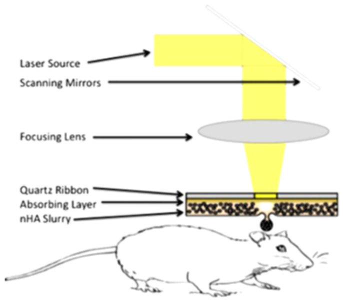
Proteins

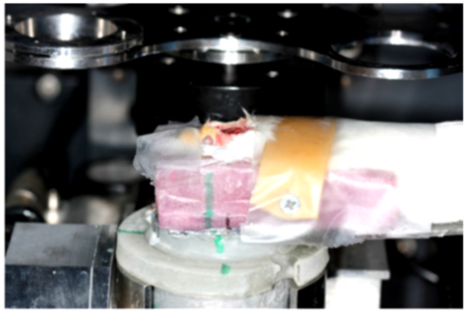
A. Palla-Papavlu et. al.
Sensors Actuators B
Chem., 192, 369, 2014.



LIFT for tissue printing

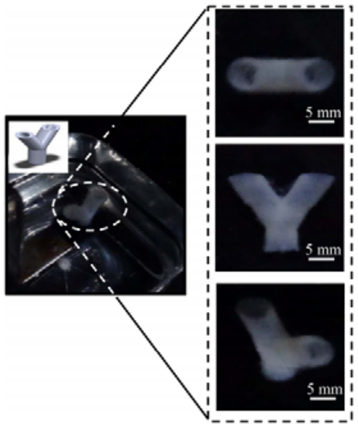
BONE-PRINTING



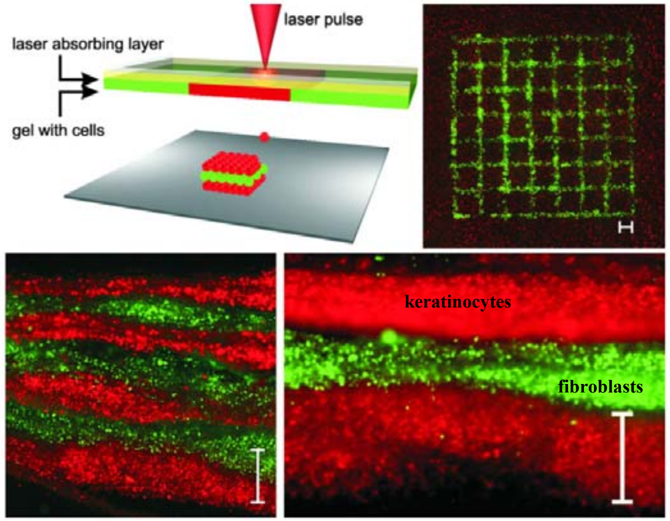


V. Keriquel et. al. **Biofabrication**, 2 (1), 014101, 2010.

R. X. et. al.
Biofabrication, 7 (4), 45011, 2015.



From DNA and protein microarrays to 3D printing of cells for tissue engineering, in vivo printing and printing of viruses

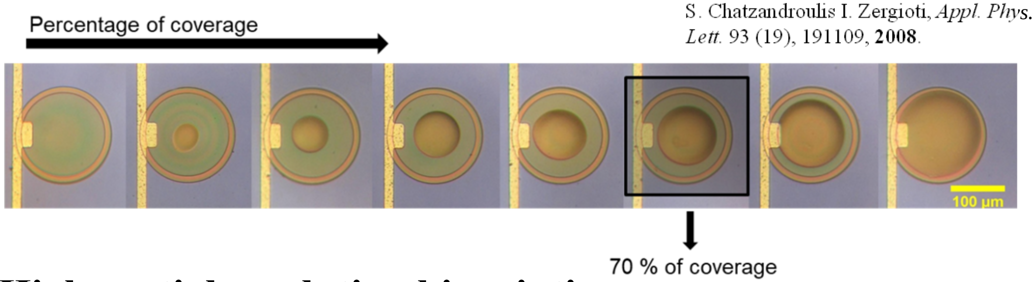


L. Koch et. al.
Biotechnology and Bioengineering, 109 (7), 1855–63, 2012.

LIFT printing @ NTUA

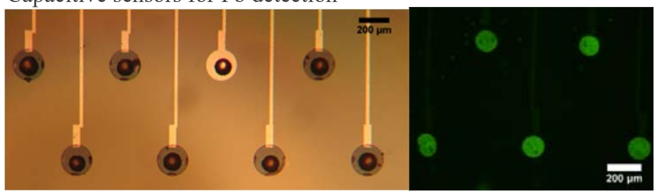
Printing Polymers-Chemical sensors

C. Boutopoulos, V. Tsouti, D. Goustouridis, S. Chatzandroulis I. Zergioti, *Appl. Phys. Lett.* 93 (19), 191109, **2008**.

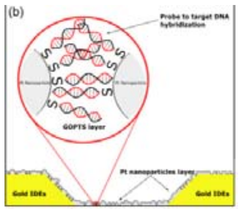


High spatial resolution bioprinting

Capacitive sensors for Pb detection



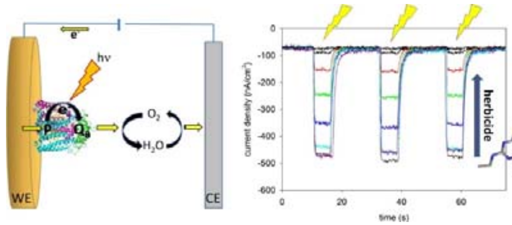
G. Tsekenis, M. K. Filippidou, M. Chatzipetrou, V. Tsouti, I. Zergioti, S. Chatzandroulis, *Sensors Actuators B Chem.*, 208, 628–635, **2015**.



Label-free DNA biosensor based on resistance change of platinum nanoparticles assemblies

E. Skotadis, K. Voutyras, M. Chatzipetrou, G. Tsekenis, L. Patsiouras, L. Madianos, S. Chatzandroulis, I. Zergioti, D. Tsoukalas, Biosensors & Bioelectronics **81**, 388–394 (2016) https://doi.org/10.1016/j.bios.2016.03.028

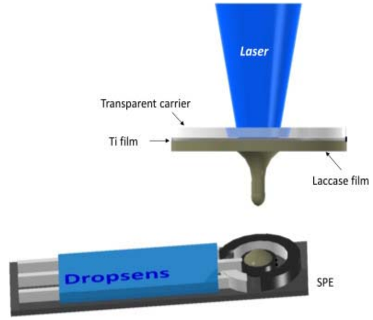
Direct immobilization of biomaterials on sensors

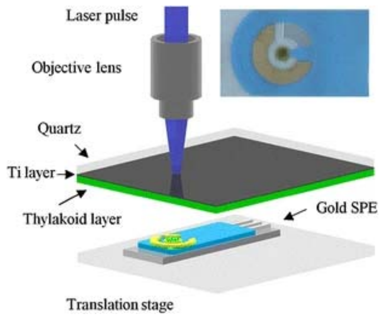


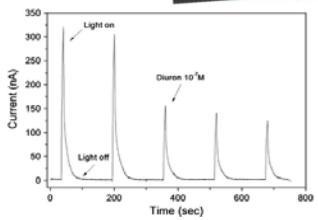
M Chatzipetrou, F Milano, L Giotta, D Chirizzi, M Trotta, M Massaouti, M.R. Guascito, I. Zergioti, Electrochemistry Communications 64, 46-50 (2016)

Enzymatic Biosensors for food applications

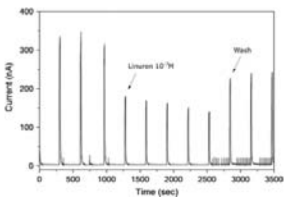
E. Touloupakis, M. Chatzipetrou, C. Boutopoulos, A. Gkouzou, I. Zergioti, *Sensors Actuators B Chem.*, 193, 301–305, **2014.**





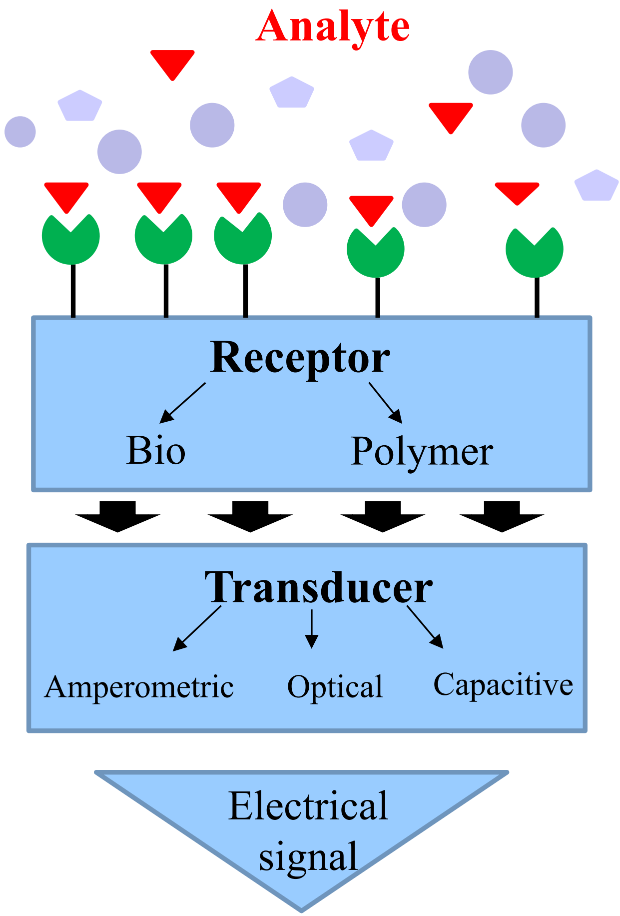


Touloupakis, E., Boutopoulos, C., Buonasera, K., Zergioti, I., Giardi, M.T. Analytical and Bioanalytical Chemistry 402 (10), 3237-3244 (2012) DOI 10.1007/s00216-012-5771-7



LIFT: Bioprinting for sensor applications

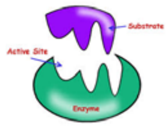
BIOSENSORS



Biosensors:

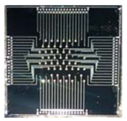
DNA and Aptamers based environmental sensor

Photosynthetic amperometric sensors for water monitoring

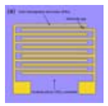


Enzymatic sensors for food quality monitoring

Transducers:

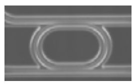


Capacitive sensors



Resistivity

Amperometric sensors

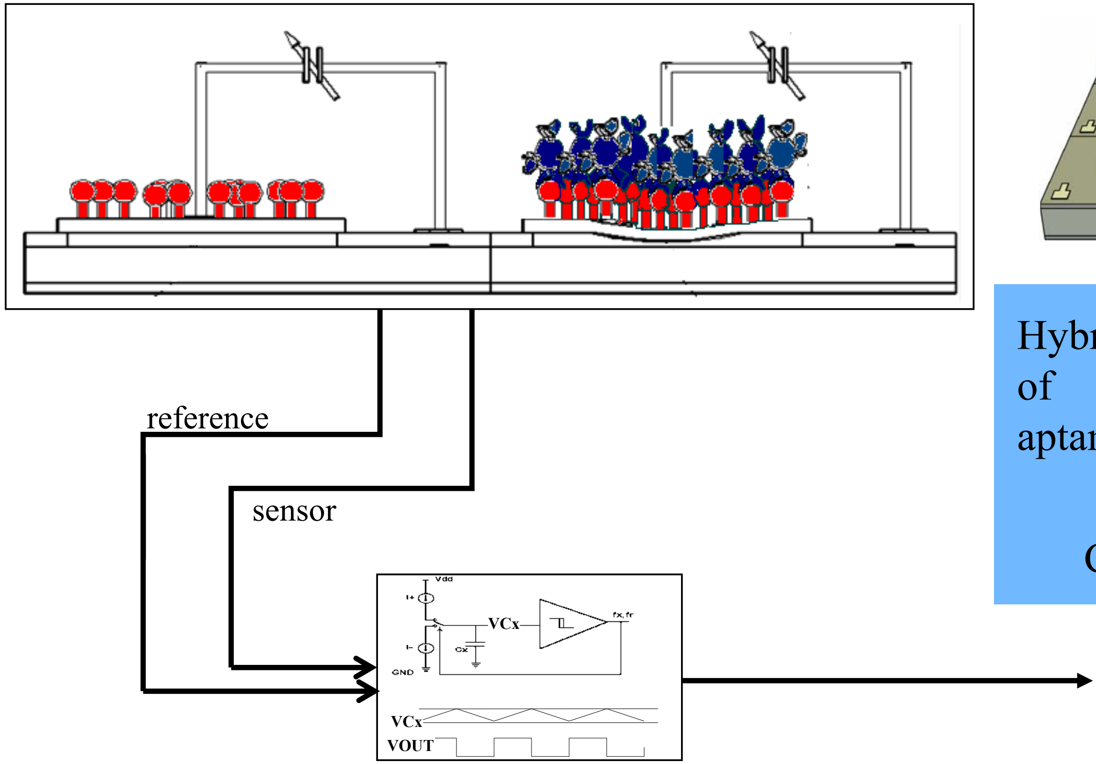


Photonic sensors

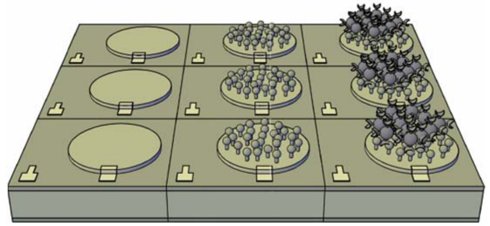
 15

Aptamers based environmental sensor

THE CAPACITIVE APPROACH FOR SENSOR DEVICES

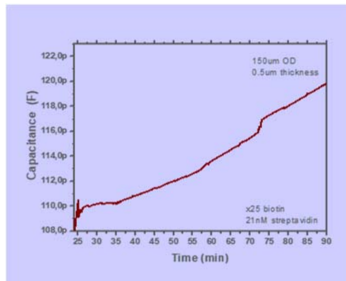


M. Chatzipetrou, G. Tsekenis, V. Tsouti, S. Chatzandroulis, I. Zergioti ,
Applied Surface Science, vol. 278, pp. 250–254, 2013.



Hybridization of aptamer → Membrane bending

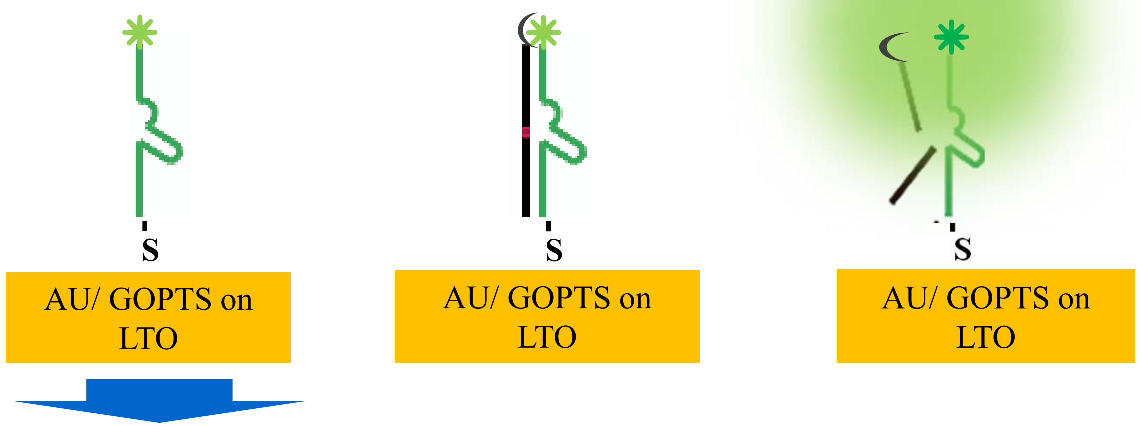
Change of Capacitance !!



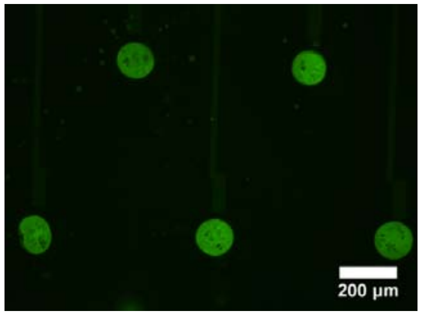
Aptamers based Capacitive sensors for Pb detection

Concept

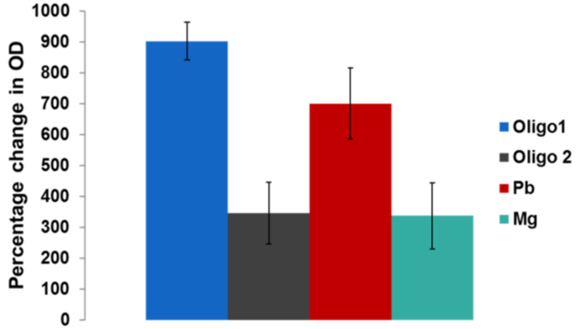
Immobilization of oligo 1 | *Hybridization with oligo 2* | *Cleavage of the DSaptamer, in the presence of Pb*



Results



LIFT conditions: 10µM on donor, 300 mJ/cm^2, Spot size: 50µm, 266 nm



G. Tsekenis, M. K. Filippidou, M. Chatzipetrou, V. Tsouti, I. Zergioti, and S. Chatzandroulis, Sensors Actuators B Chem., vol. 208, pp. 628–635, 2015.

A miniature Bio-photonics Companion Diagnostics platform for cancer treatment monitoring.

BIOCDx

H2020-ICT-2016-1
(2016-2020)

future diagnostics · LioniX International · SURFIX · BRFAA Biomedical Research Foundation Academy of Athens · LEAD PHARMA · csem · Esterline LRE Medical Esterline Corporation

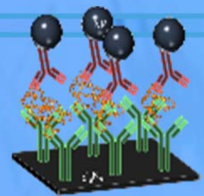
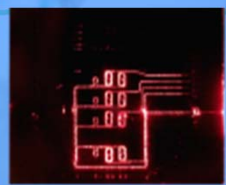
Nano-biochemical Platform
Antibodies selection, novel transfer and binding of antibodies, nanoparticles

Photonic Platform
6 Parallel asymmetric MZIs arrays for multiplex detection of the cancer biomarkers

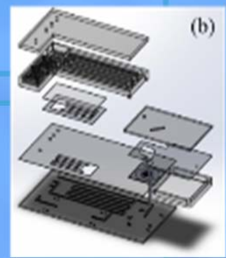
Microfluidics Platform
Disposable Cartridge: Fluids handling, sample pre-treatment, filtering

Reader Development
System electronics, packaging and integration to PoC device

Individual platforms

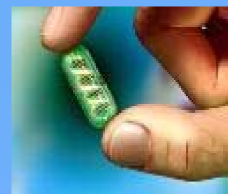

System Integration


Preclinical & Clinical Validation



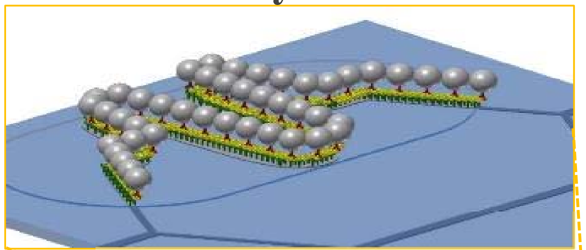
Exploitation

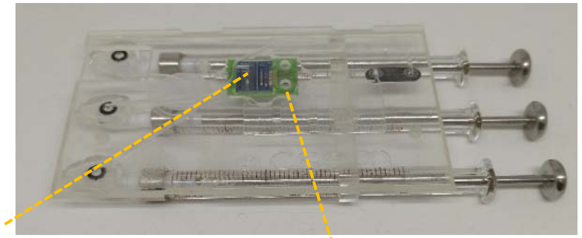



FDA
EUROPEAN MEDICINES AGENCY

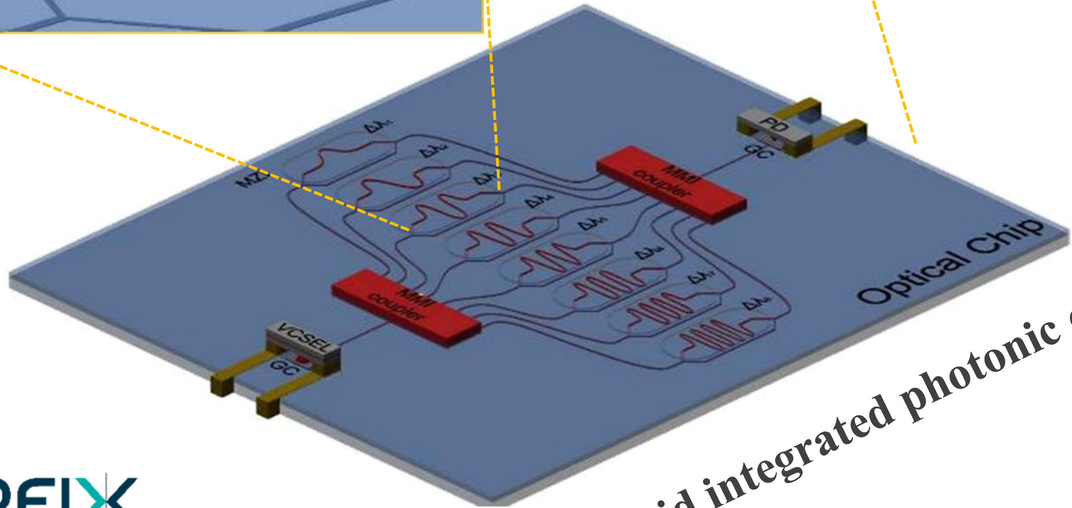
A miniature Bio-photonics Companion Diagnostics platform for cancer treatment monitoring.

Bio-photonic chip
Nanoparticle-based immunoassay



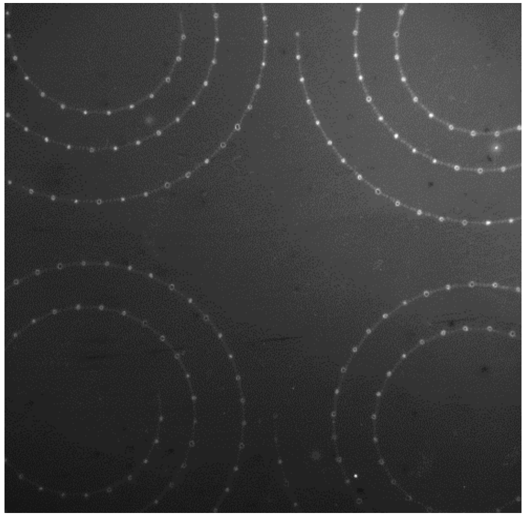


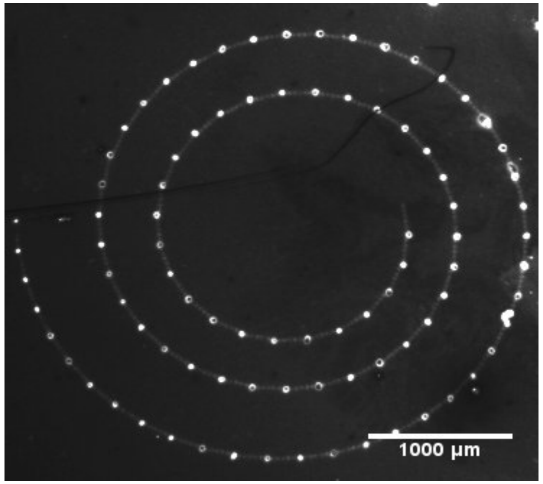
Disposable BIOCDx cartridge

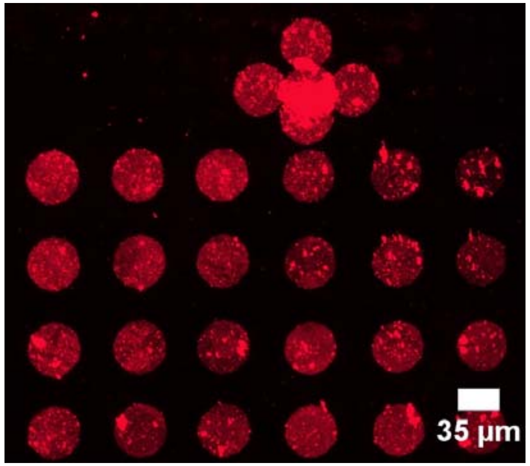


Hybrid integrated photonic chip

LIFT & photo polymerization of hydrogels



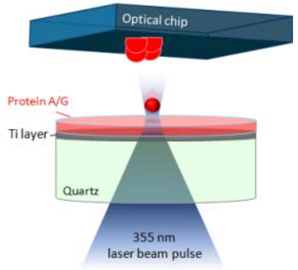




* 250μg/ml DAG Cy3

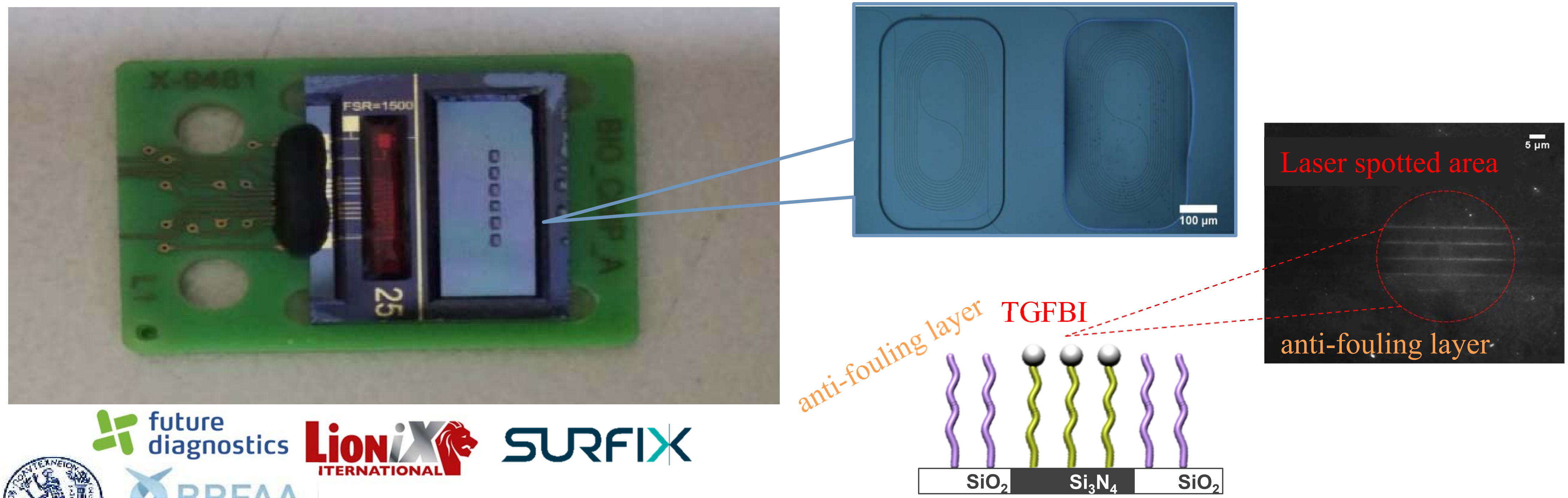
- ✓Improving the resolution
- ✓Creating sophisticated structures
- ✓Control on the thickness of the polymer film by laser pulses

LIFT @ asymmetric Mach Zehnder Interferometers (aMZIs)



LIFT in combination with material-selective coating - Detection of spiked samples

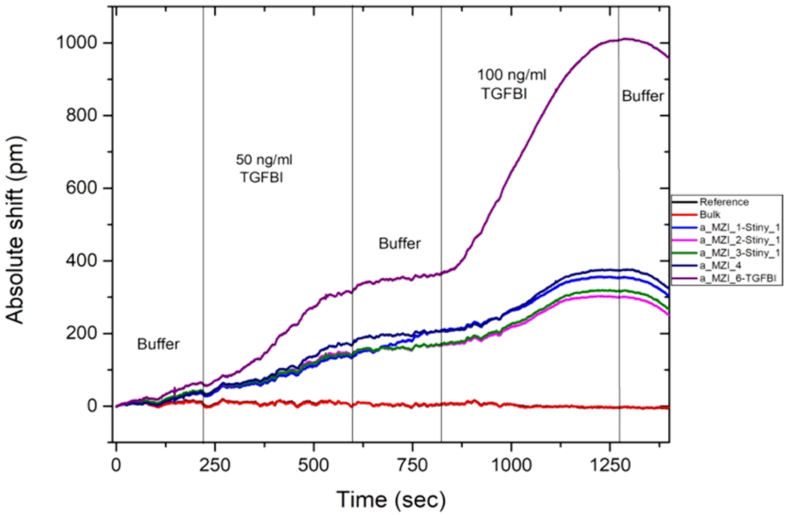
- Selective surface modification of Si_3N_4
- Each chip contains of 6 sensing and 6 reference aMZIs
- Multiplexing of the senor by spotting of different antibodies at each aMZI



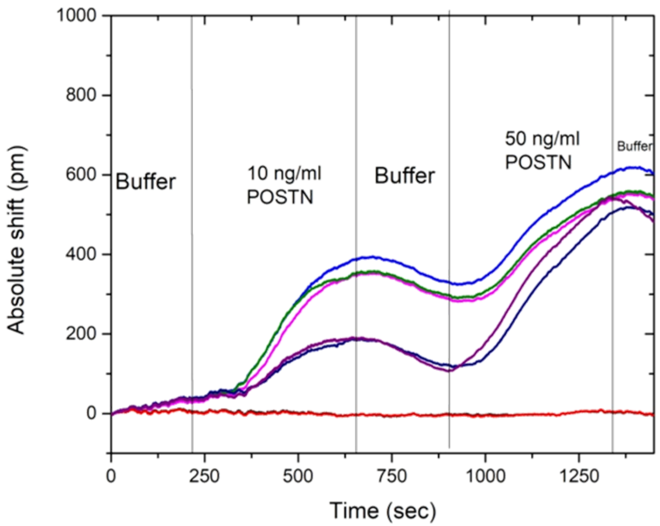
Evaluation of performance on aMZIs

Testing with spiked samples of increasing complexity

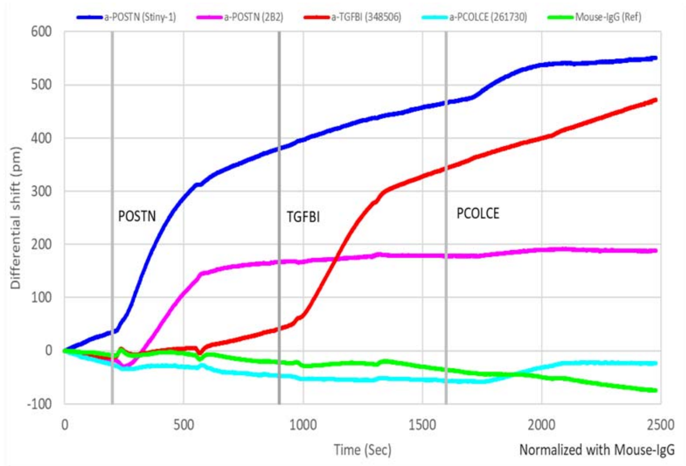
Binding of recombinant TGFBI



Binding of recombinant POSTN



Multiplexing of the same chip

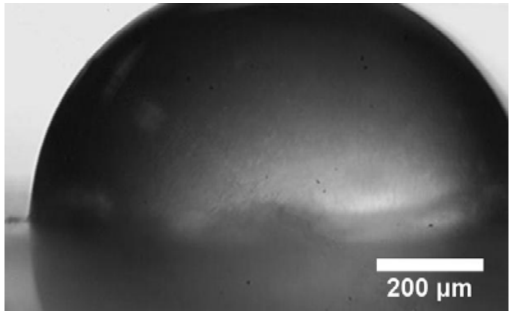


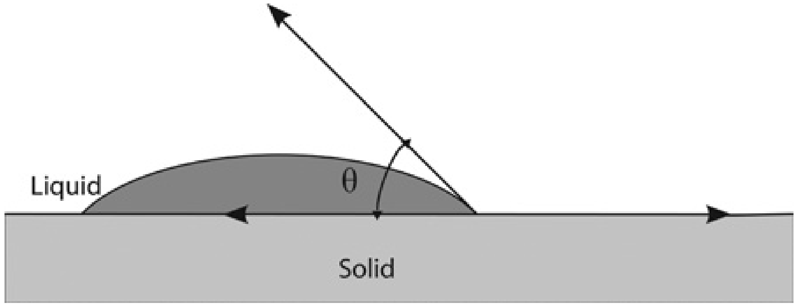
Gradual detection of 50 ng/ml, 100 ng/ml, TGFBI and 10 ng/ml, 50 ng/ml POSTN
Multiple detection of POSTN and TGFBI possible by spotting of multiple antibodies

LIFT: Lasers can tune the wettability of the surfaces

23

Laccase enzyme direct immobilization on graphite SPE

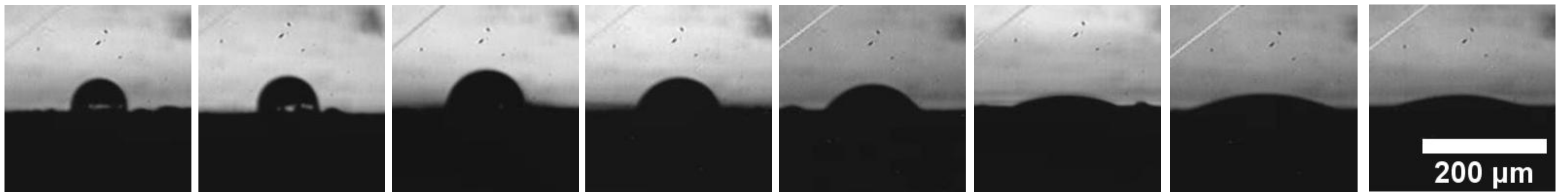




Reference pipette spotting (θ = 89.4º)

E (mJ/cm²)

125	150	175	200	225	250	275	300

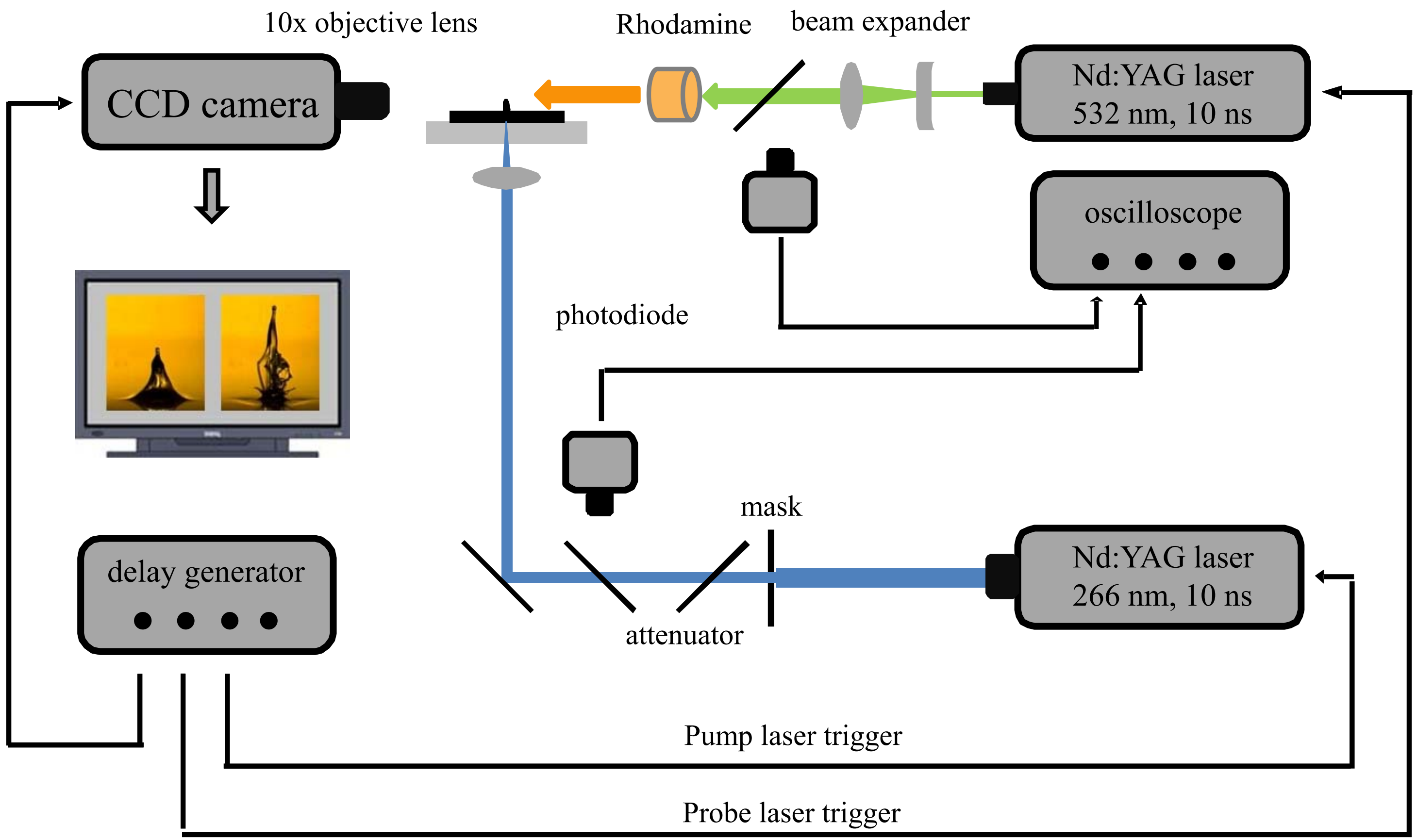


89.1º ± 2.6º	88.2º ± 8.6º	93.1º ± 5.2º	71.1º ± 11.7º	59.6º ± 7.1º	33.8º ± 5.5º	27.5º ± 12.2º	18.5º ± 3.5º

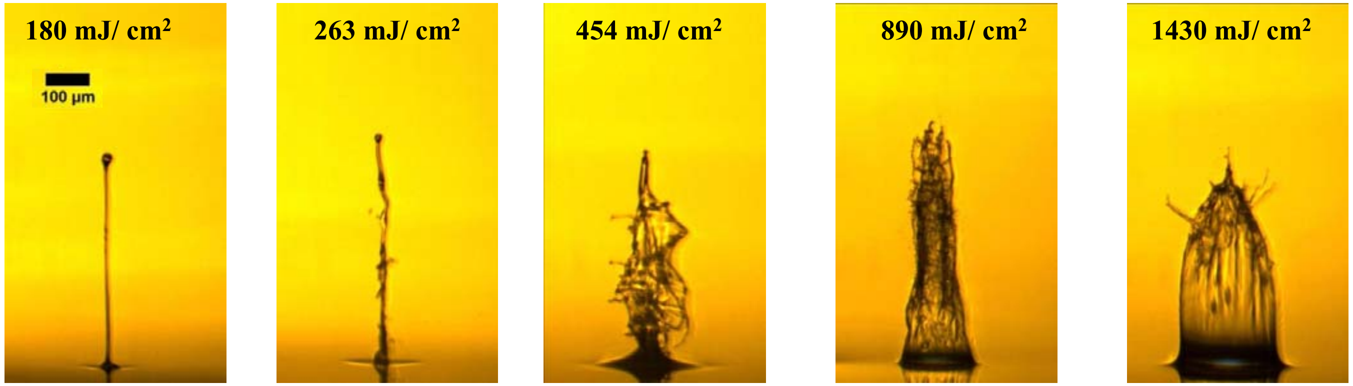
Contact angle

E. Touloupakis, M. Chatzipetrou, C. Boutopoulos, A. Gkouzou, and I. Zergioti, Sensors Actuators, B Chem., vol. 193, pp. 301–305, 2014.

Shadowgraphic imaging setup



Laser Induced Forward Transfer Shadowgraphy study



Distance = 467 µm
Time= 14,8 µs

Distance = 506,8 µm
Time= 10,3 µs

Distance = 412,9 µm
Time= 6,36 µs

Distance = 534 µm
Time= 1,82 µs

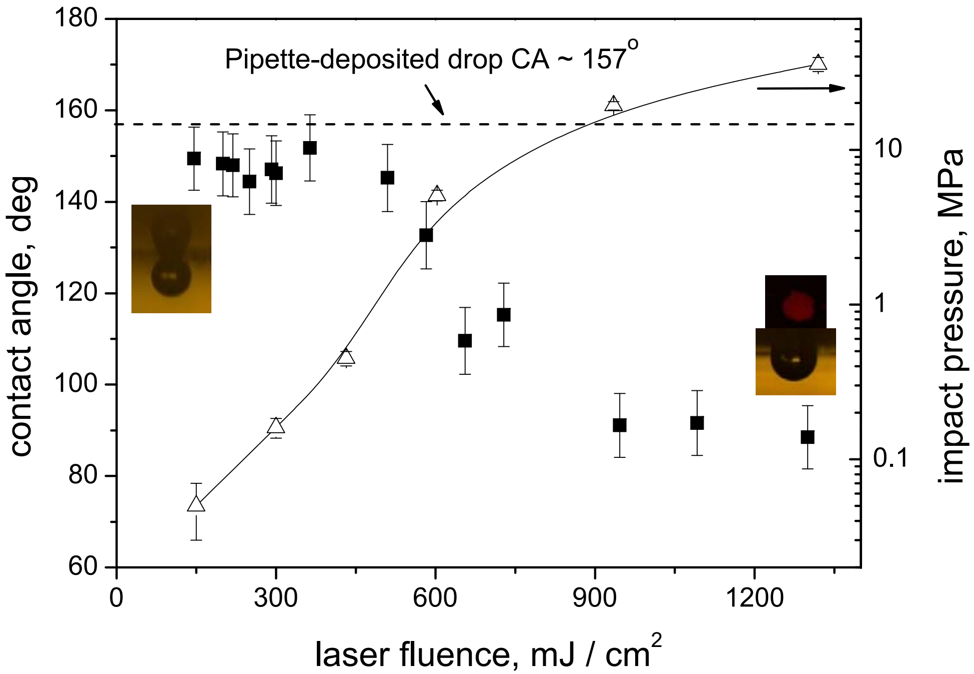
Distance = 470,3 µm
Time= 1,84 µs

- ***Printing solution: 1M phosphate buffer pH8***
- ***Laser printing wavelength: 266 nm***
- ***Laser illumination wavelength: 532 nm***
- ***Laser spot size: 50 µm***
- ***Laser pulse duration:10 ns***

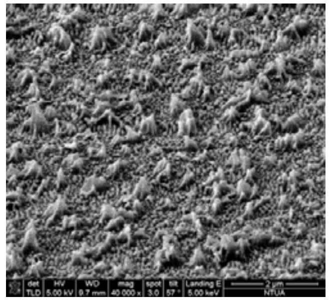
J (mJ/cm^2)	u (m/s)	P=1/2*ρu^2 (MPa)
180	33	*0,61*
260	47	*1*
450	70	*3*
900	255	*36*
1400	260	*39*

M. Chatzipetrou, K. Ellinas, E. Gogolides, A. Tserepi, I. Zergioti, submitted manuscript at APL

Wetting states transition due to high velocity impact



$$P_d = ½ \cdot \rho \cdot V_{im}^2$$



4 min oxygen plasma etched nanotexture PMMA resulting at 600 nm roughness

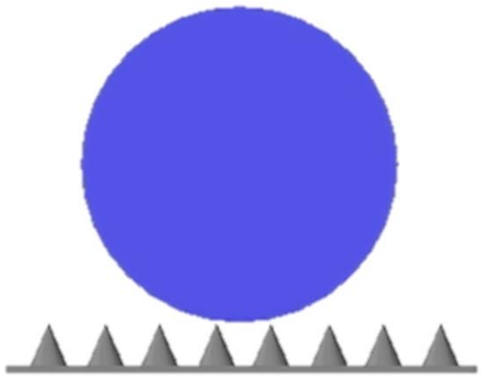
Transition from partial to complete wetting

C. Boutopoulos, D. P. Papageorgiou, I. Zergioti, and A. G. Papathanasiou, Appl. Phys. Lett., vol. 103, no. 2, p. 024104, 2013.

30 μL phosphate buffer on Ti coated quartz target (60 μm thickness), 130 μm spot size

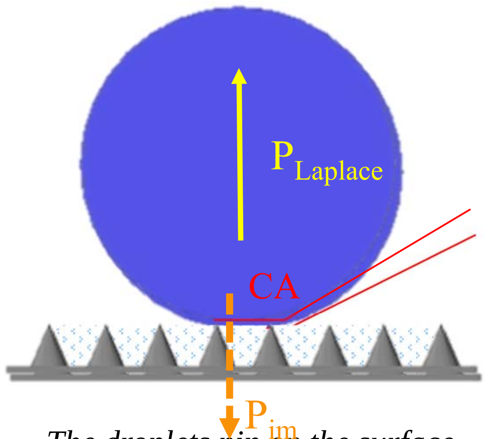
Wetting states

Non wetting state



The droplets roll off

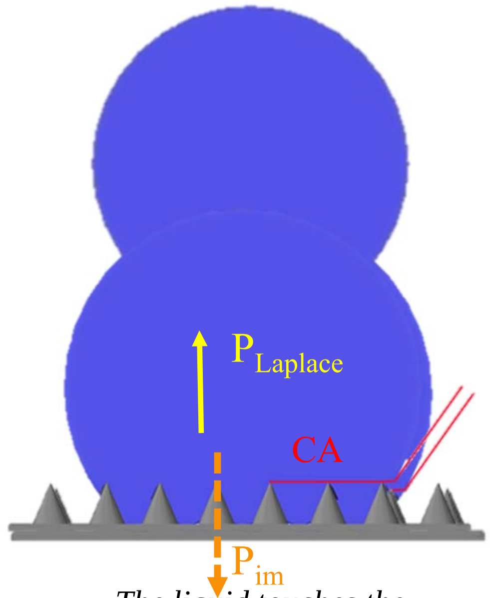
Partial wetting state



The droplets pin on the surface

Air trapped between the pillars ⇒ Laplace Pressure > Impact Pressure

Complete wetting state

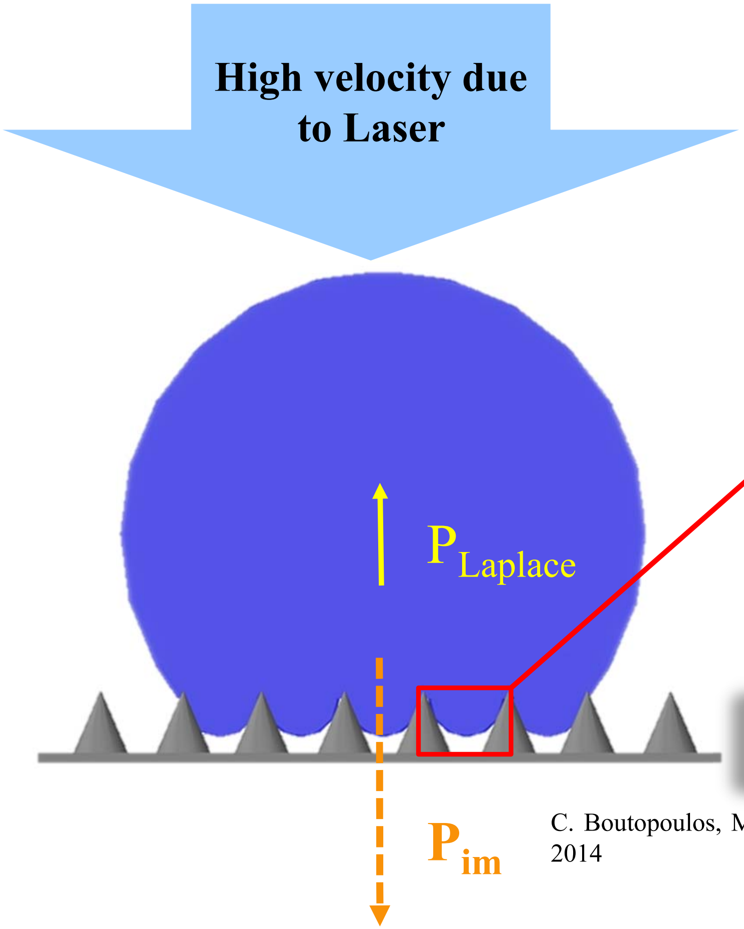


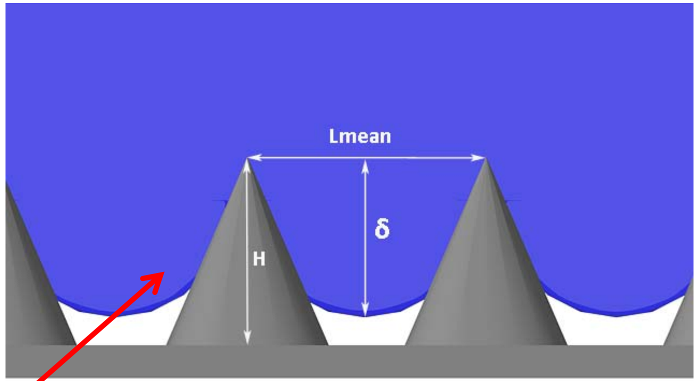
The liquid touches the bottom of the surface

Impact Pressure > Laplace Pressure ⇒ the liquid force itself between the surface protrusions

C. Boutopoulos, M. Chatzipetrou, A. G. Papathanasiou, and I. Zergioti, Laser Phys. Lett., vol. 11, no. 10, p. 105603, 2014.

Laser immobilization mechanisms





$$\delta = \frac{L_{mean}^2 * P_{Laplace}}{16\,\gamma}$$: droop of droplet

H: Height of the pillars

L_{mean} : Mean pitch between the pillars

γ: air-liquid interfacial tension

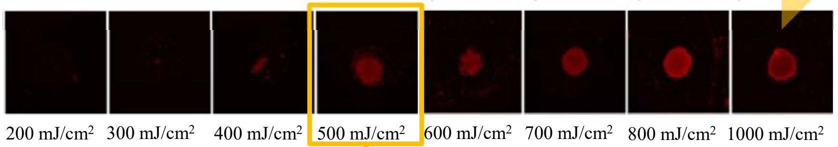
$P_{im} > P_{Laplace} \Rightarrow \delta \geq H/2 \Rightarrow$ Direct Immobilization

C. Boutopoulos, M. Chatzipetrou, A. G. Papathanasiou, I. Zergioti,, Laser Physics Letters, 11:105603, 2014

Direct Immobilization of thylakoid membranes on different surfaces

Rough PMMA-Height: 869±30 nm

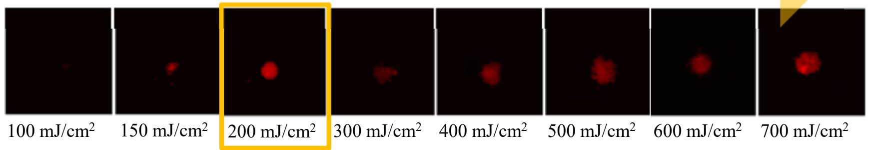
Increasing Impact Pressure



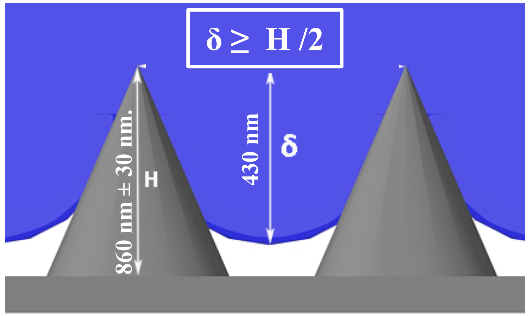
Threshold for direct immobilization: P_{im} = 1,2 MPa

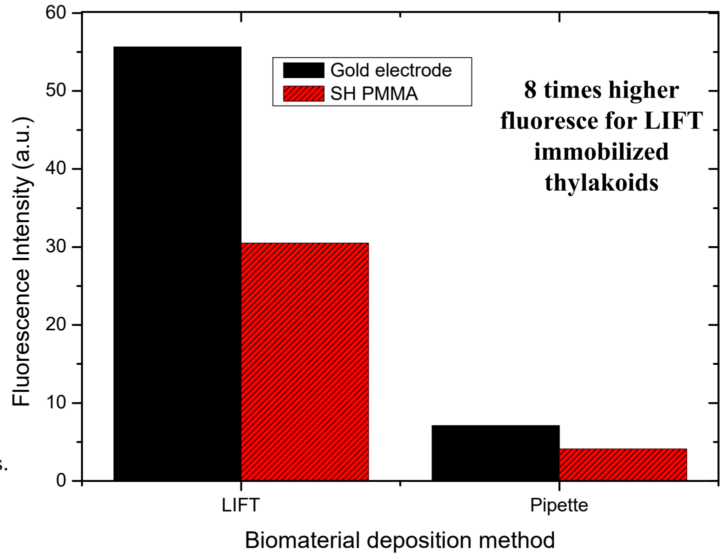
Rough gold SPEs- Height: 560±3 nm

Increasing Impact Pressure



Threshold for direct immobilization: P_{im} = 0.07 MPa

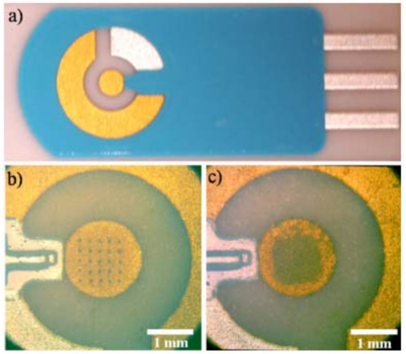


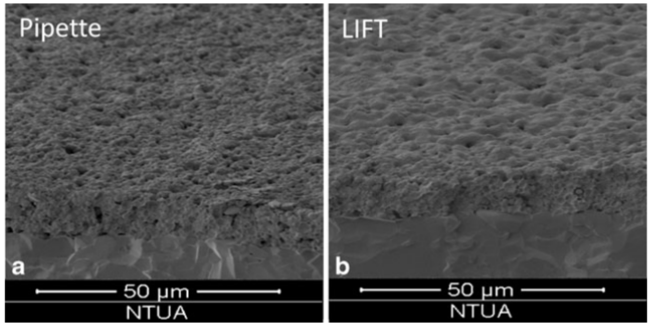


C. Boutopoulos, M. Chatzipetrou, A. G. Papathanasiou, and I. Zergioti, Laser Phys. Lett., vol. 11, no. 10, p. 105603, 2014.

LIFT: A laser-based immobilization technique

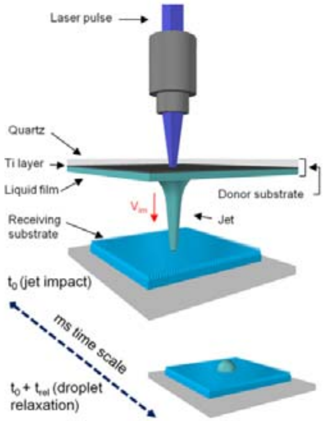
Direct Immobilization of Biomaterials on sensor devices

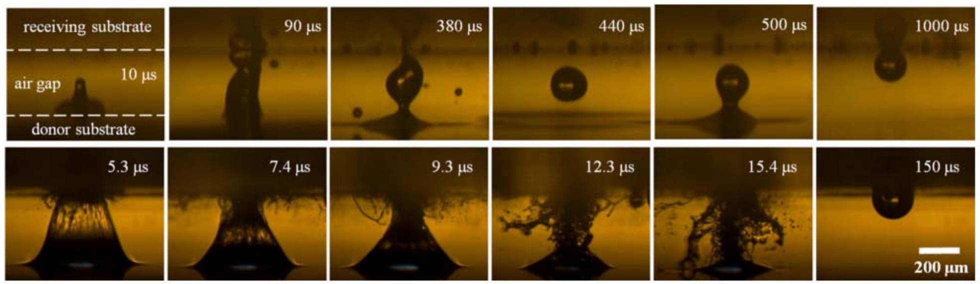




- E. Touloupakis et al. A photosynthetic biosensor with enhanced electron transfer generation realized by laser printing technology. **Anal. Bioanal. Chem 402 (10), 3237 (2012).**
- C. Boutopoulos et al. Direct laser immobilization of photosynthetic material on screen printed electrodes for amperometric biosensor. **APL 98(9), 093703 (2011).**
- E. Touloupakis et al. A polyphenol biosensor realized by laser printing technology. **Sens. Actuators B-Chem193: 301 (2014).**

Laser can tune the wettability of the surfaces





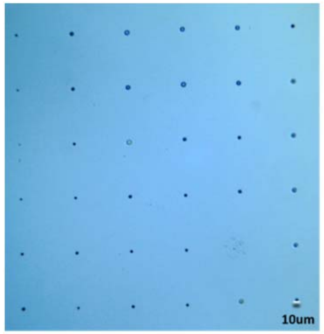
- C. Boutopoulos, et al. (2013). "Sticking of droplets on slippery superhydrophobic surfaces by laser induced forward transfer." **APL 103(2): 024104 (2013).**
- C. Boutopoulos, et al. "Time resolved imaging and Immobilization study of bioliquids on hydrophobic and suberhydrophobic surfaces by means of Laser-Induced Forward Transfer." **Laser Physics Letters (2014).**

LIFT: Printing of cells

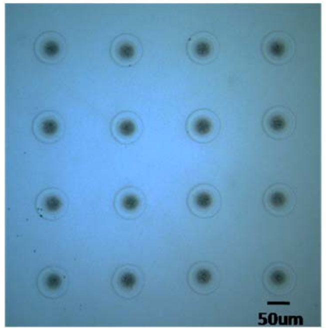
LIFT printing of cells mixed with hydrogels

LIFT printing on glass

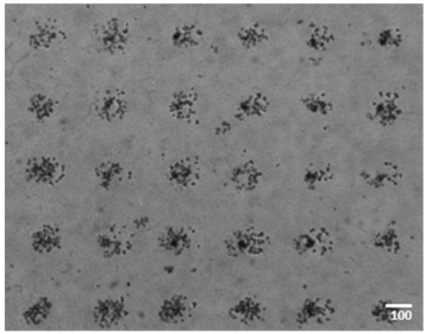
Gelatin



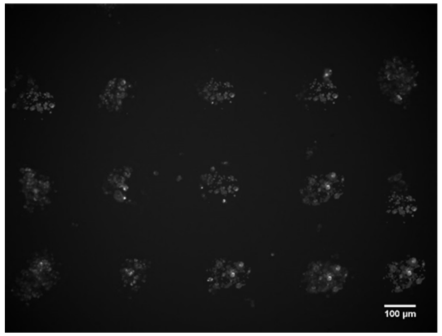
Matrigel



after LIFT printing

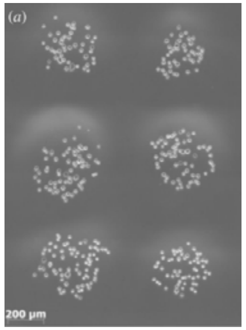


1hour after LIFT printing

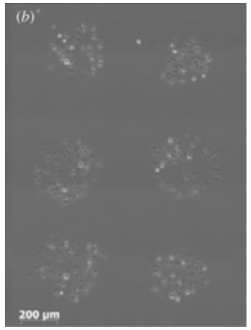


Fluorescence images of Human Embryonic Stem cells mixed with alginate

Cancer cells



after LIFT printing



1hour after LIFT printing

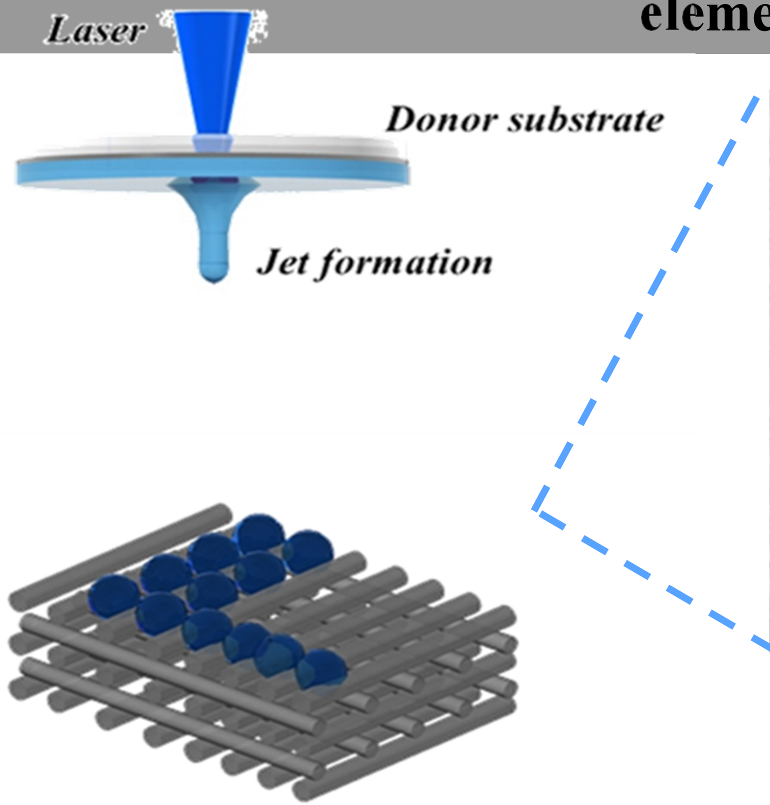
LIFT-printed A375 melanoma cancer cell line expressing the green fluorescent protein (GFP)

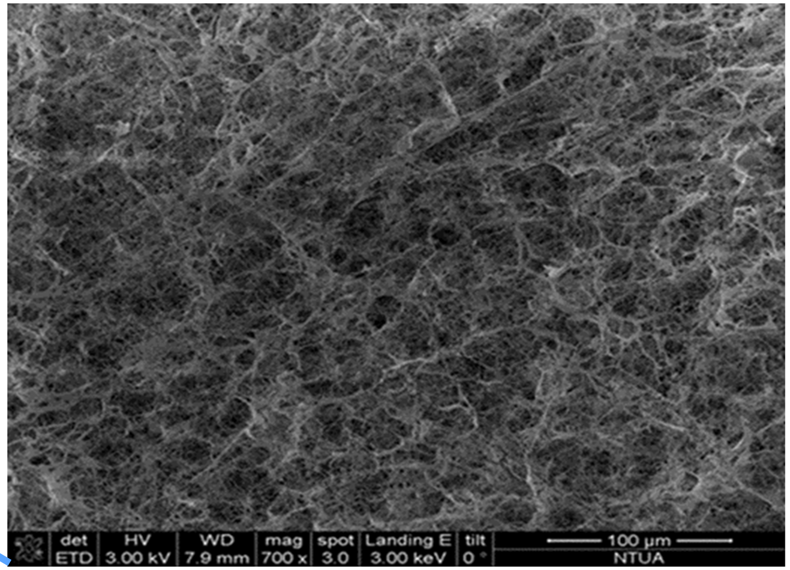
LIFT technique enables,

- ✓ **Deposition of cells at specific patterns**
- ✓ **No cells damage after printing**

LIFT printing of liver cells on collagen scaffolds

Control the positions of cells on porous collagen scaffold in order to generate a co-culture element with controlling cell adhesion.





SEM image of porous collagen scaffold structure

In collaboration with Dimitrios Tzeranis, and Achilleas Gravanis at FORTH IMBB-Hellas

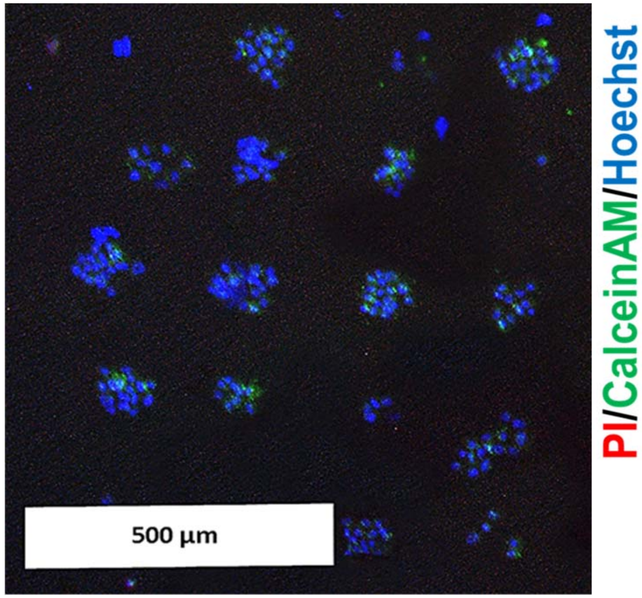
Using porous collagen scaffold as receiver substrate

Cell adhesion and cell culture after printing process.

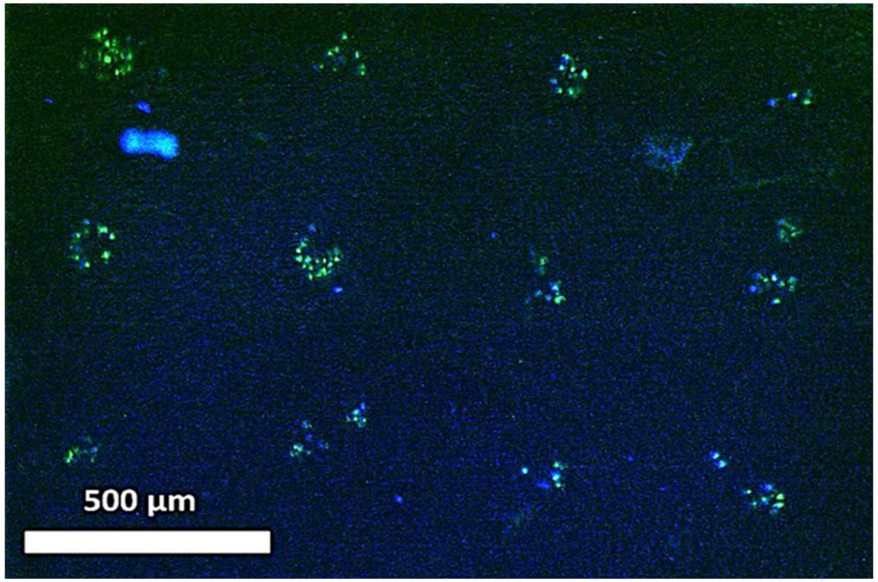
"Direct Laser Printing of Liver Cells on Porous Collagen Scaffolds", V. Leva, M. Chatzipetrou, L. Alexopoulos, D. S. Tzeranis, I. Zergioti, JLMN-Journal of Laser Micro/Nanoengineering **13** (3), (2018)

LIFT printing of liver cells on collagen scaffolds

- LIFT technique enables the deposition of cells in porous collagen scaffolds at specific patterns.
- No cells damage after printing and the viability is approximately 100%.



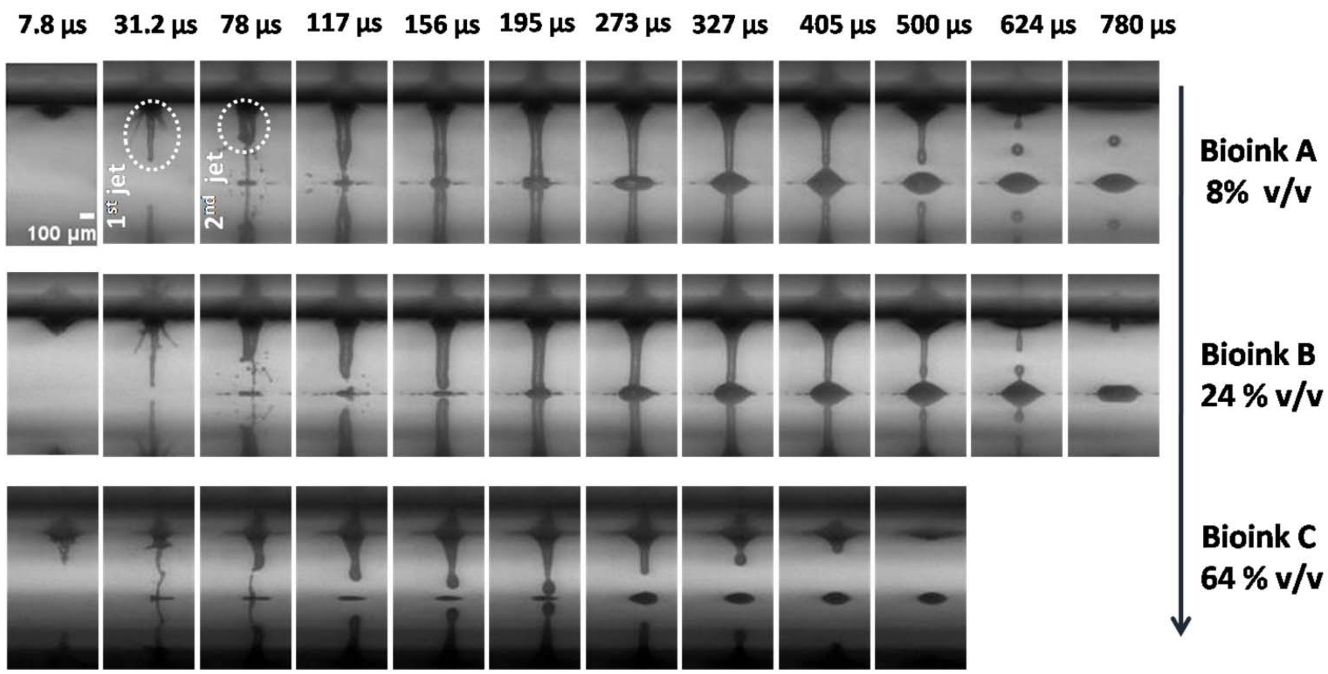
Fluorescence image of LIFT printed Huh7 cells **2 h after printing.**

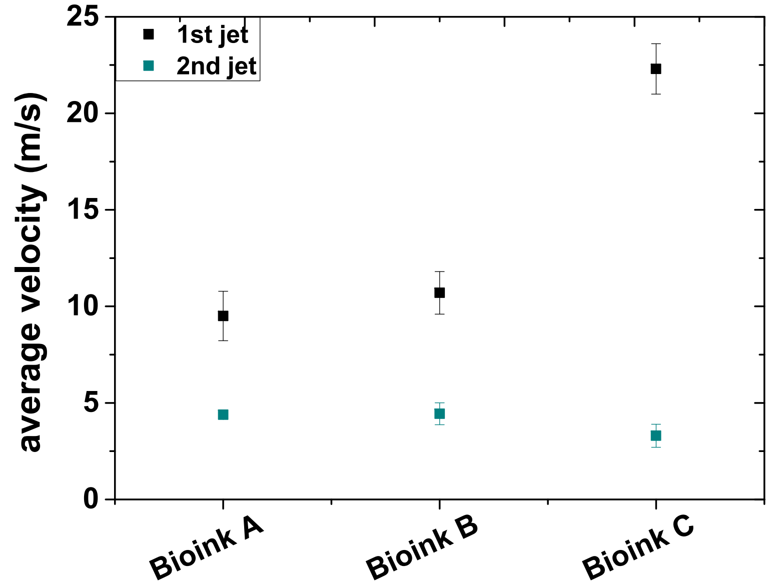


Fluorescence image of LIFT printed Huh7 cells **24 h after printing.**

V. Leva, M. Chatzipetrou, L. Alexopoulos, D. S. Tzeranis and I. Zergioti , Direct laser printing of liver cells on porous collagen scaffolds, JLMN, pp.234-237, 2018

High speed visualization of different cell concentrated bioinks

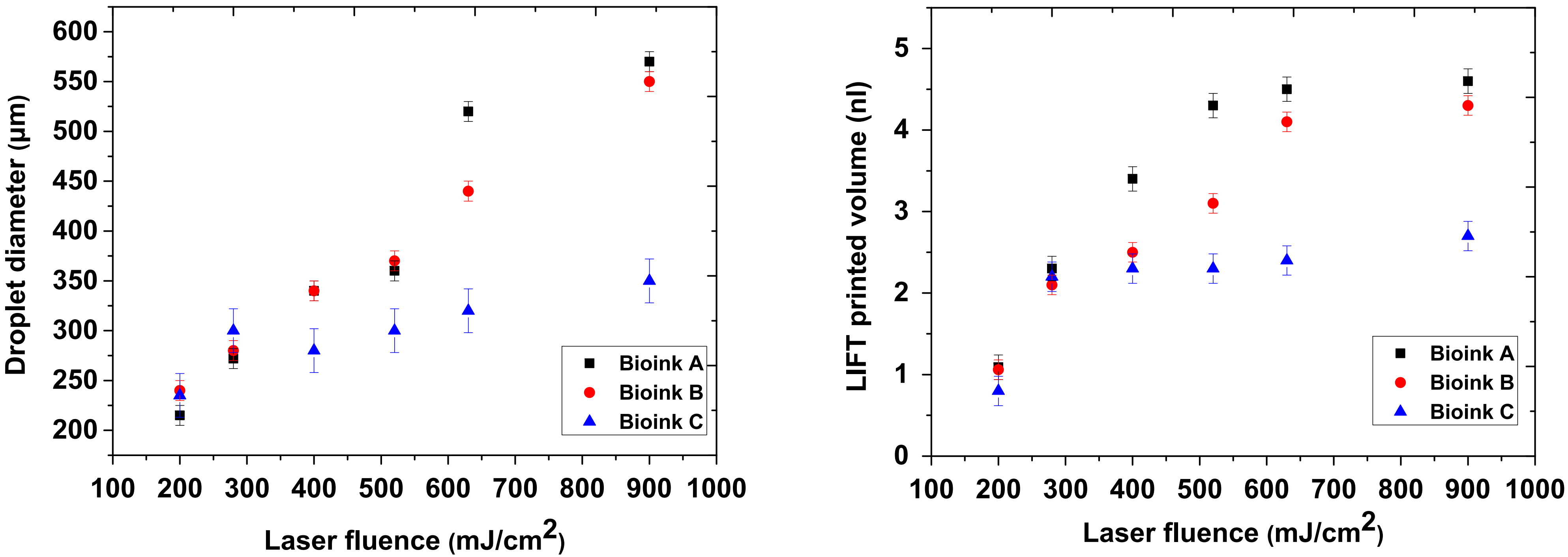




Formation of 2 jets

- 2nd jet velocity ~ 5 m/s
- 2nd jet carries the main amount of material

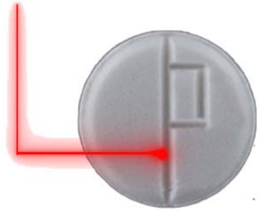
Influence of different cell concentrated bioinks on printed volume and droplet size as a function of laser fluence



- Droplet diameter is correlated with the concentration of the bioinks and the laser fluence.
- Both droplet diameter and volume has no systematic dependence on the cell concentration at different laser fluences

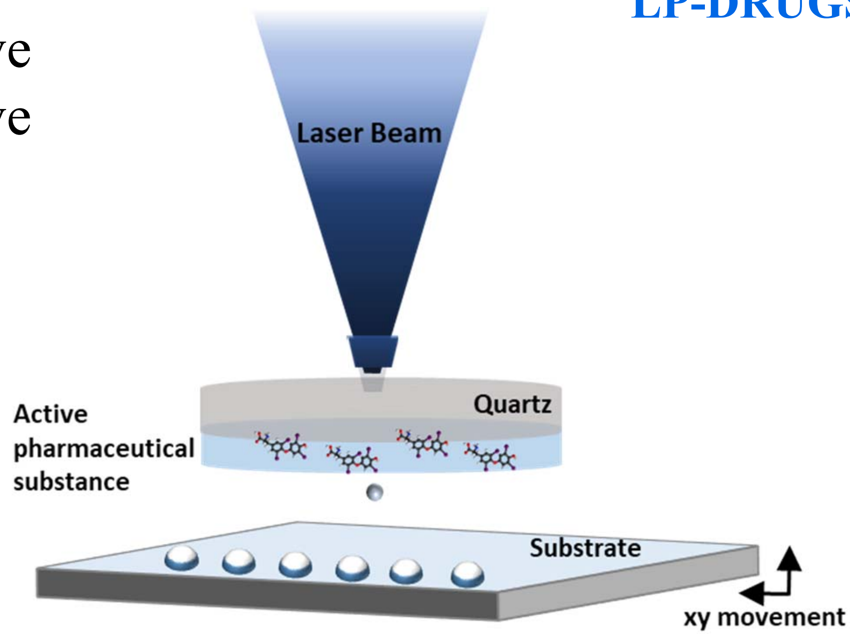
LIFT: Printing of drugs

Laser printed drugs



LP-DRUGS

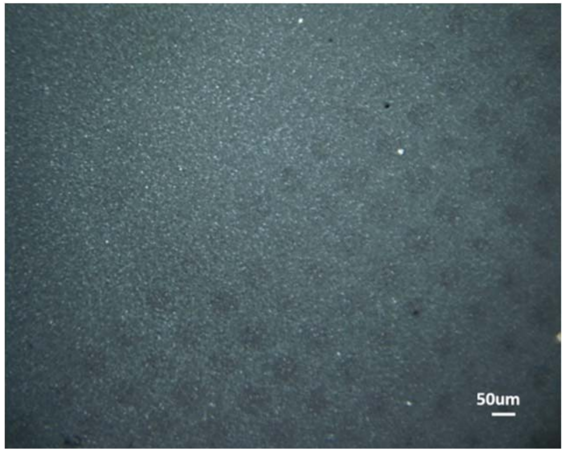
- Faster dilution,
- More accurate than liquid dosage,
- Immediate absorption by the Mucous membrane
  - Bypass absorption of the API (active pharmaceutical ingredient) by the digestive system
  - Lower Dosage
  - Less side affects
- Non invasive,
- Personalized dosage



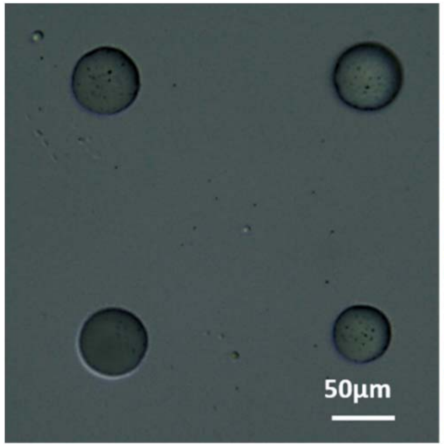
Laser printed drugs

(I) LIFT printing of Levothyroxine Sodium (thyroid diseases)

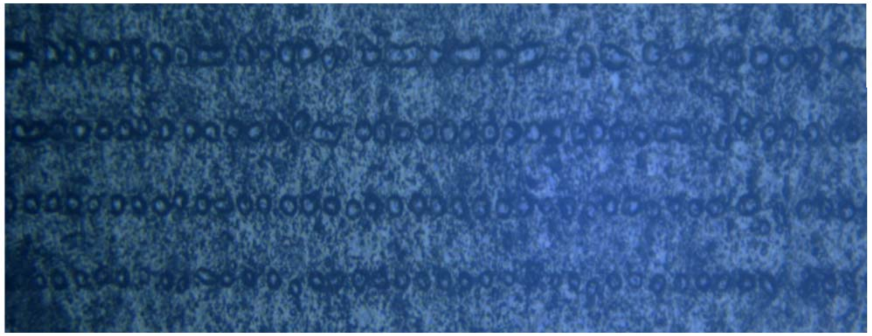
LP-DRUGS



Substrate: polycarbonate membrane



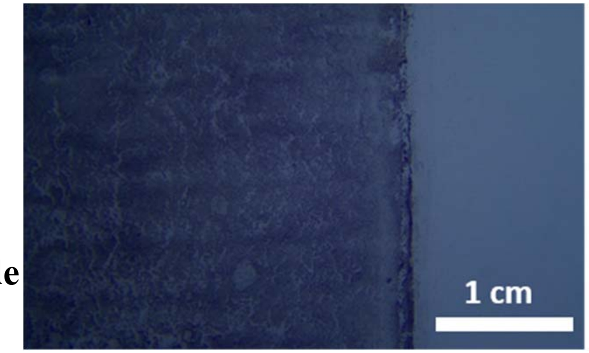
Substrate: cellulose



Substrate: Orodispersible Film (ODF), 2 cm length

(II) LIFT printing of Isosorbide Mononitrate (vascular diseases)

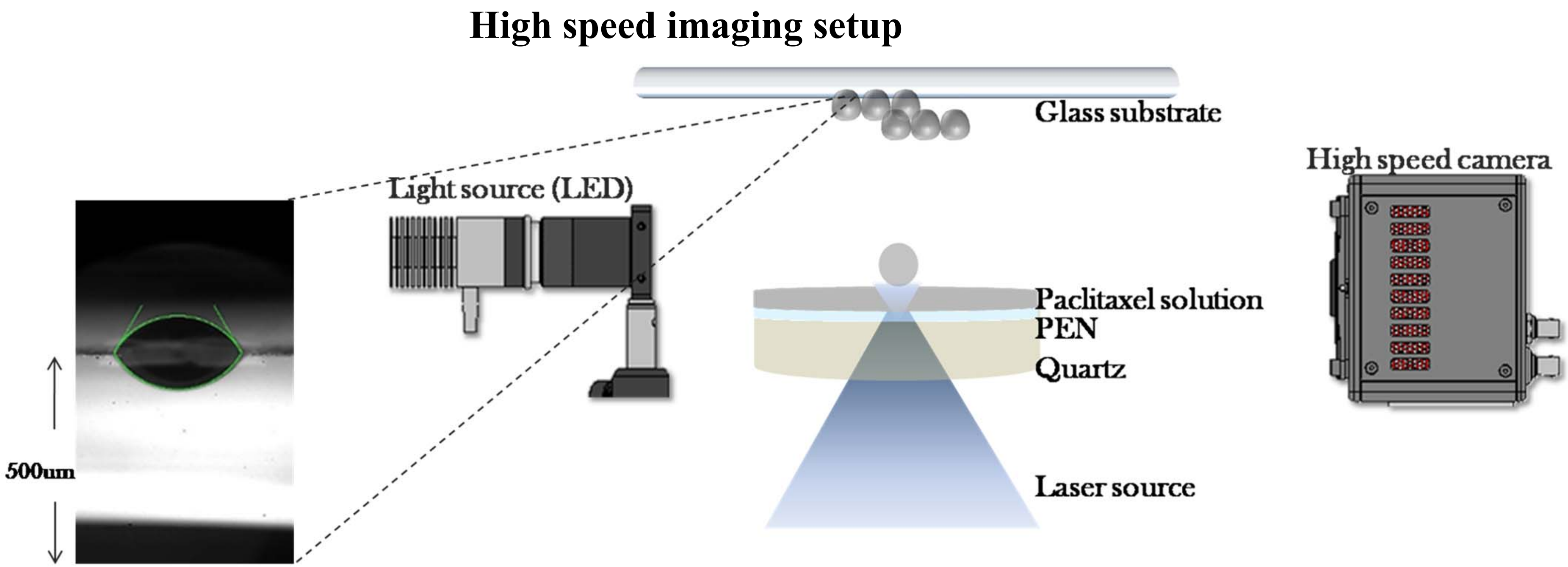
Substrate: glass slide



BRFAA Galenica

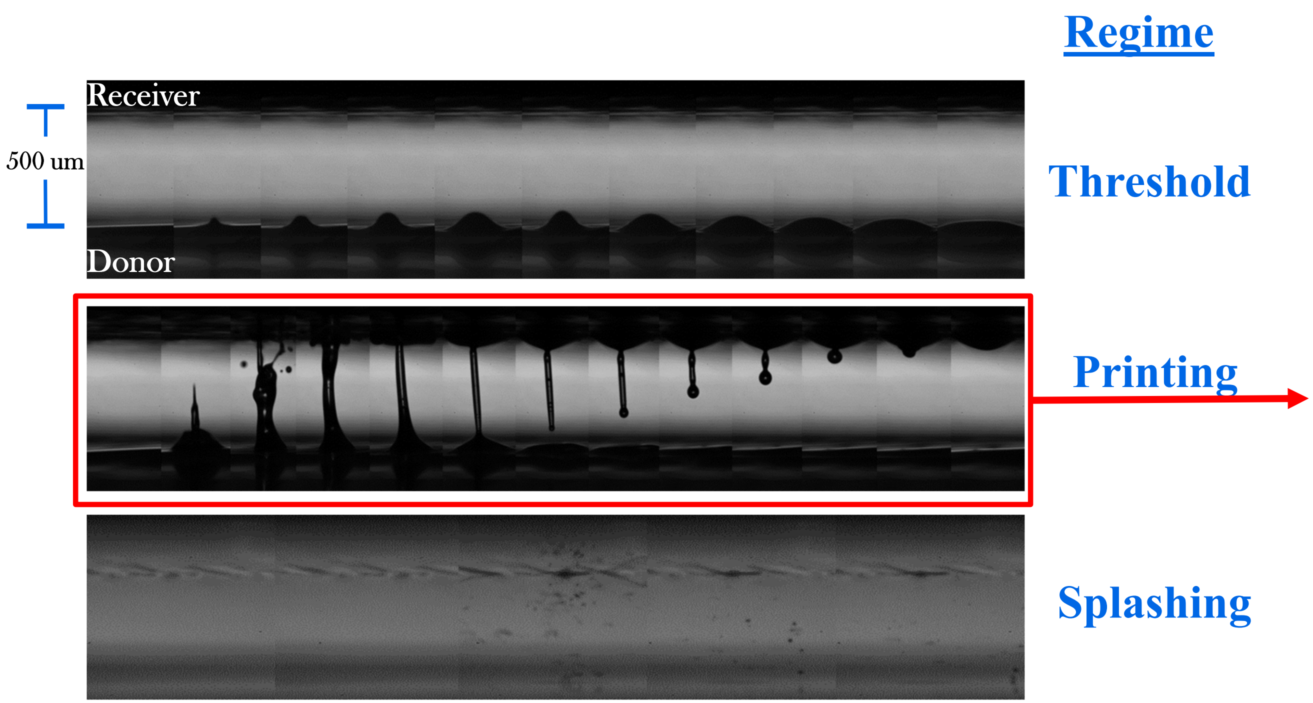
IIBEAA Galenica

Printed volume calculation



High speed jet visualization of paclitaxel solution

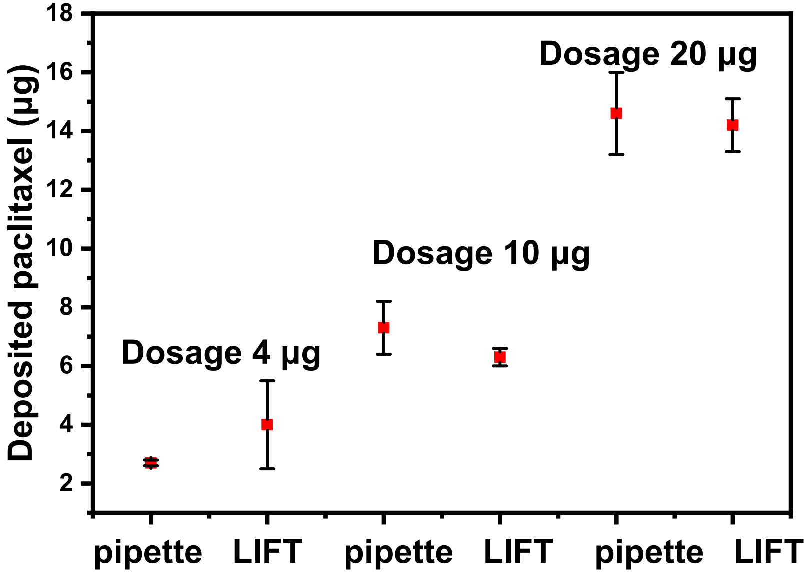
LP-DRUGS



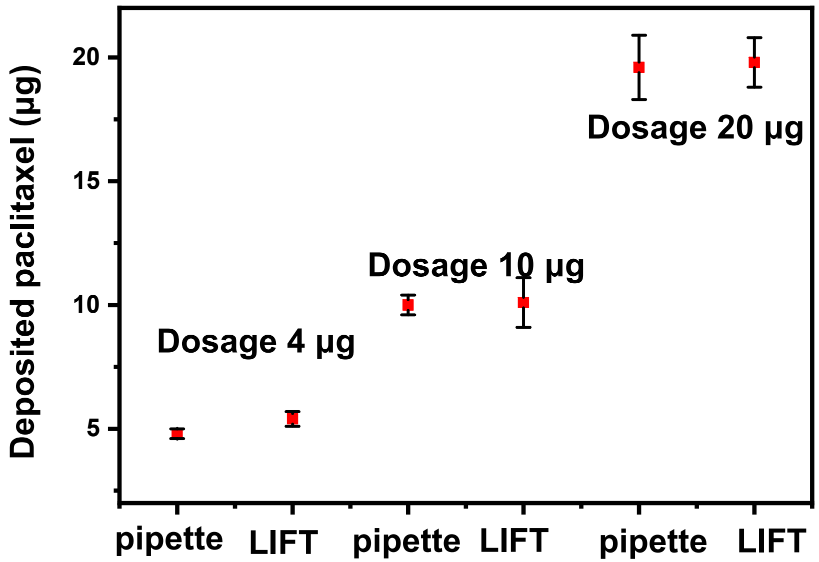
- ❑ Large laser printing window
- ❑ Jet front velocity ~ 25 m/s
- ❑ Bridging of donor-receiver substrates
- ❑ Creation of secondary and satellite droplets

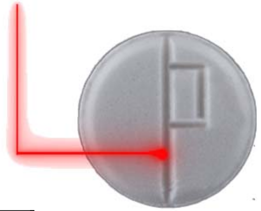
Validation via HPLC

Printed paclitaxel on wafer paper



Printed paclitaxel on glass





LP-DRUGS

BRFAA

Galenica

Conclusions

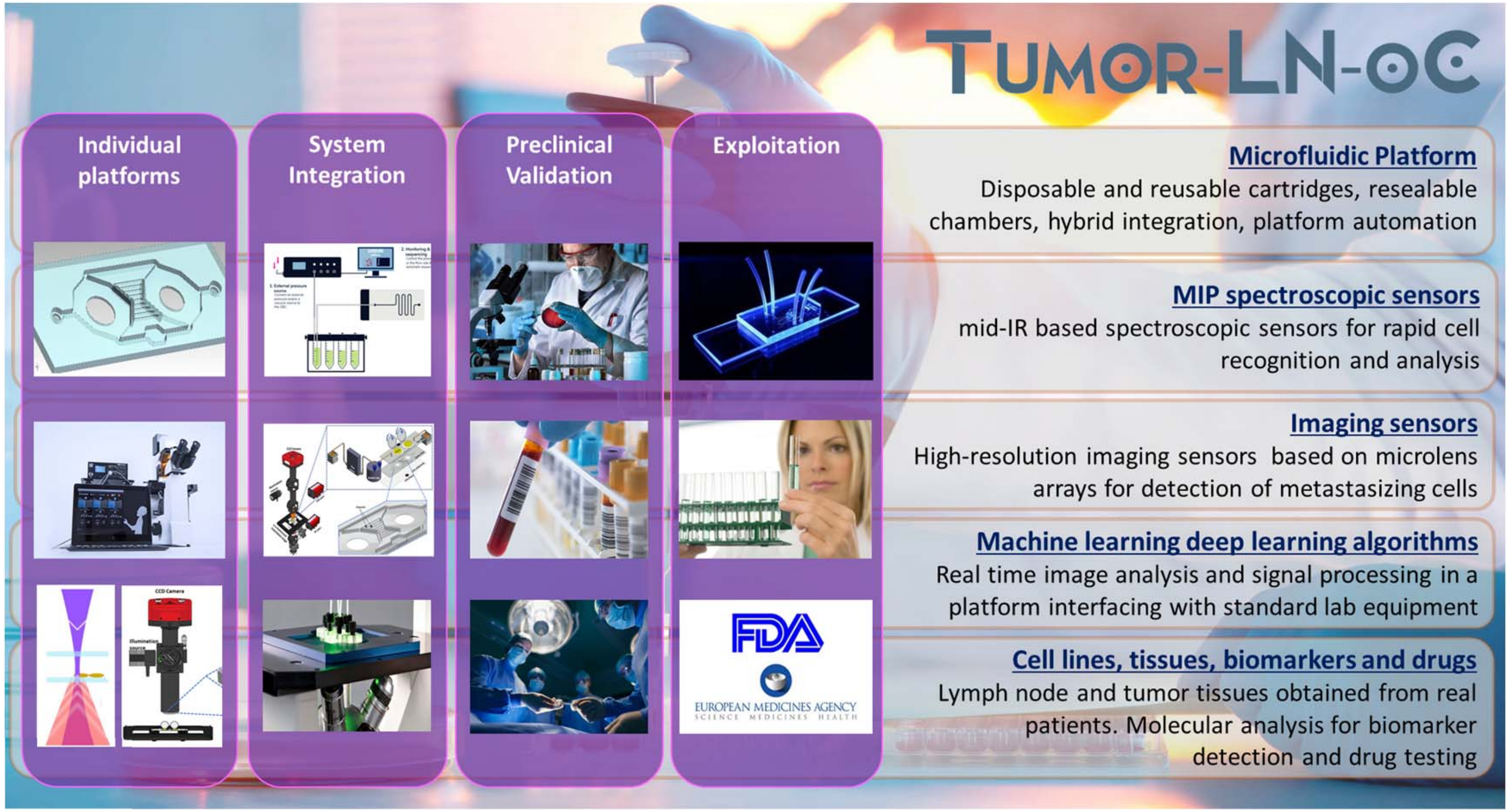
LIFT can do much more than printing:

- Initiating Chemical Reactions
- Immobilization of biomolecules on the substrates
- Printing of sensors
- Printing of cells
- Printing of drugs

Tumor-LN-oC's overall Goal

A **Tumor-lymph node-on-chip** platform composed of 3D tissue models and microfluidic chips which will connect surgically removed human primary tumors and LN tissue from the same lung cancer patient serving a s a "**biological twin**" of the patient

GA No: 953234
Call: H2020-NMBP-TR-IND
Start: 01/05/2021-30/4/2025
Duration: 48 months
Topic: DT-NMBP-23-2020 (LS)

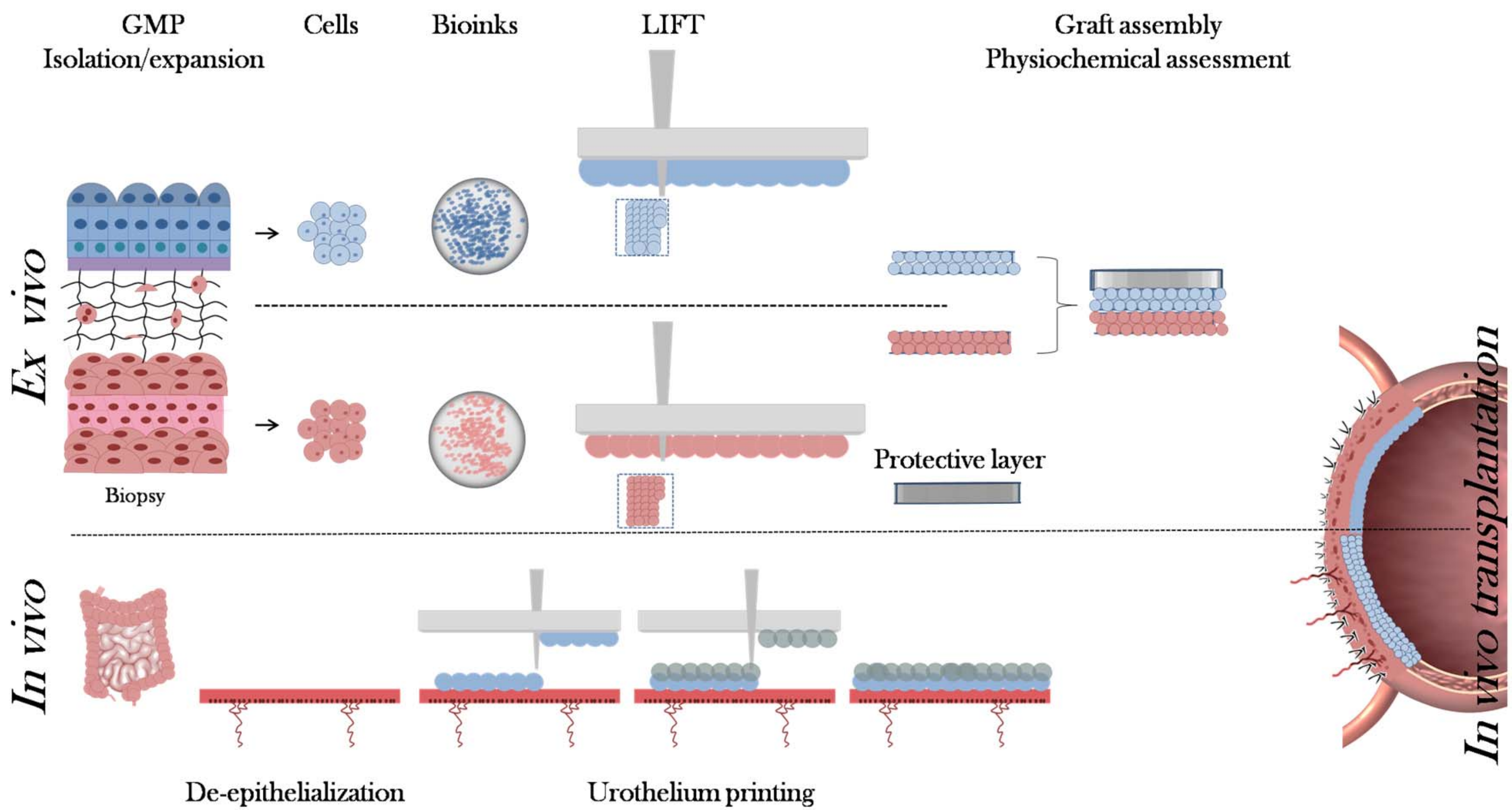


UroPrint's overall Goal

Urinary bladder bioprinting for autologous transplantation

The ultimate goal of UroPrint relies on a radically new concept: the anatomical structural and functional transdifferentiation at the tissue level (tissue transdifferentiation).

GA No: 964883
Call: H2020-FETOPEN-2018-2019-2020-01
Start: 01/09/2021-31/08/2025
Duration: 48 months
Topic: FETOPEN-RIA-2019-01



PhosPrint

3D Laser Bioprinter Solutions & Services

Aspiring to be a key player in the tissue regeneration and biotechnology field

IOANNA ZERGIOTI,
CO-FOUNDER AND CTO

Our product: PhosDB·I

Meet PhosDB·I

A high-resolution, user-friendly laser bioprinter
for demanding cell-printing applications

Read more

Executive summary

- We are a high tech spin off, established as a PC (IKE) at the Attica Technology Park "Lefkippos"
- We aspire to make laser bioprinting technology attractive to researchers and developers primarily in the Biomedical sector with our compact laser bioprinter.
- We have IP (PCT/EP2017/084740, 28/12/2017 and US Provisional Patent 63062176, 6/8/2020).
- We have a fully functional pre-industrial prototype and we are in the process of developing our product
- We are also focusing on testing applications on tissue regeneration, such as bladder, esophagus and cartilage.

Team

Dr Ioanna Zergioti

Co-founder, CEO co-inventor
First Scientist worldwide to apply
LIFT for solid phase DNA printing

Dr Apostolos Klinakis

Co-founder, Clinical Director
25-year background on cancer biology
mouse genetics and stem cell biology

Dr Symeon Papazoglou

Co-founder, CTO, co-inventor
Researcher with >5 years experience in laser printing systems

Maria Pallidou

Co-founder, CFO
20 years experience Health Care
Industry in EMEA Region

Advisors

Dr Achilleas Gravanis

Professor of Pharmacology Medical School
University of Crete. Researcher IMBB FORTH,
Affiliated Research Professor Center of Drug
Discovery Northeastern University Boston

Dr Ioannis Viniotis

Professor at the Department of Electrical
and Computer Engineering at North
Carolina State University

Dr Dimitri Papaioannou

Managing Director of Exelon Partners a
specialty management consulting firm based
in Athens & Silicon Valley.

Spin off from ICCS

Our story so far

- 2016 : Initiation of dual beam Laser bioprinting process by I. Zergioti/ICCS
- 2017/2018: Pre-industrial prototype, IP Protection (PCT/EP2017/084740)
- 2019 PhosPrint PC incorporated-spin off ICCS/NTUA
- 2019: Grant from Bodossaki Foundation in Greece to support our IP costs
- 2019: EU Seal of Excellence/SME instruments phase I
- 2020: Winner of an accelerator Science Park (50k€)
- 2020: Filing of US Provisional Patent Application on bladder regeneration including also cartilage and esophagus application cases
- 2021 May - 4 years: European Funded Project “Tumor-LN-oC” under the H2020 NMBP-23-2020 call
- 2021 September – 4 years: European Funded Project “UroPrint” under the H2020-FETOPEN-2018-2020

PhosPrint

Group and collaborators

1. *E. Elezoglou, MSc student*
2. *H. Cheliotis, MSc student*
3. *K. Magoula, MSc student*
4. *M. Logotheti, MSc*
5. *C. Kryou, PhD student*
6. *M. Chliara, PhD student*
7. *Ch. Katopodis, PhD student*
8. *S. Kananakis, Meng, MSc*
9. *D. Mandala, MSc*
10. *Dr. S. Papazoglou*
11. *Dr. M. Makrygianni*
12. *Dr. F. Zacharatos*
13. *Dr. M. Chatzipetrou*
14. *Dr. C. Chandrinou*
15. *Dr. I. Theodorakos*

BRFAA
BIOMEDICAL RESEARCH FOUNDATION
ACADEMY OF ATHENS

A. Klinakis
P. Karakaidos

C. Tamvakopoulos
M. Orfanou
G. Tsekenis