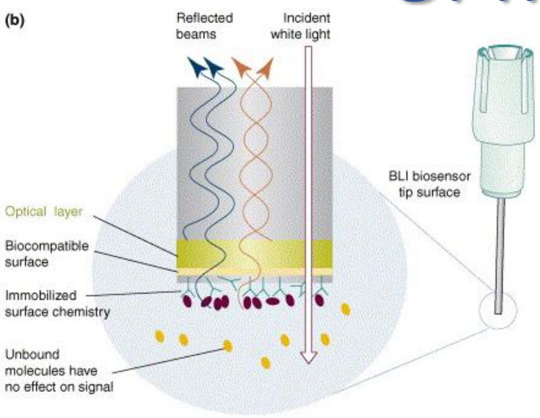
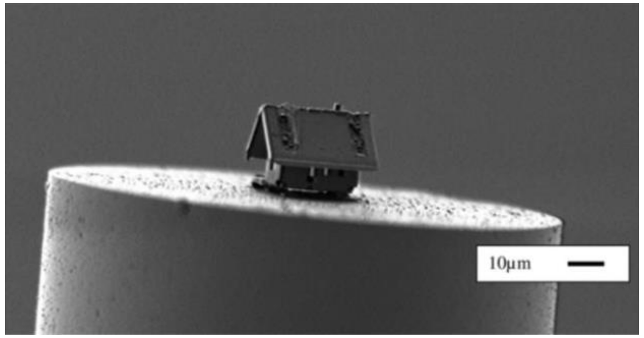
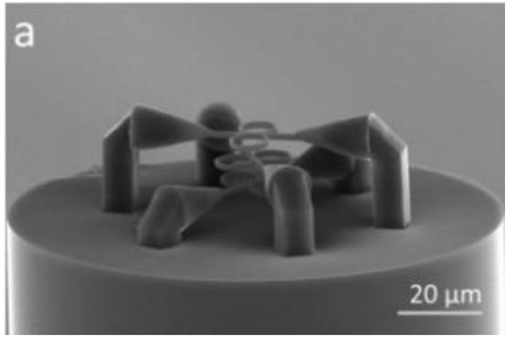
Lab on Fiber Technology: Towards New Advanced Optical Optrodes for Life Science Applications







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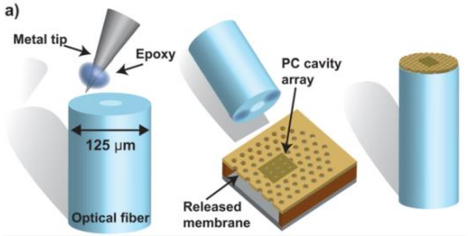
UNIVERSITÀ DEGLI STUDI DEL SANNIO Benevento

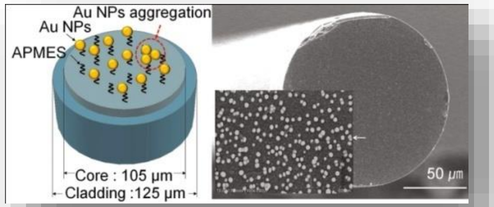
OPTOELECTRONICS group University of Sannio

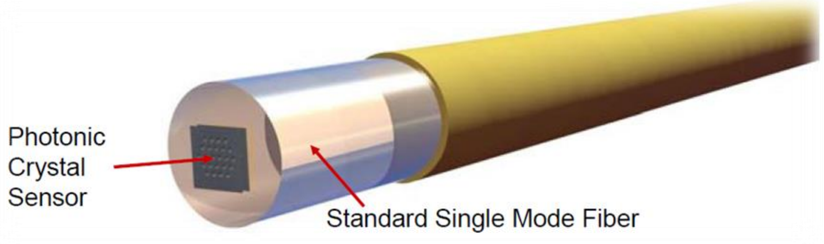
LAB ON FIBER TECHNOLOGY:

TOWARDS INTEGRATED AND MULTIFUNCTIONAL NANO-PROBES

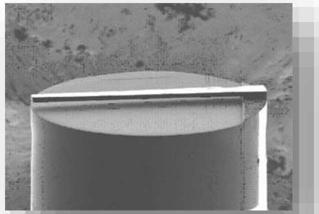
Integration and patterning at micro and nano scale of different functional materials with desired optical, physical and chemical properties

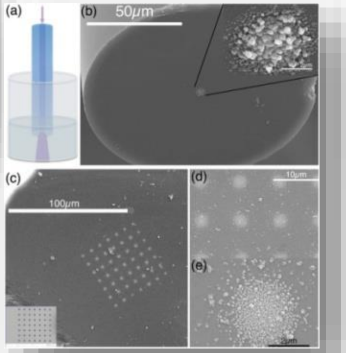


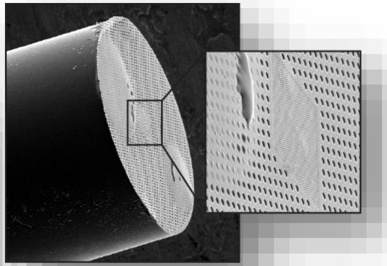


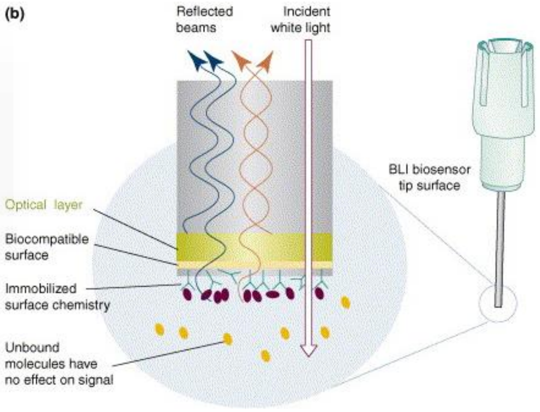


Increased light matter interaction and creation of a technological world completely integrated within optical fibers with significant advantages in terms of functionality, performances, miniaturization, robustness, cost effectiveness and power consumption









MAIN BARRIER

Definition of a reliable ***fabrication procedure able to integrate, at micro- and nano-scale,*** several materials onto unconventional substrates such as the optical fibers.

THE LAB ON FIBER TECHNOLOGY

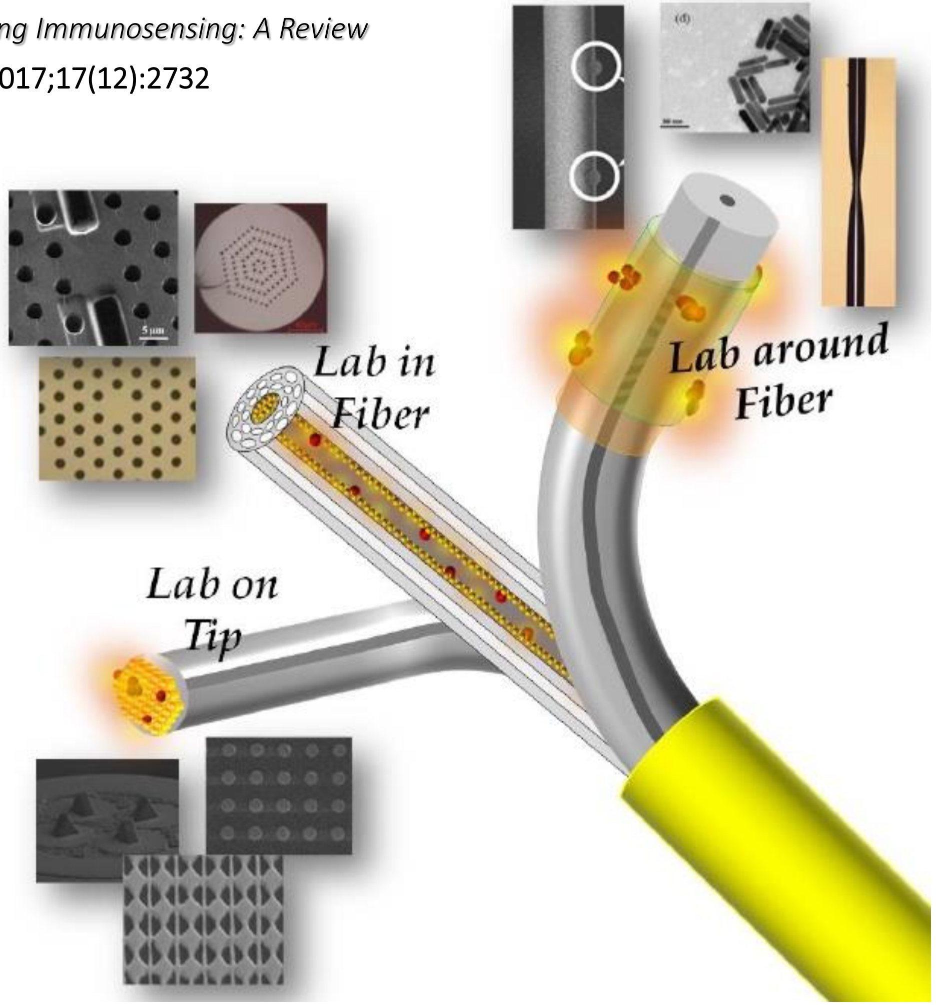
Shrinking the 'labs' onto the optical fibers

F. Chiavaioli, F. Baldini, S. Tombelli, C. Trono, A. Giannetti
Biosensing with optical fiber gratings
Nanophotonics, vol. 6, no. 4, 2017

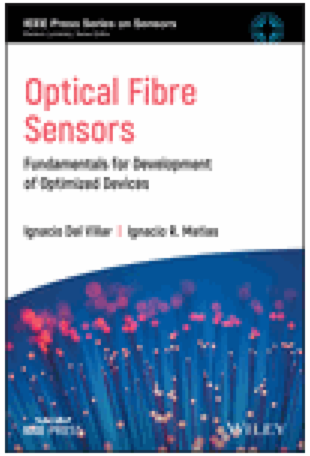
T. Guo, Á . González-Vila, M. Loyez, C. Caucheteur
Plasmonic Optical Fiber-Grating Immunosensing: A Review
Sensors (Basel). 2017;17(12):2732

Stavros Pissadakis
Lab-in-a-fiber sensors: A review
Microelectronic Engineering, Vol. 217, 2019

P. Vaiano, A. Cusano et al.
Lab on Fiber Technology for biological sensing applications.
Laser & Photonics Reviews, 2016, **10**(6), 922-961



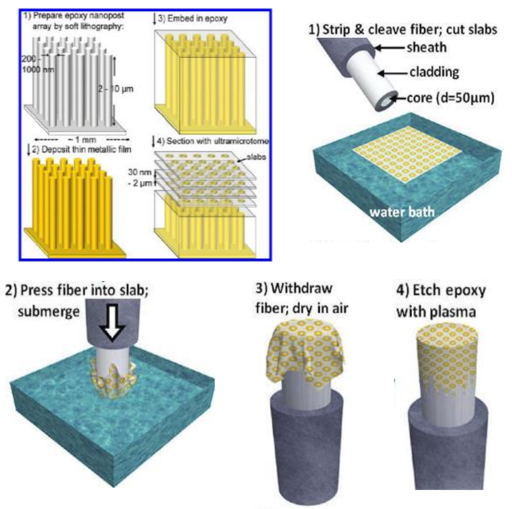
Editor(s): Ignacio Del Villar, Ignacio R. Matias
Optical Fibre Sensors: Fundamentals for Development of Optimized Devices
IEEE Press & Wiley 2020



THE FABRICATION ROUTES

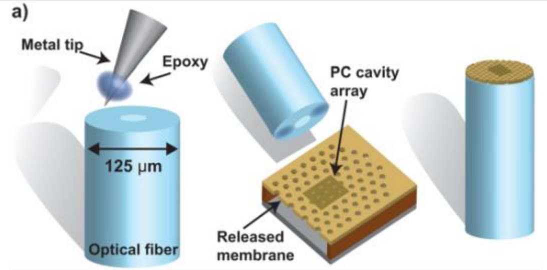
NANO-TRANSFERRING

Soft lithography, nano-skiving and dipping

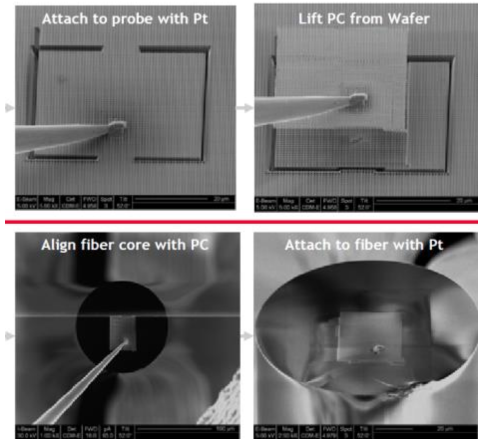


D. J. Lipomi, F. Capasso et al., Nano Lett. 2011, 11(2) 632-6

Epoxy bonding and welding



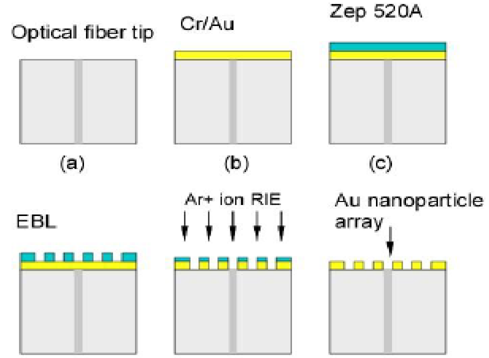
G. Shambat, J. Vuckovic et al., Appl. Phys. Lett. 99, 191102 (2011)



W. Jung, O. Soolgard et al., IEEE J. Lightwave. Tech. 29, pp 1367-74 (2011)

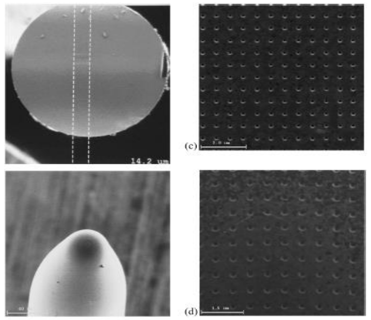
DIRECT-WRITING

EBL and RIE



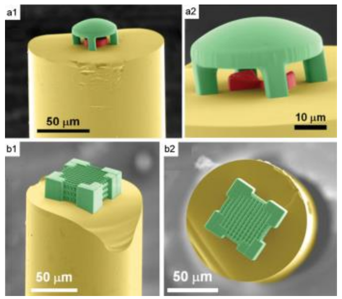
Y. Lin, et al., Biomed Opt Express. 2011; 2(3): 478–484.

FIB milling

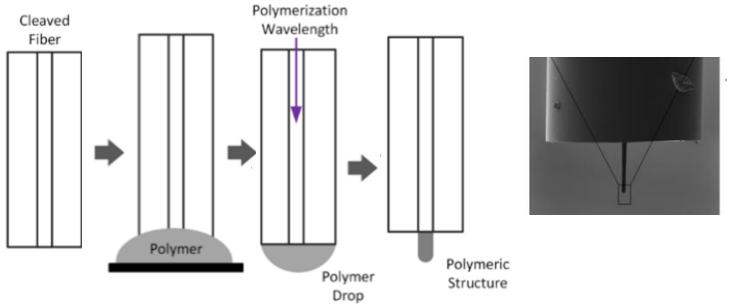


A. Dhawan et al., Sens. J. IEEE 2008, 8, 942-950

Multi-photon direct laser writing/polymerization



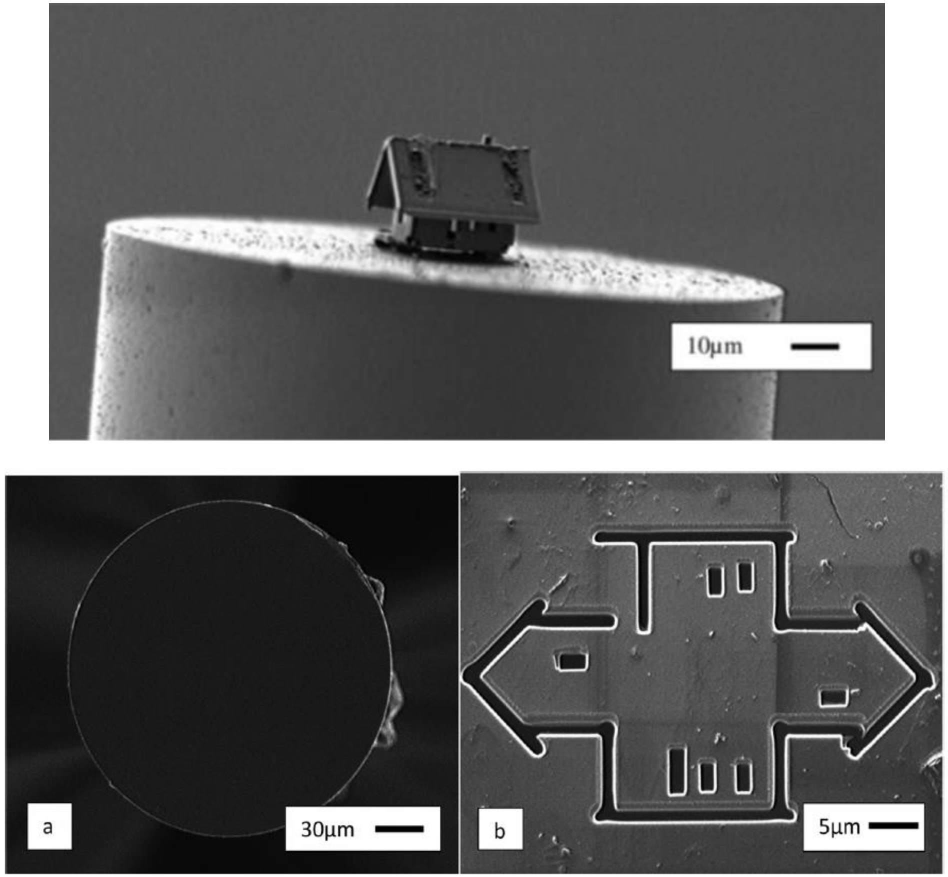
H. E. Williams et al., Opt. Express 19, 22910 (2011)



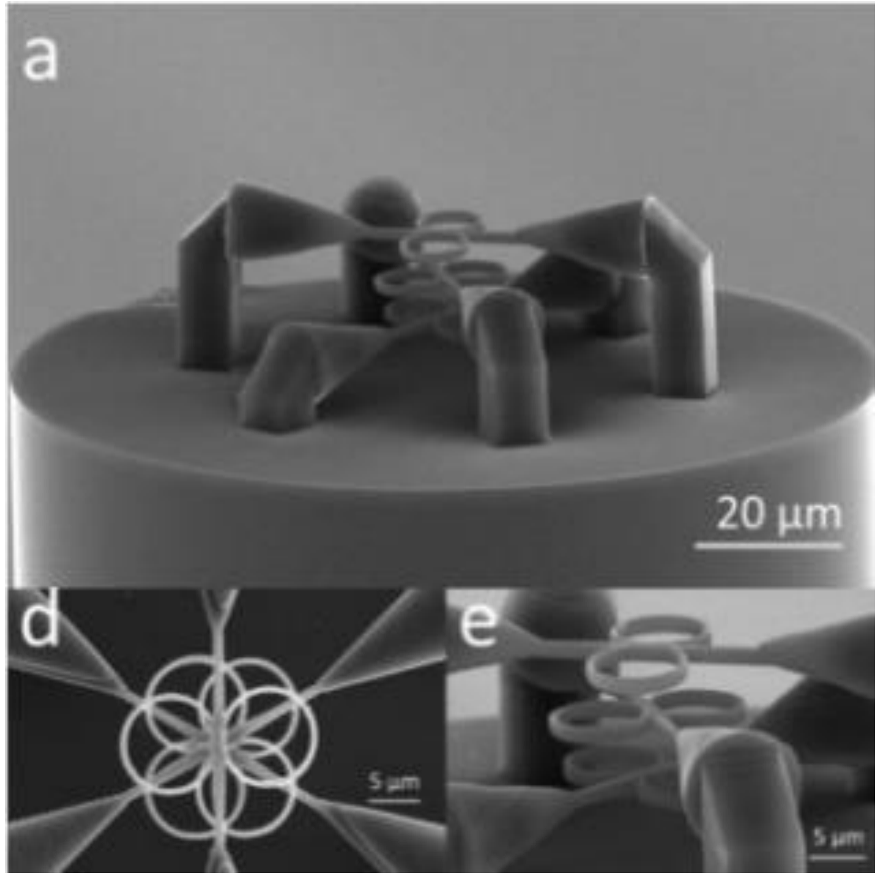
Ribeiro R. et al. Photonics 2, pp 634-645 (2015)

"Lab-on-fiber technology: A roadmap toward multifunctional plug and play platforms"
"Pisco, M., Cusano, A. *Sensors (Switzerland)*, 2020, 20(17), pp. 1-20, 4705

TOWARDS 3D LAB ON FIBER TECHNOLOGY



J. Rauch et al. *J. of Vacuum Science and Technology 36 (2018): 041601.*



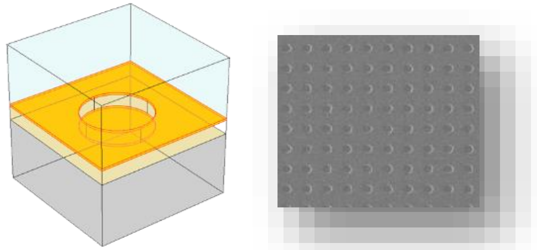
Q. Liu et al, *Optics Express 28, 8, (2020)*

TECHNOLOGY CLUSTER

IMM

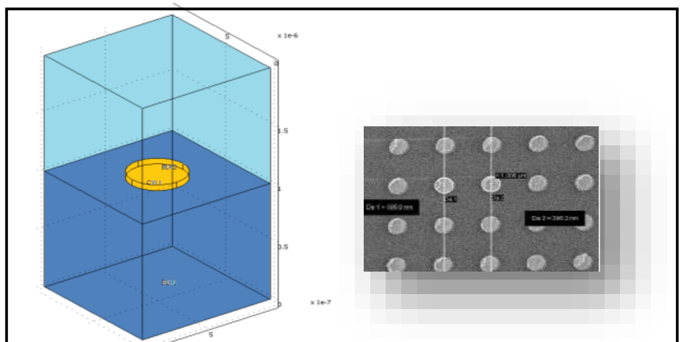
Istituto per la Microelettronica e Microsistemi NAPLES

Hybrid metallo-dielectric nanostructures

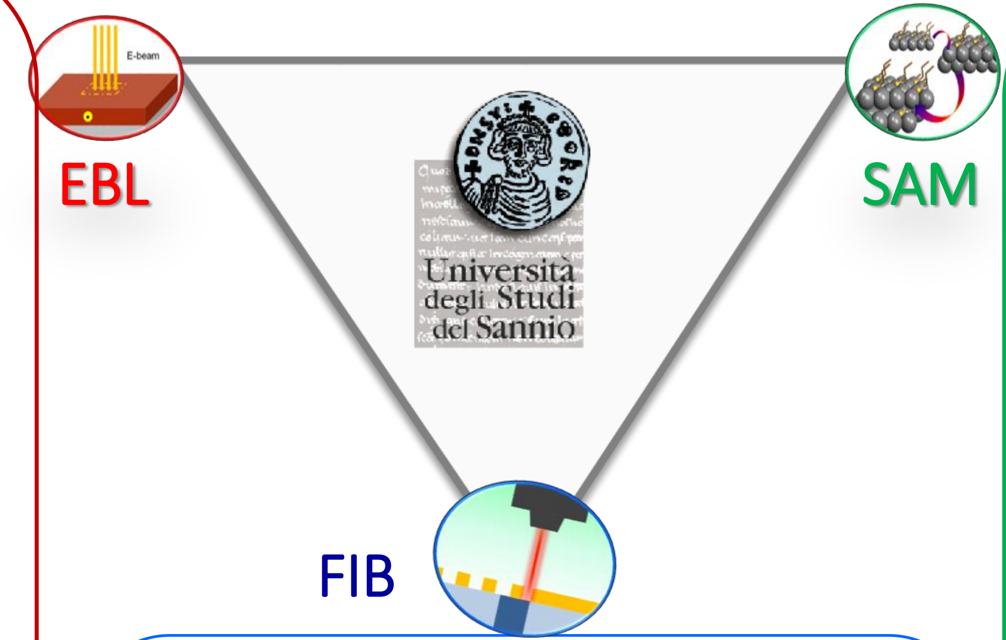


Consales et al, ACS Nano, 6 (4), pp 3163–3170 (2012)
Cusano et al. Adv. Funct. Mater. 22, 4389-4398 (2012)
Ricciardi et al./ Optical Fiber Technology, Vol. 19, pp. 772-784, 2013

Gold nanopillars



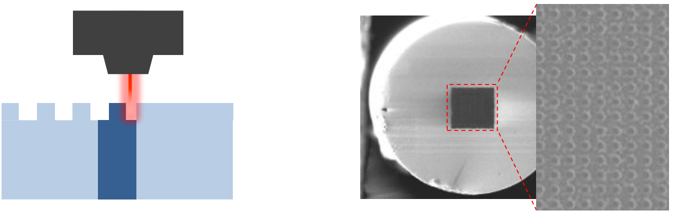
Ricciardi et al, Analyst, 2015, 140, 8068-8079



ENEA

Ente Nazionale per l'Energia e l'Ambiente, Portici (NAPLES)

Fiber tip templating/ gold nanopatterning

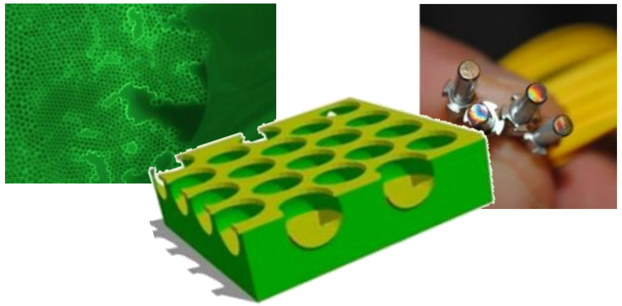


Micco, A. et al./ Scientific Report 5, 15935 (2015)
M. Principe et al, Light: Science & Applications (2017) ***6****, e16226.*

ISMAC

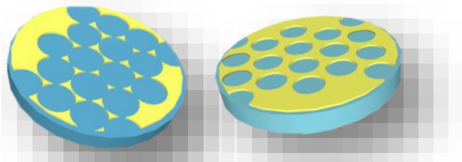
CNR -Istituto per lo studio delle Macromolecole, MILAN

Self assembly – Breath figure



Pisco et al./ ACS Photonics, 1 (10), pp 917-927 (2014)

Nanosphere lithography



Pisco et al. Light: Science & Applications (2017) 6, e16229

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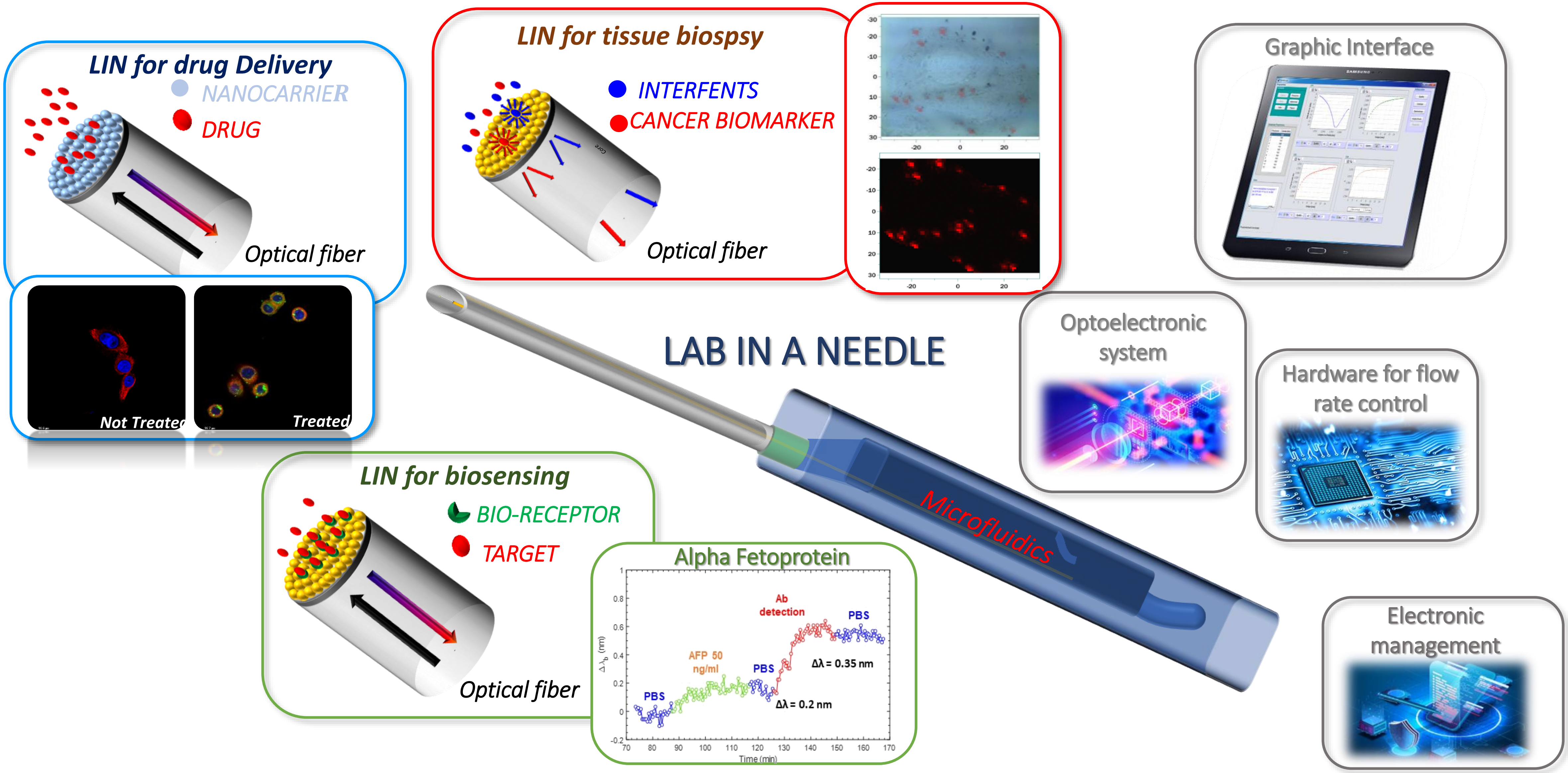
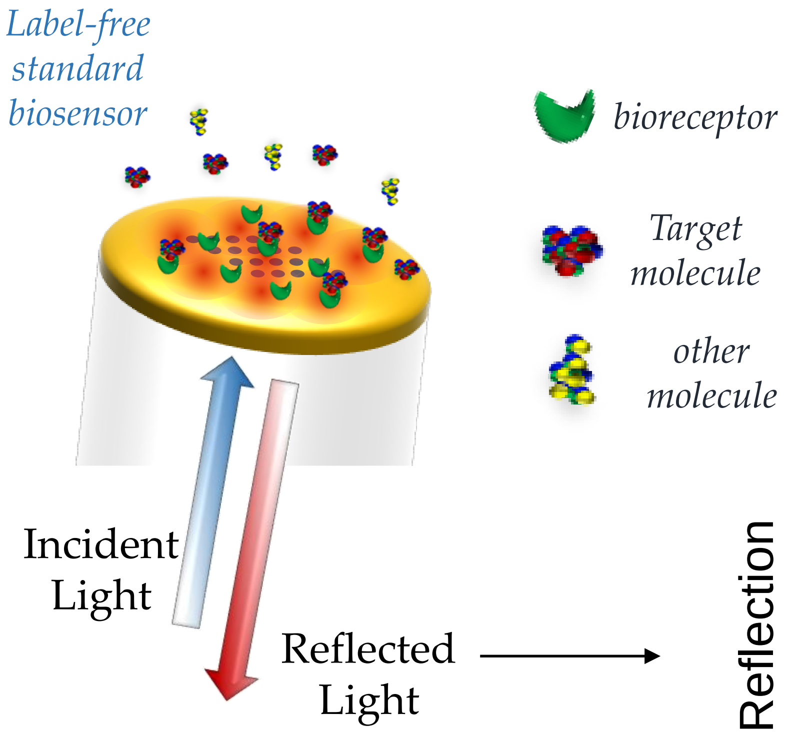
THE VISION

OPTOELECTRONICS group University of Sannio

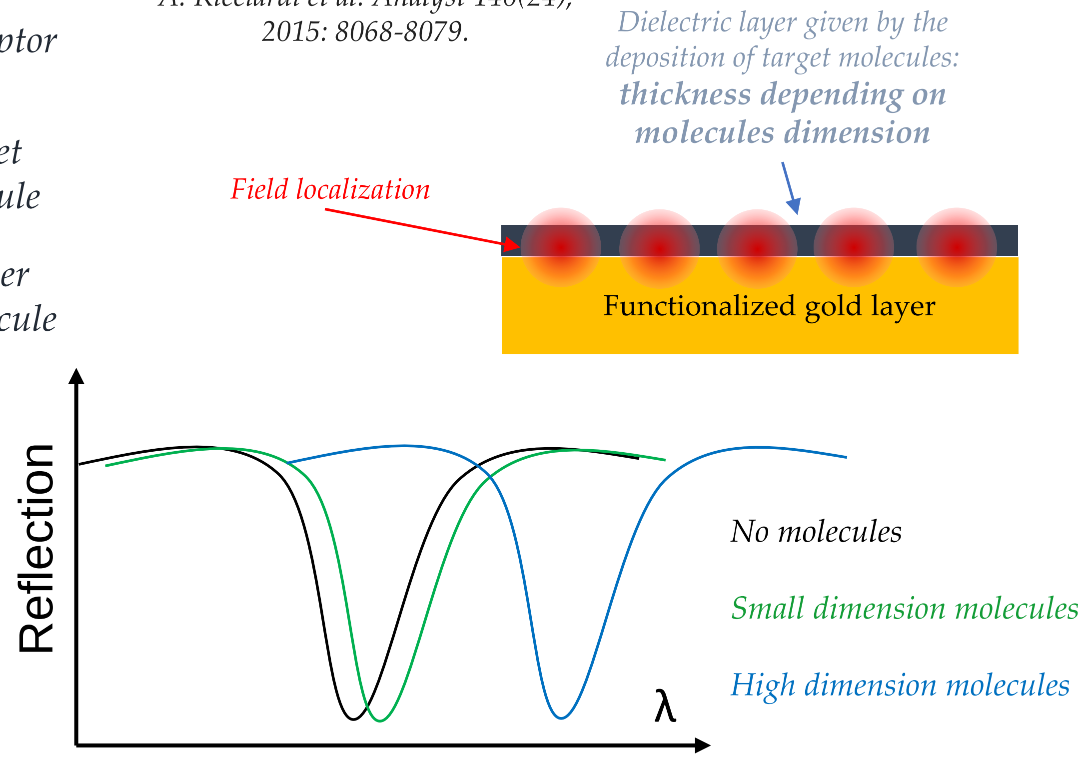


MAIN LIMITATIONS OF LAB ON TIP LABEL FREE PLATFORMS

Local refractive index changes due to the capture of the target biomarker to the bioreceptor are detected as resonant wavelength shift in the reflection spectrum.



A. Ricciardi et al. Analyst 140(24), 2015: 8068-8079.

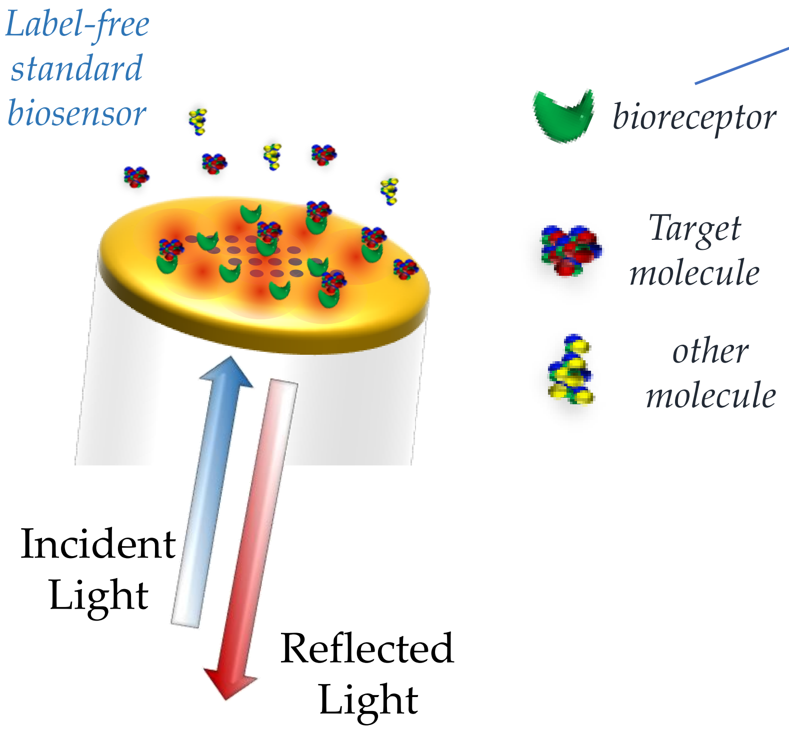


Main limitation: the maximum wavelength shift is related to the concentration and molecule dimension.

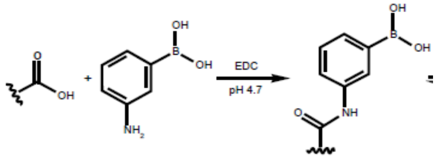
A Lab-on-Fiber Plasmonic Device for Biological Sensing

Label-free standard approach

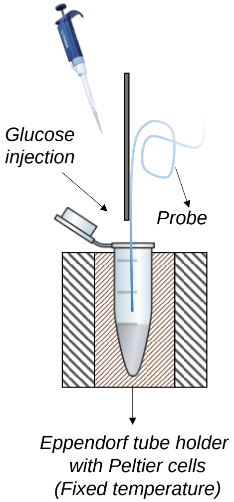
Local refractive index changes due to the capture of the target biomarker to the bioreceptor are detected as resonant wavelength shift in the reflection spectrum.

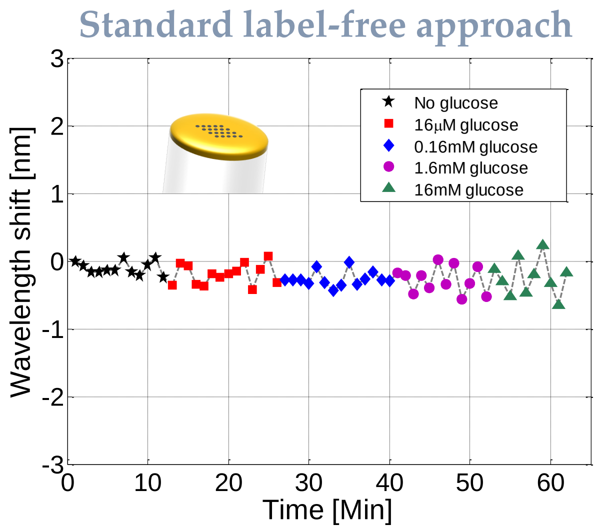


Amino-Phenyl **Boronic (APBA)**



Glucose as banchmark small molecule (180 Dalton)





Main limitation: the maximum wavelength shift is related to the concentration and molecule dimension.

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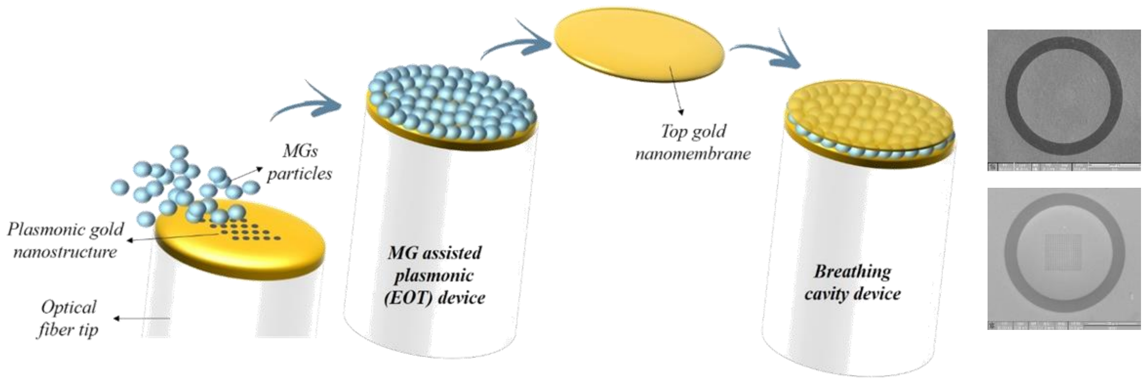
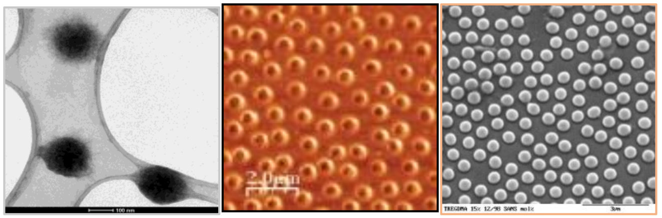
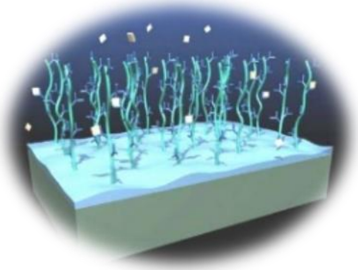
CAVITY ENHANCED LAB-ON-FIBER TECHNOLOGY



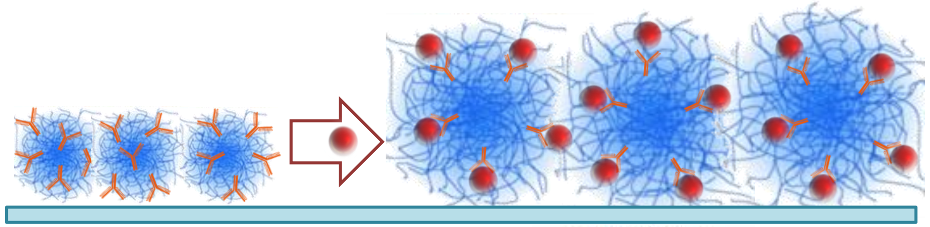
Sub-micrometer hydrogel particels i.e Crosslinked water soluble polymers (physically restricted, dimensionally stable)



MICROGELS AS AMPLIFICATION SYSTEM FOR LABEL-FREE DETECTION



Translating an interaction surface in an interaction volume



1. Amplification of the binding sites

2. Enhance the superficial changes due to binding

MICROGEL ASSISTED LAB-ON-FIBER OPTRODE

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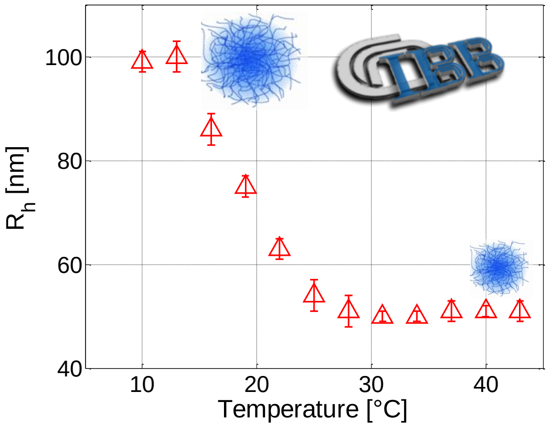
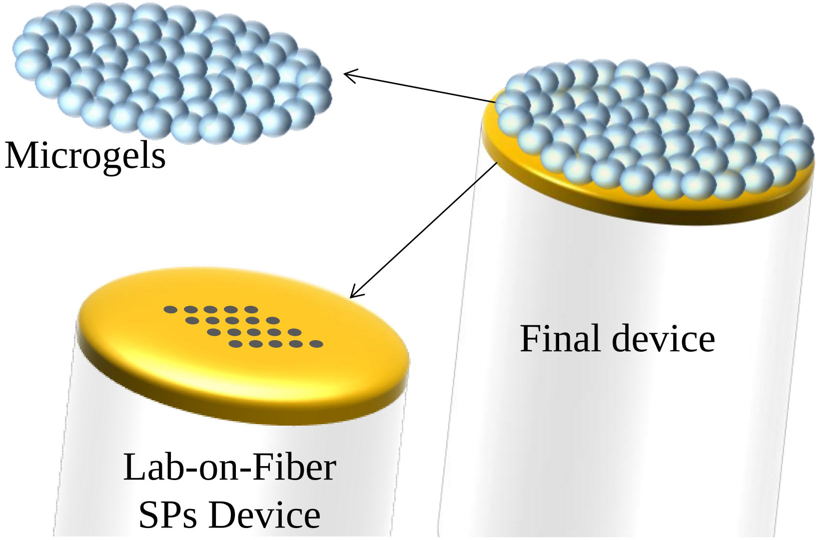
Microgel synthesis and characterization

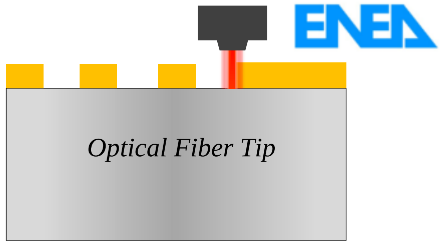




Aliberti et al., Sci. Rep., 7, 2017

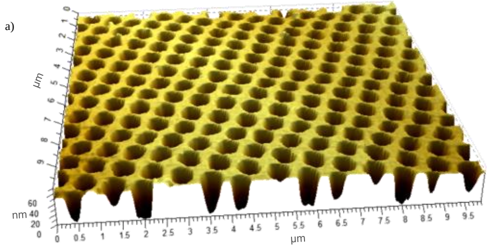
Lab-on-Fiber device design, fabrication and characterization

FIB lithography

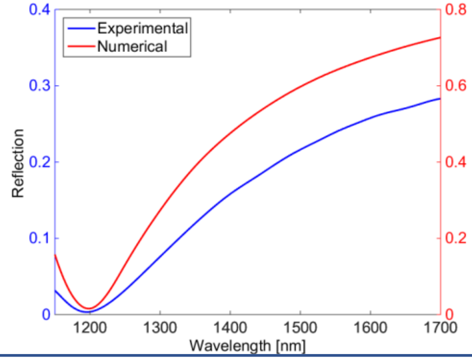


Period: 700nm
Radius: 219 nm

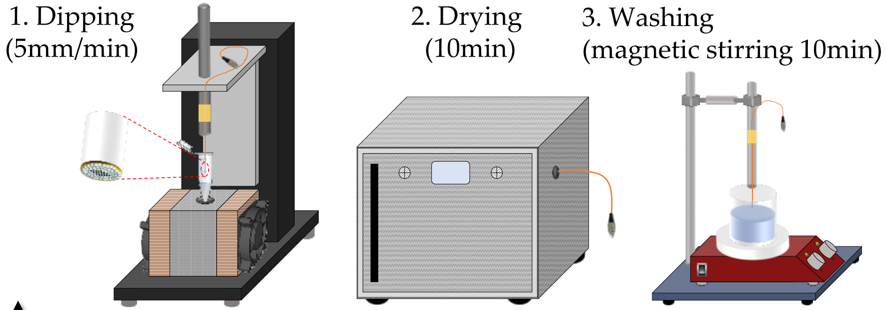
AFM Analysis

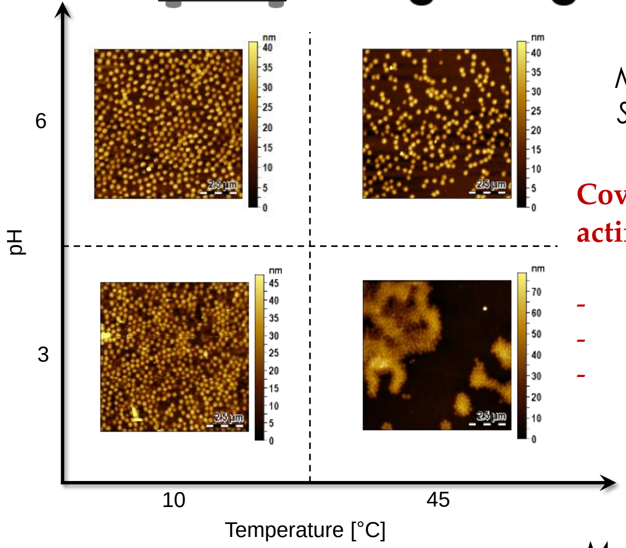


Optical characterization



Microgel Microgel film deposition





M. Giaquinto et al., Sensors, 18(4), 2018

Coverage factor control acting on:

- Solution temperature
- Solution pH
- Microgels concentration

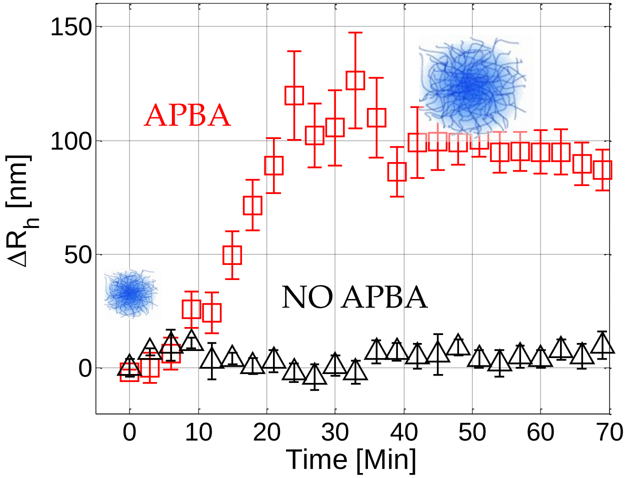
M. Giaquinto et al., Scientific Reports, 18, 2018

$$h_{slab} = 2.4R - 0.92r_b$$

$$n_{slab} = \overline{\gamma}(n_p - n_s)\frac{3hr_b^2 + h^3}{6\overline{r}^2}\frac{1}{h_{slab}} + n_s$$

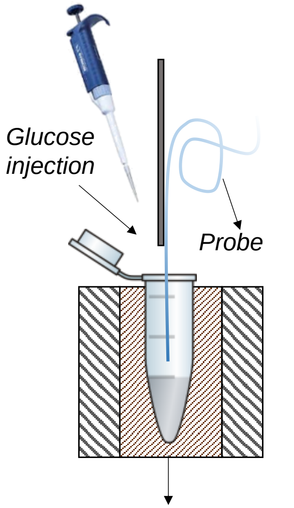
MICROGEL ASSISTED LOF OPTRODE FOR BIOSENSING

DLS measurements

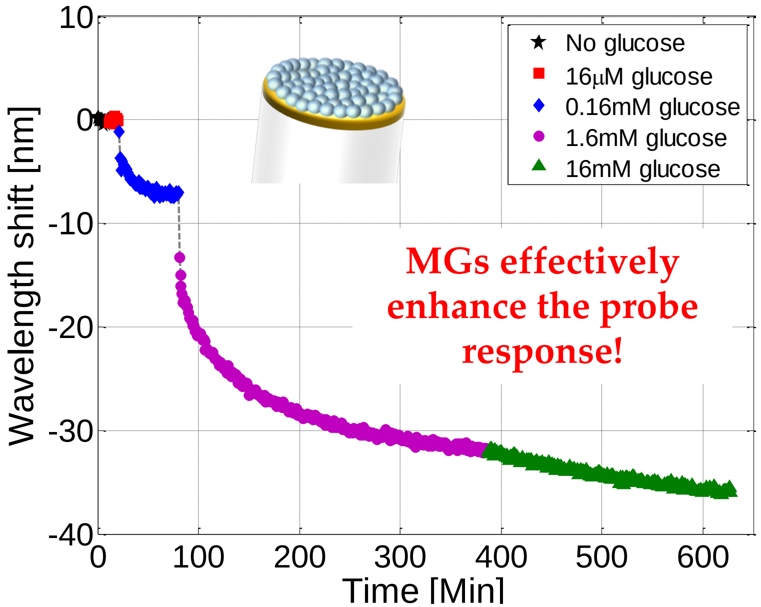


Microgels swelling

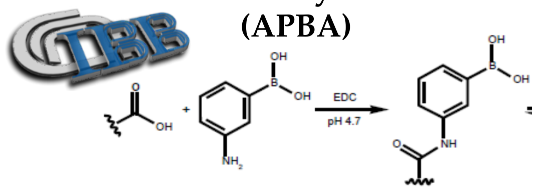
RI decrease



MGs-assisted LOF device

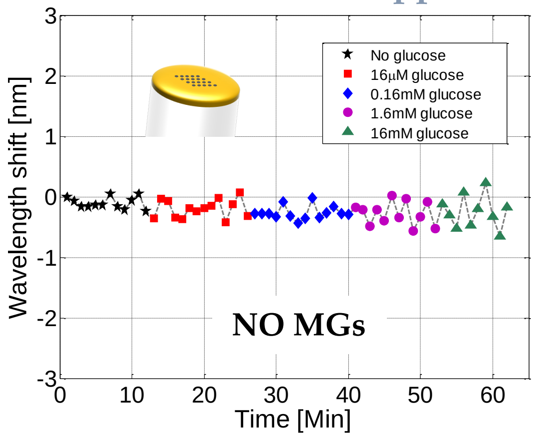


Amino-Phenyl Boronic (APBA)



Glucose as banchmark small molecule (180 Dalton)

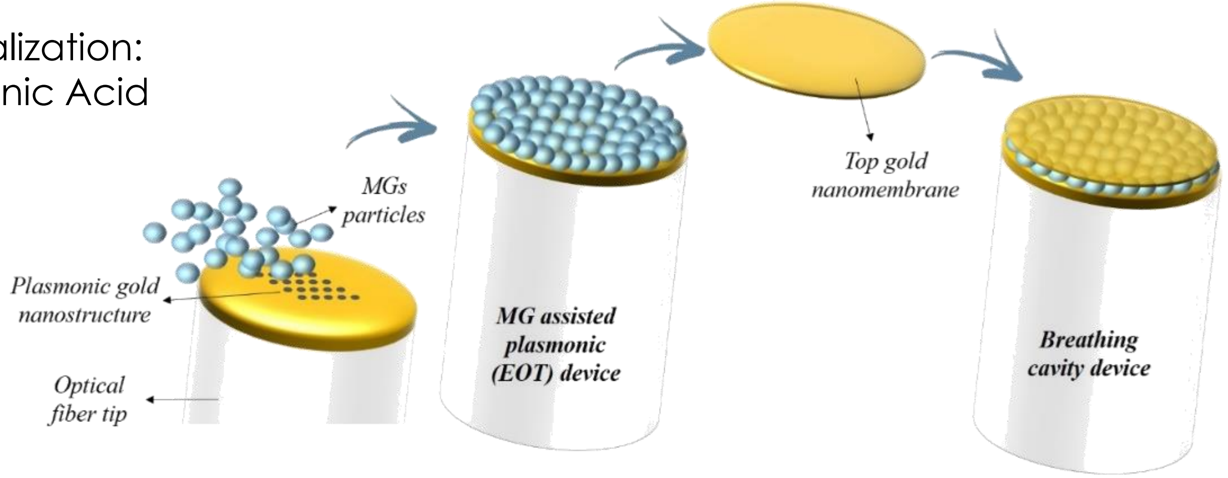
Standard label-free approach



Aliberti, et al. "Microgel assisted Lab-on-Fiber biosensors", Scientific Reports, 7, 2017

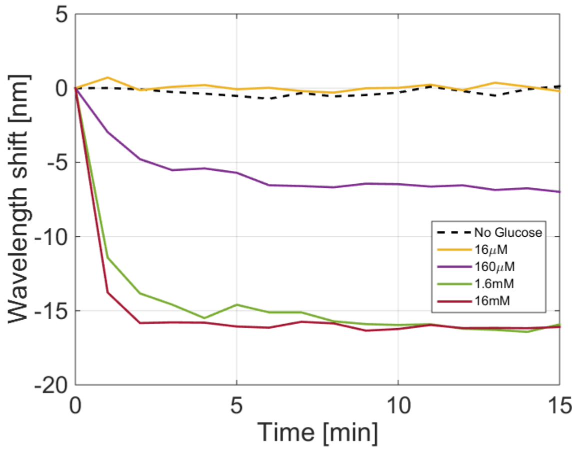
Cavity Enhanced Lab-on-Fiber Technology

Microgel functionalization:
Amino-Phenyl Boronic Acid

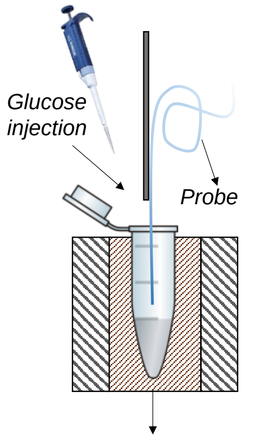


Small molecules (glucose) detection

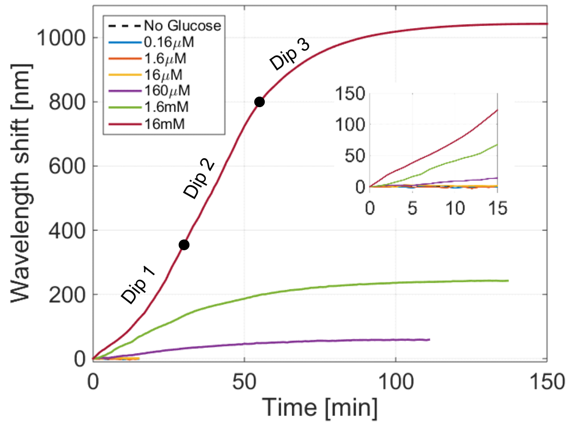
Standard 'open' device



Glucose as benchmark small molecules (180 Dalton)



Cavity enhanced device



Aliberti, A. et al., Scientific reports 7(1), 14459. (2017)

Giaquinto, M., et al ACS Photonics 6(12), 3271-3280. (2019)

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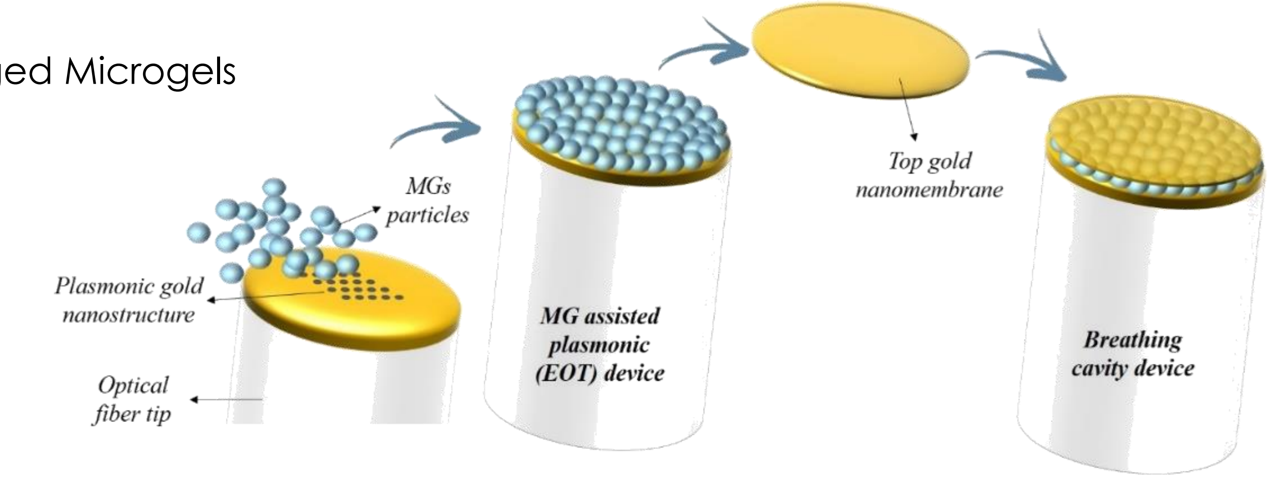
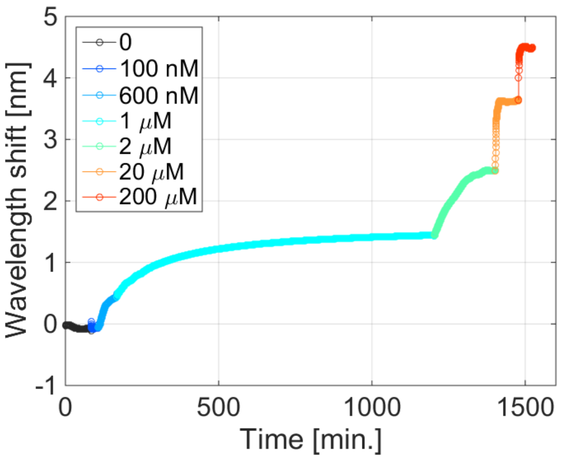
CAVITY ENHANCED LAB-ON-FIBER TECHNOLOGY

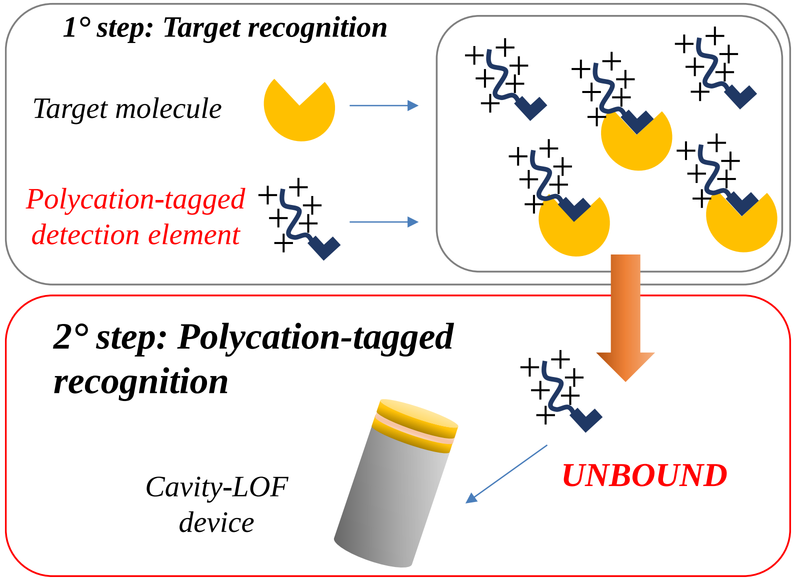
Negatively charged Microgels



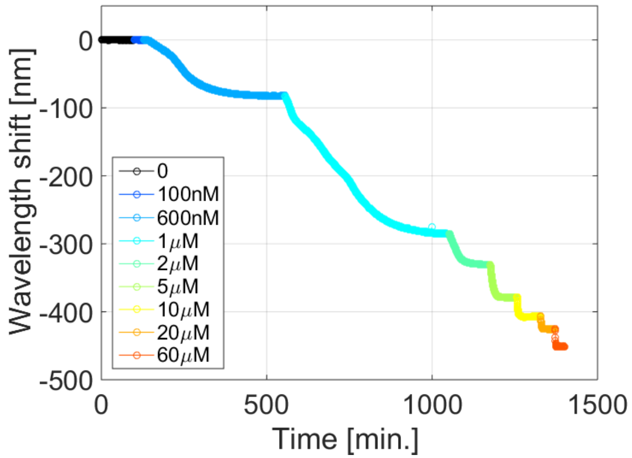
POLYCATIONS DETECTION FOR INDIRECT ASSAYS

Standard 'open' device





Cavity enhanced device

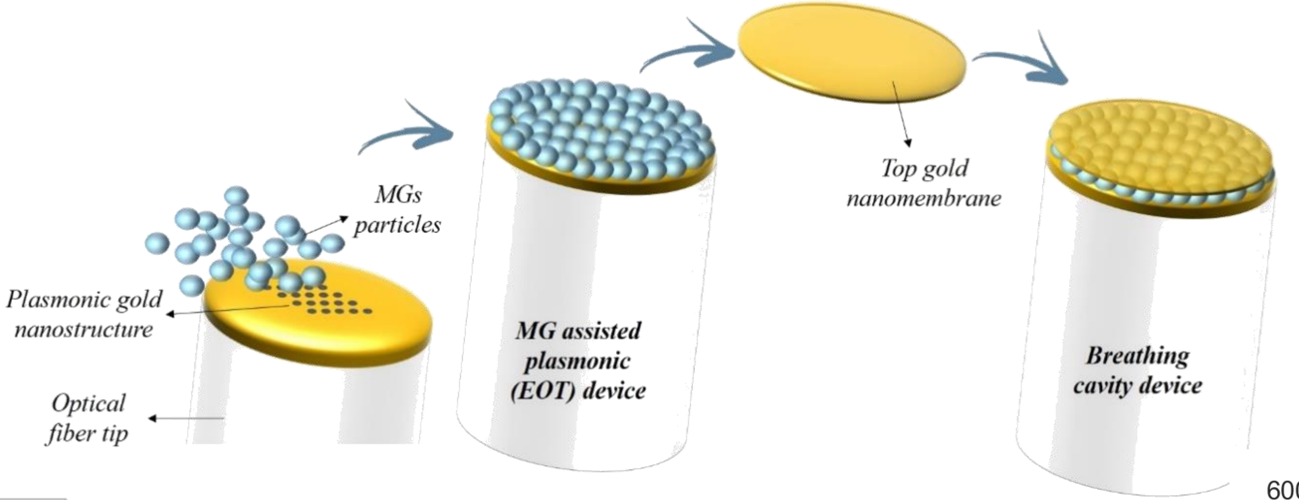


F. Gambino, et al, Sensors and Actuators B: Chemical, 353, 2022

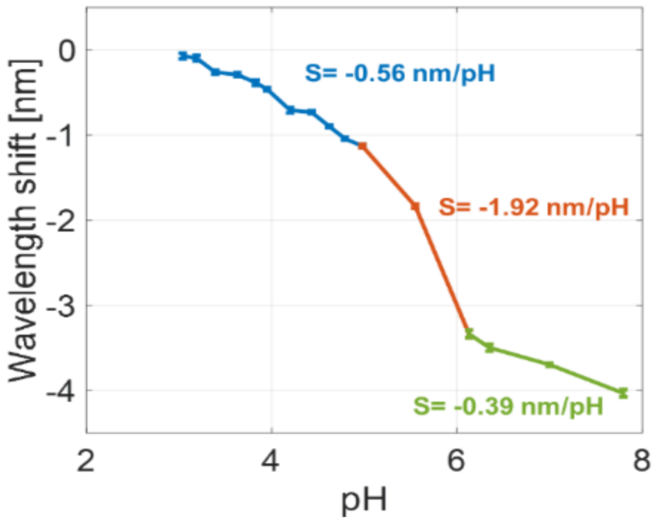
CAVITY ENHANCED PROBE FOR pH MONITORING

UNIVERSITÀ DEGLI STUDI DEL SANNIO Benevento

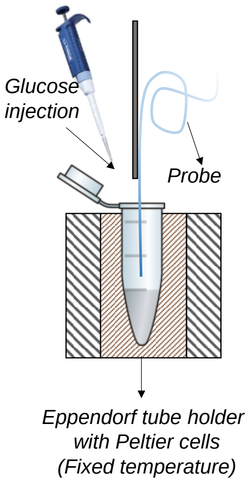
OPTOELECTRONICS group University of Sannio



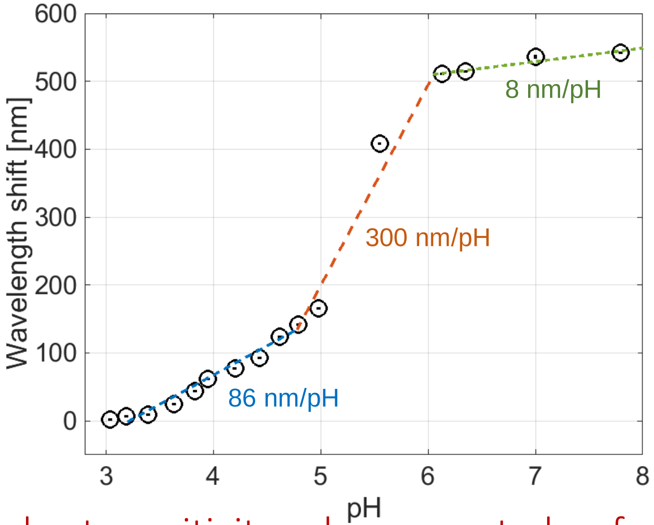
Standard "Open" Device



pH Measurements



Cavity device working in Etalon-like regime

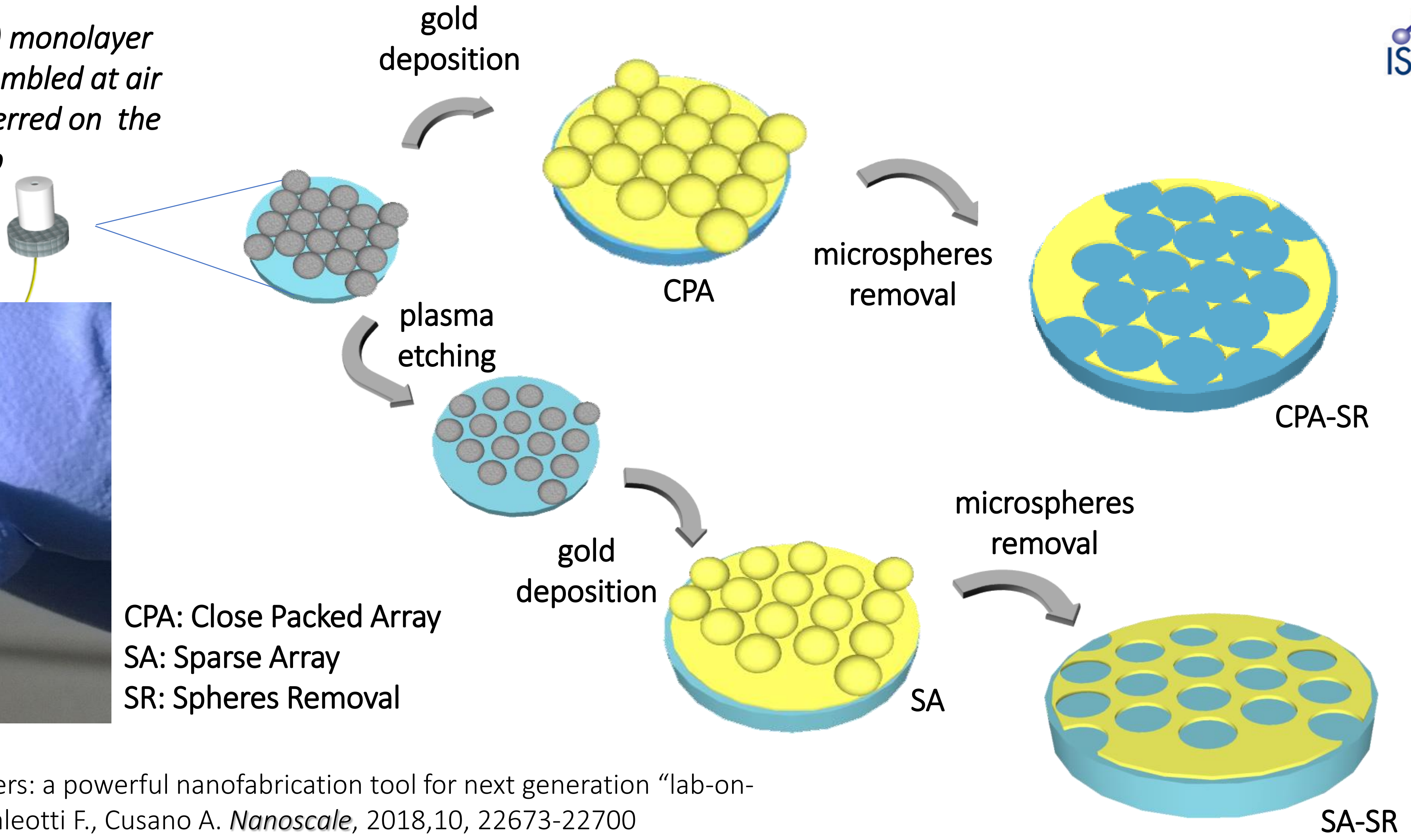


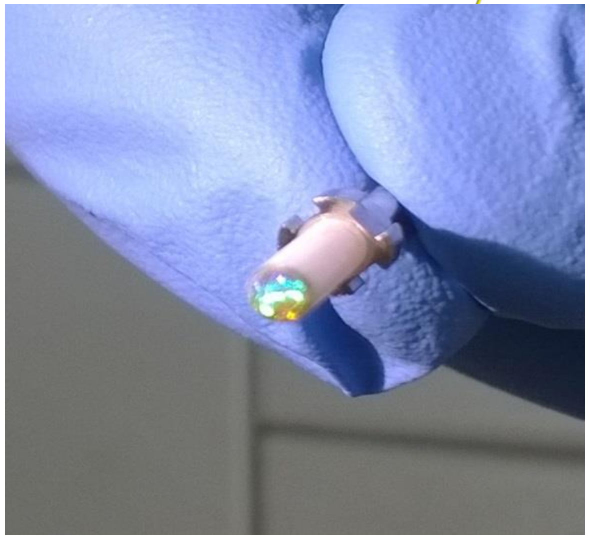
Highest sensitivity values reported so far with optical fiber pH sensors

F. Gambino, et al, Sensors & Diagnostics, 2022

NANOSPHERE LITHOGRAPHY ON FIBER: TOWARDS REPEATABLE SERS SUBSTRATES

A polystyrene spheres (PS) monolayer colloidal crystal is self-assembled at air water interface and transferred on the optical fiber tip



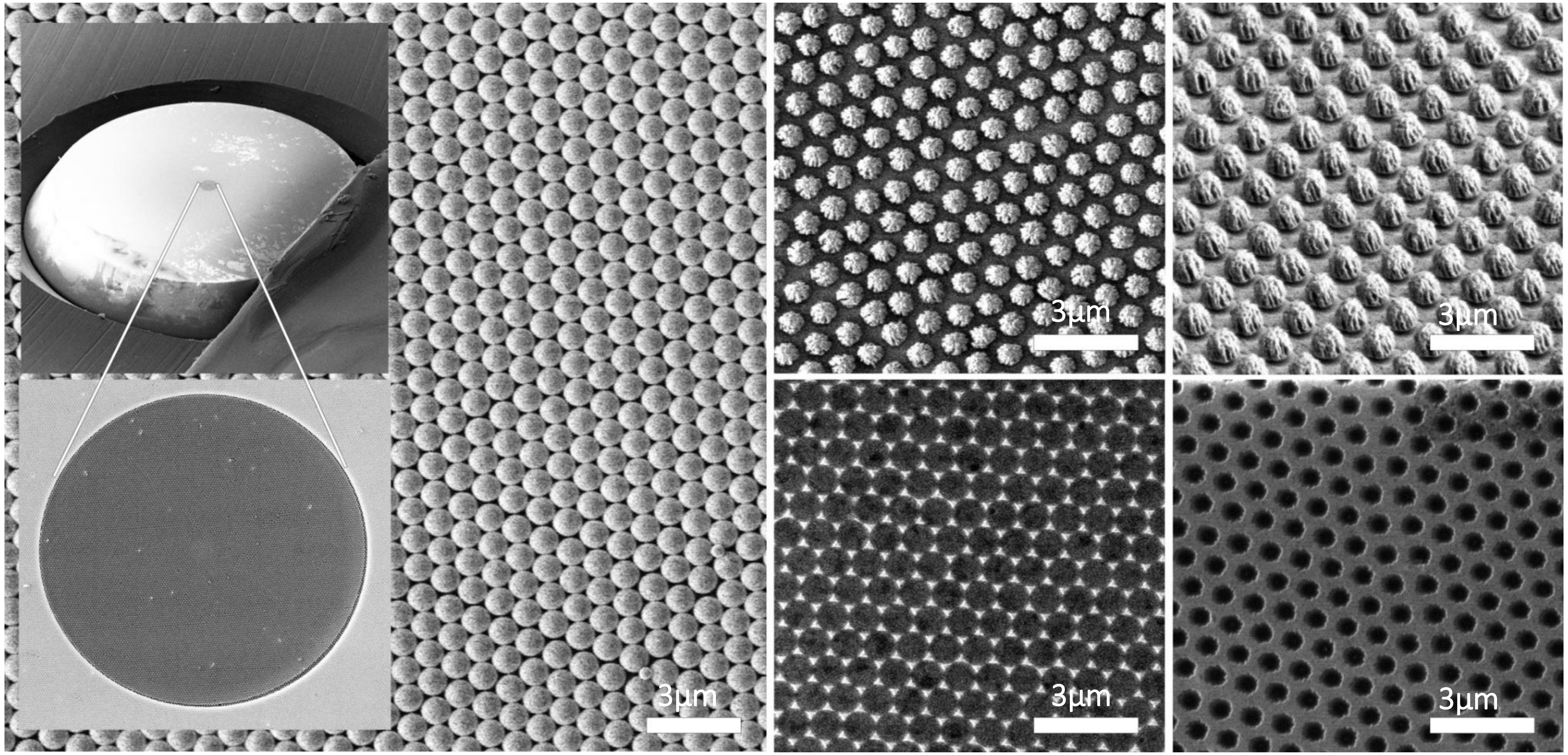


CPA: Close Packed Array
SA: Sparse Array
SR: Spheres Removal

“Self-assembly on optical fibers: a powerful nanofabrication tool for next generation “lab-on-fiber” optrodes” Pisco M., Galeotti F., Cusano A. *Nanoscale*, 2018,10, 22673-22700

NANOSPHERE LITHOGRAPHY ON THE OPTICAL FIBER TIP

Four different kinds of structural motifs are realized directly on the optical fiber facet, each of which giving rise to a different metallo-dielectric periodic pattern



M. Pisco et al., «Nanosphere lithography for optical fiber tip nano-probes», Light: Science & Applications (2017) 6, e16229

UNIVERSITÀ DEGLI STUDI DEL SANNIO Benevento

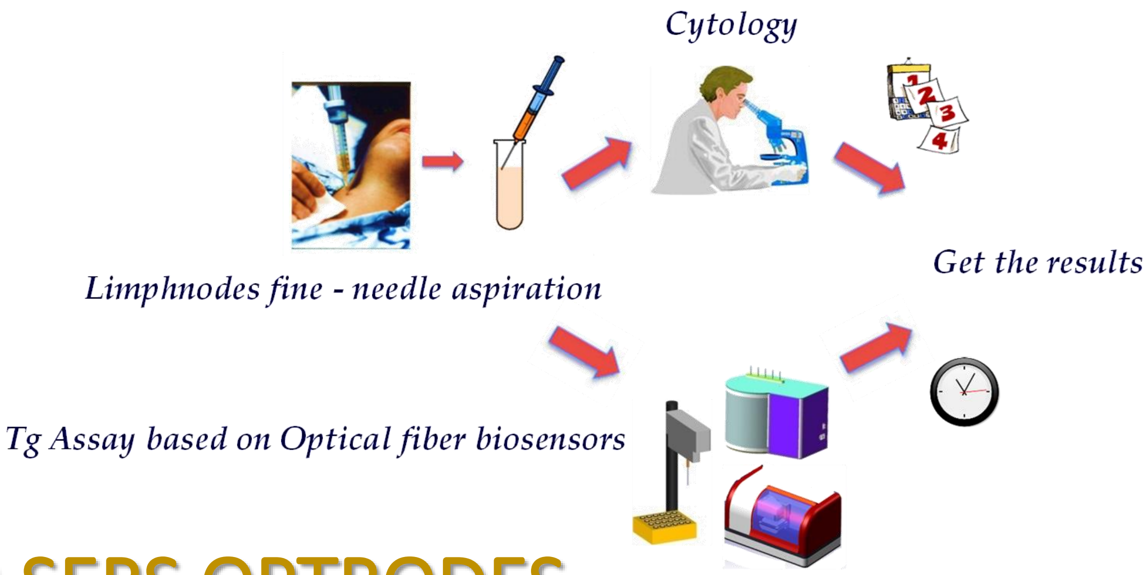
THYROID CANCER – *NEON* PROJECT

OPTOELECTRONICS group University of Sannio

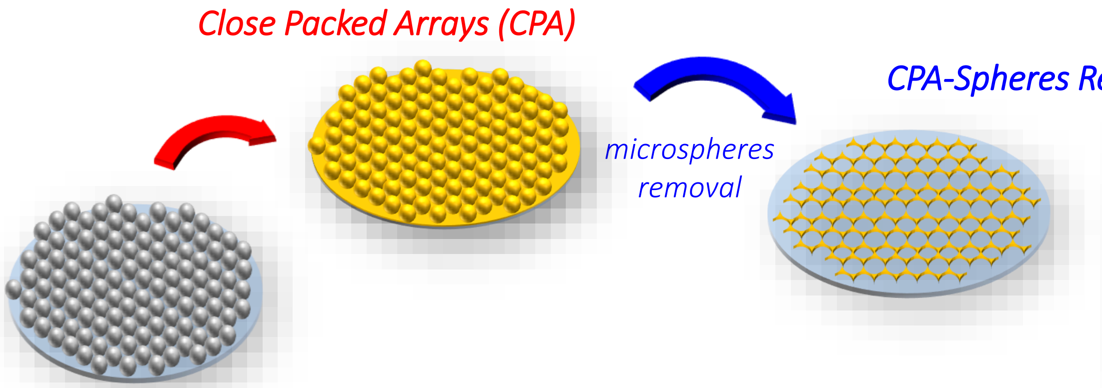
Istituto di Biochimica e Biologia Cellulare
Institute of Biochemistry and Cell Biology

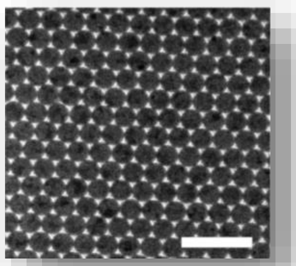
- **Thyroglobulin** is a glycoprotein (size 660 kDa) produced and used exclusively in the thyroid glands

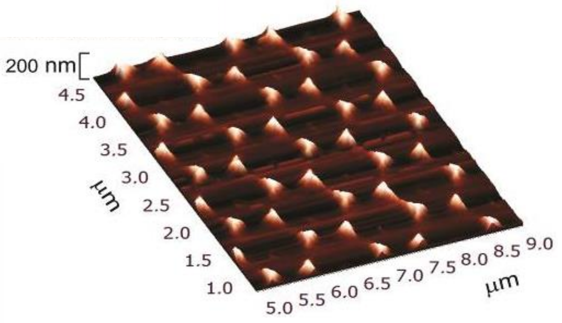
- High values of Tg concentration in the lymph nodes specifically identify the presence of differentiated thyroid cancer cells

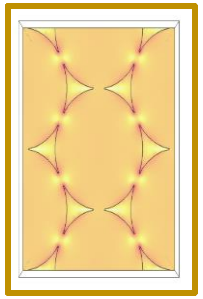


LAB ON FIBER SERS OPTRODES









SERS “hot-spots”

S. Managò *et al.*, Sensors and Actuators B: Chemical, 339, 2021

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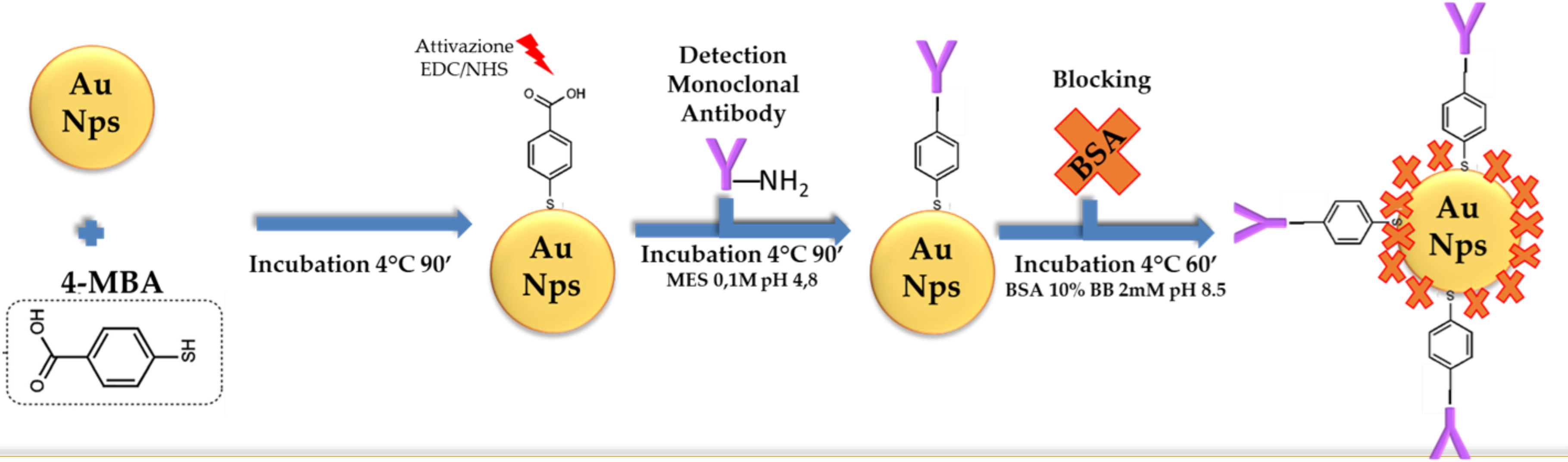
OPTOELECTRONICS group University of Sannio

SERS PLATFORM FOR HIGH-SPECIFICITY TUMOR BIOMARKER IDENTIFICATION IN LIQUID BIOPSY

PREPARATION OF RAMAN REPORTER:

i. To yield an intense Raman spectrum

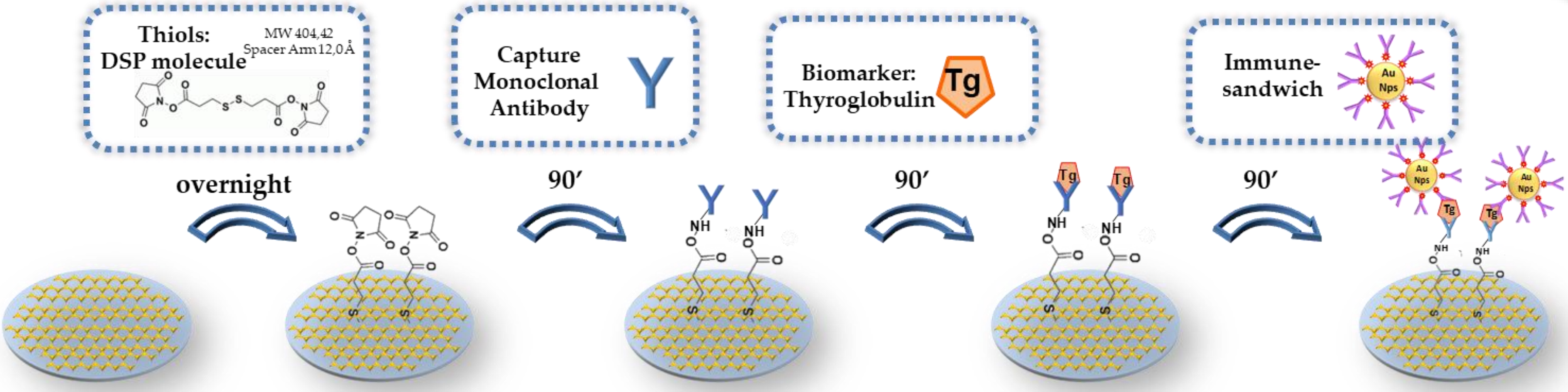
ii. To impart immunospecificity for the target biomarker



SERS-BASED IMMUNOASSAY PLATFORM:

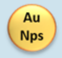
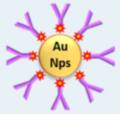
i. Antibodies were fixed on a platform to capture antigen

ii. NPs conjugated with both Raman tags and detection antibodies can then be captured for Raman/SERS detection.

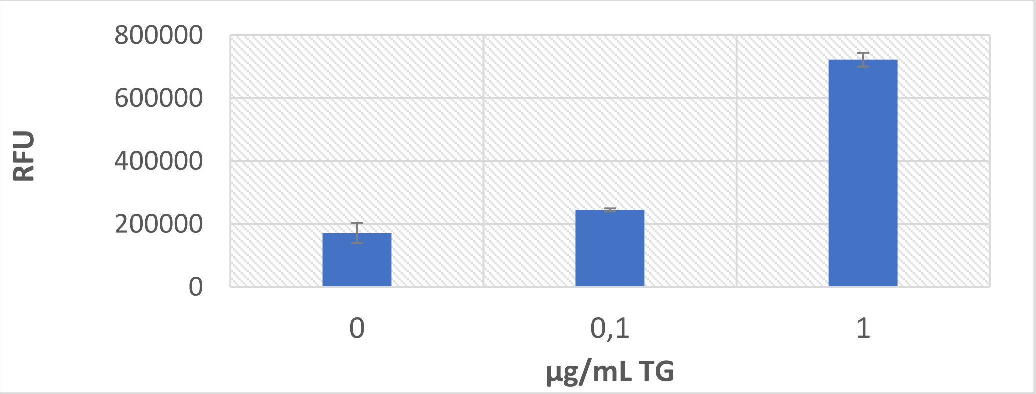


AuNps CHARACTERIZATION

DLS

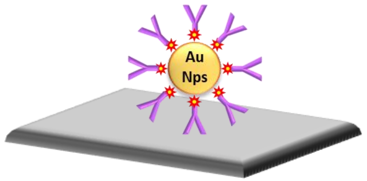
	Sample	Size (d nm)	PDI	Z pot (mV)
	40 nm naked	41,26 ± 0,05	0,130 ± 0,013	-39,7 ± 1,02
	Post functionalization	130 ± 1,40	0,206 ± 0,02	-27,8 ± 1,03

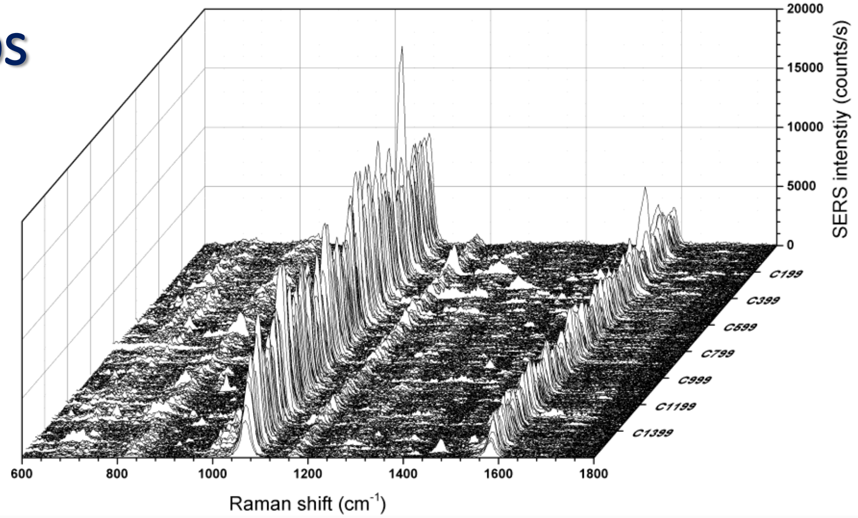
ELISA

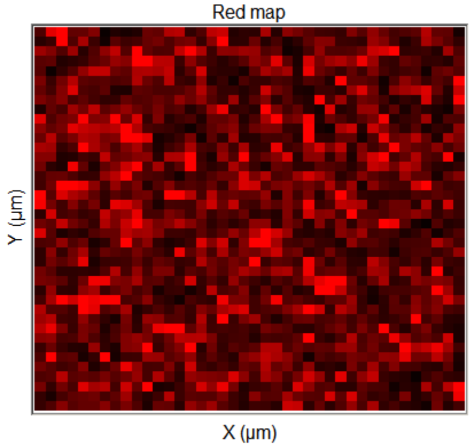


SERS signal of functionalized AuNps

The SERS spectrum of 4-MBA is dominated by the strong bands at about **1590 and 1080 cm-1** *which are assigned to aromatic ring vibrations.*







The red map of 4-MBA main peak at 1080 cm^{-1}

SERS immunoassay:

towards a Lab on Chip platform for liquid biopsy

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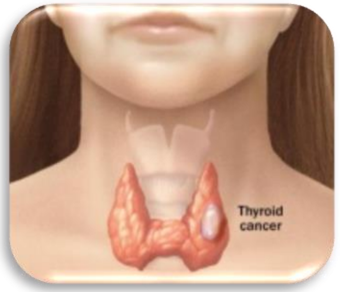
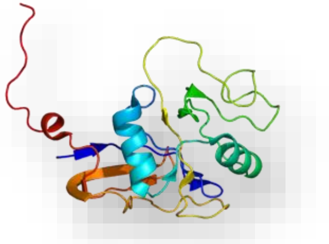
OPTOELECTRONICS group University of Sannio

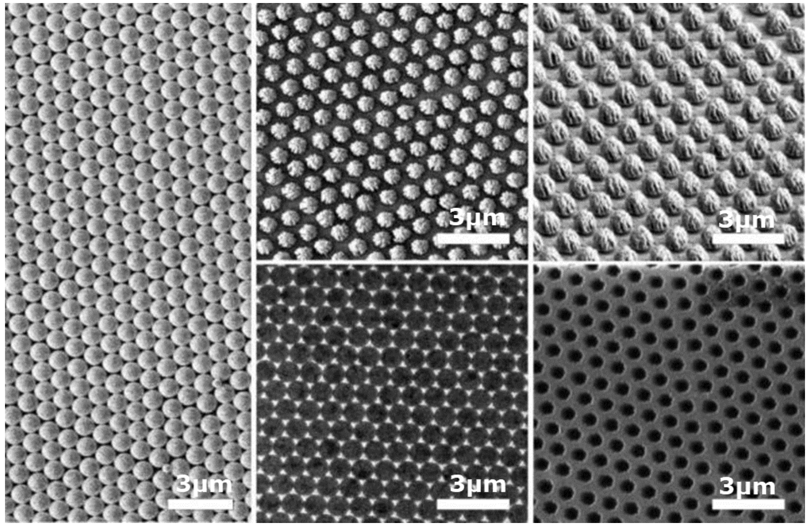
Biosensors and Bioelectronics
Volume 233, 1 August 2023, 115322

Thyroglobulin is a glycoprotein produced and used exclusively in the thyroid glands

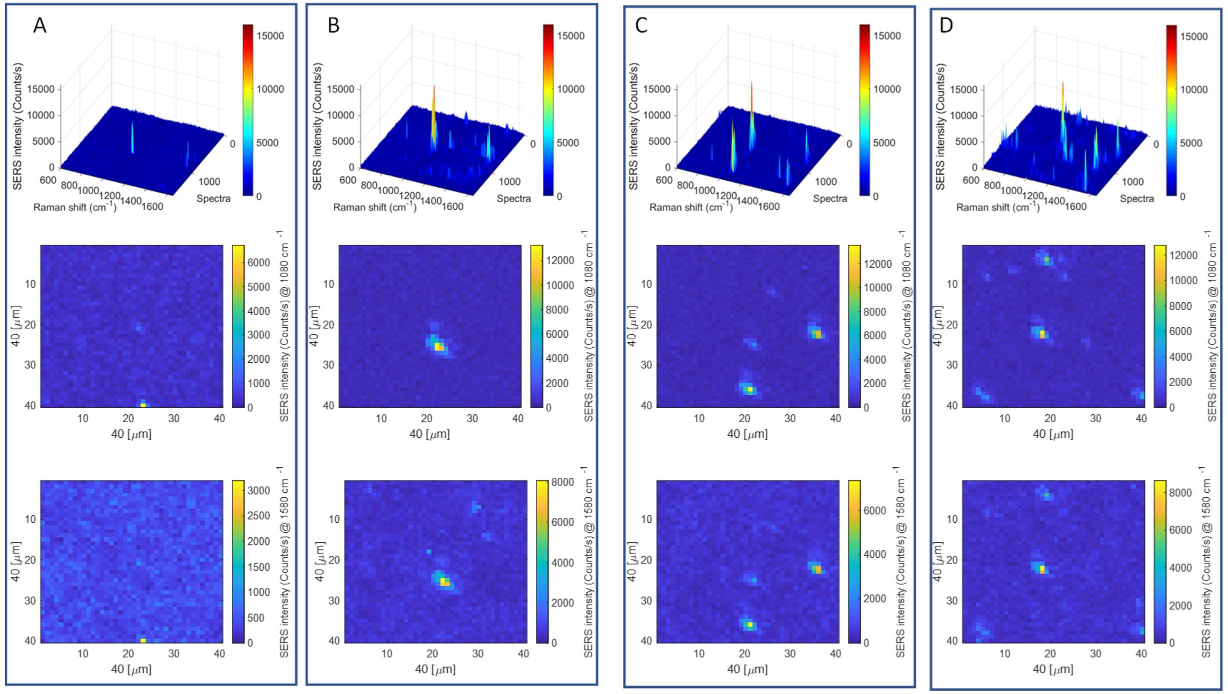




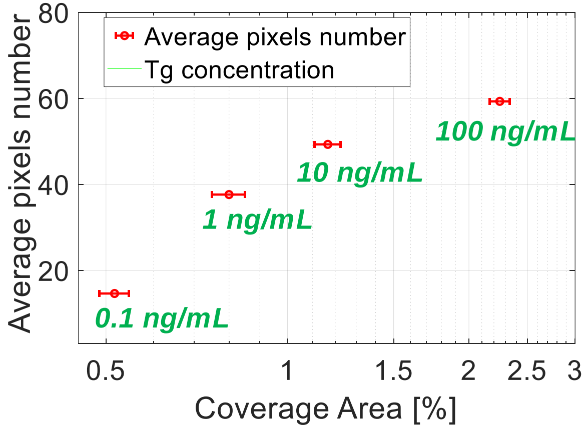
Biofunctionalized SERS substrate

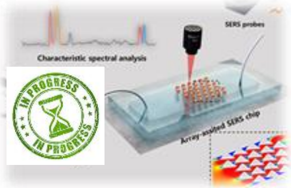


S. Managò *et al.*, Sensors and Actuators B: Chemical, 339, 2021
G. Quero, *et al.*, Sensors, Vol. 18, 3, 2018
M. Pisco *et al.*, Light: Science & Applications, 6, 2017



Strict correlation between average nanoparticle coverage (from AFM) and the Tg concentration (from SERS)



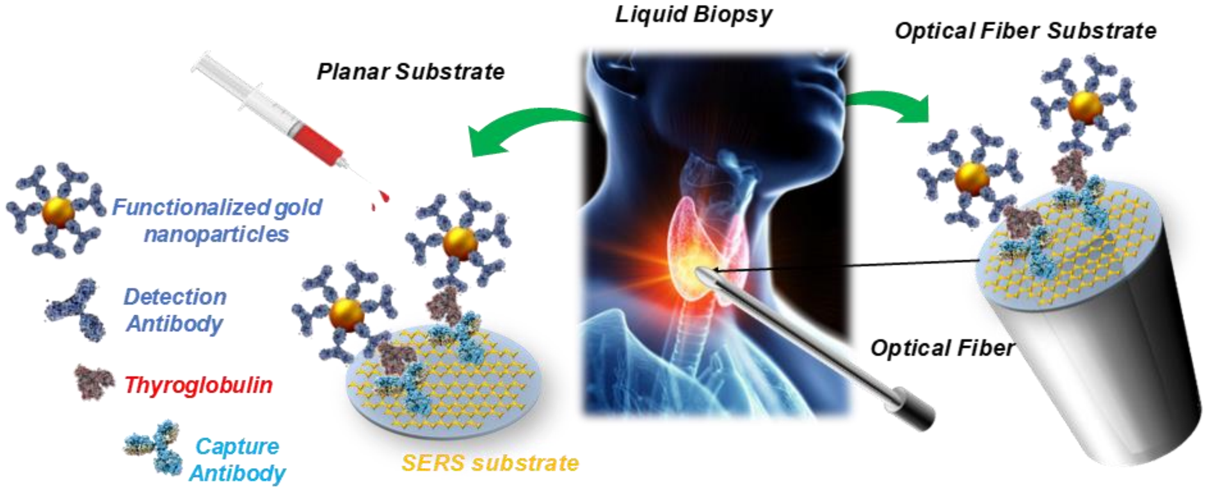


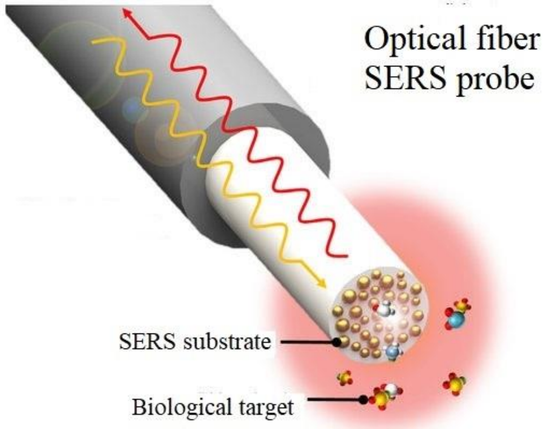
Azienda Ospedaliera Universitaria

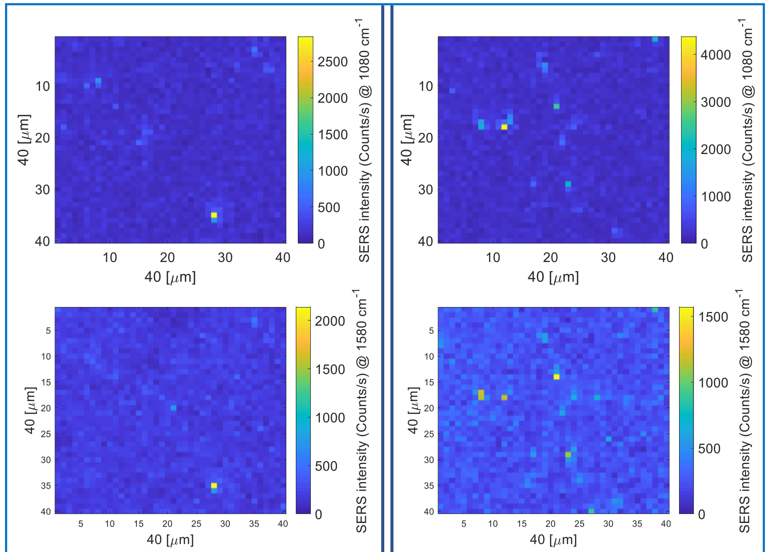
SCITEC

Institute of Applied Sciences and Intelligent Systems ScienceApp

Human Tg detection and SERS optrodes

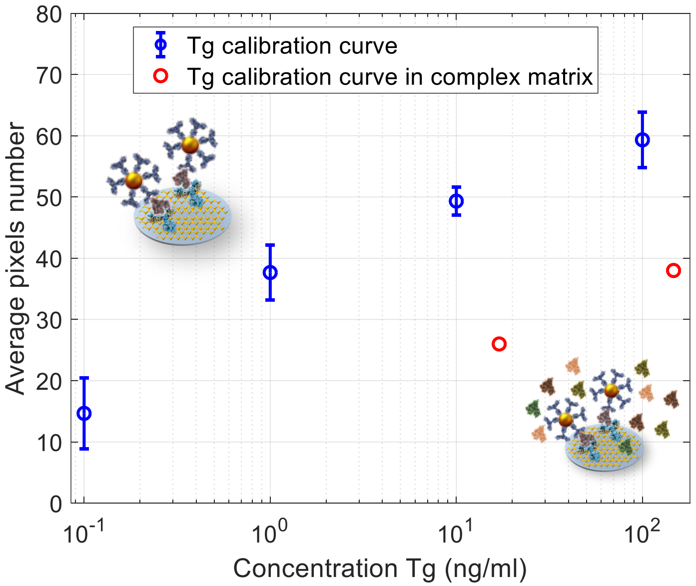


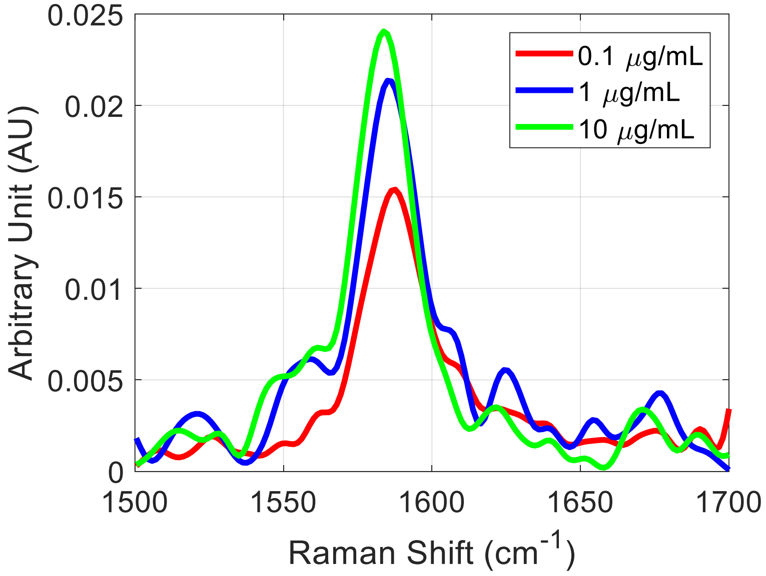




17 ng/ml

147 ng/ml





Samples from washout fluids of needle aspiration biopsies

LOD: 7 pg/mL

Biosensors and Bioelectronics Volume 233, 1 August 2023, 115322

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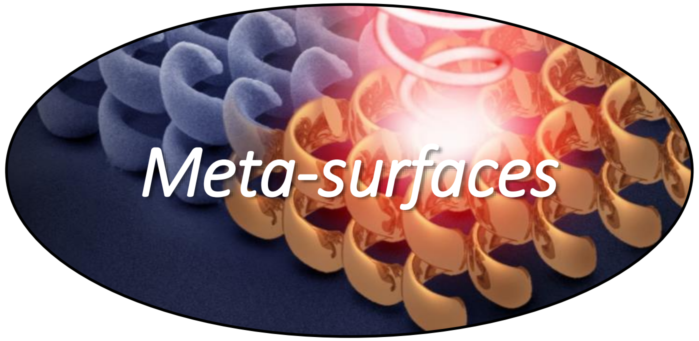

+

ENABLING ADVANCED CAPABILITIES OF LIGHT CONTROL AND MANIPULATION USING OPTICAL FIBERS

- Metalenses
- Optical tweezer
- Optical Computing
- High-perfomance sensing platform

[Meng Y., ...Cusano A. et al. "Optical meta-waveguides for integrated photonics and beyond" Light Science & Applications (in press December 2021)

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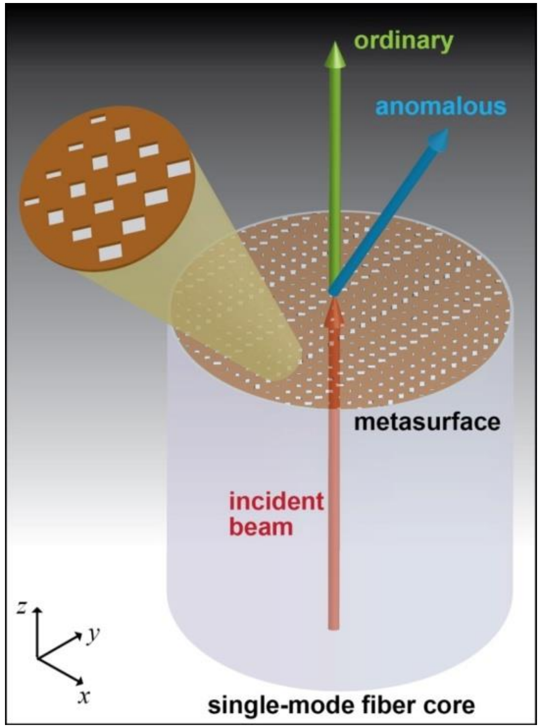
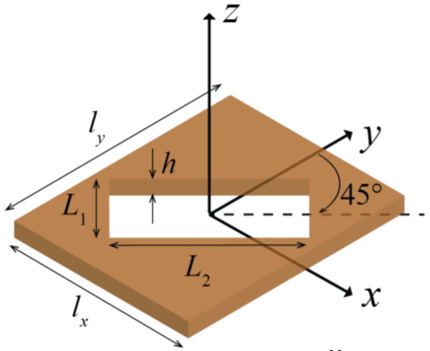
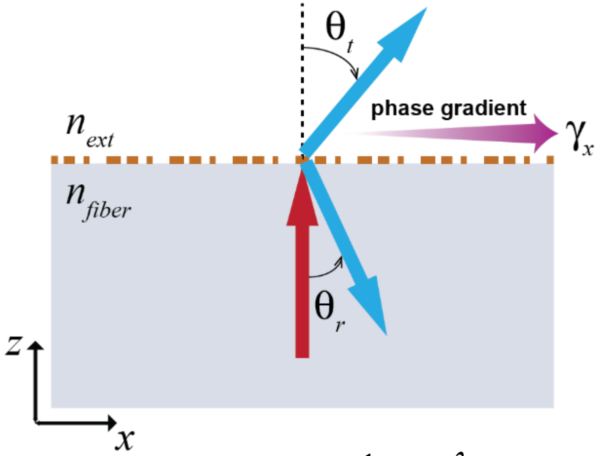
OPTICAL FIBER META TIPS (OFMTs) FOR BEAM STEERING APPLICATIONS





unit cell

GENERALIZED FRESNEL LAWS



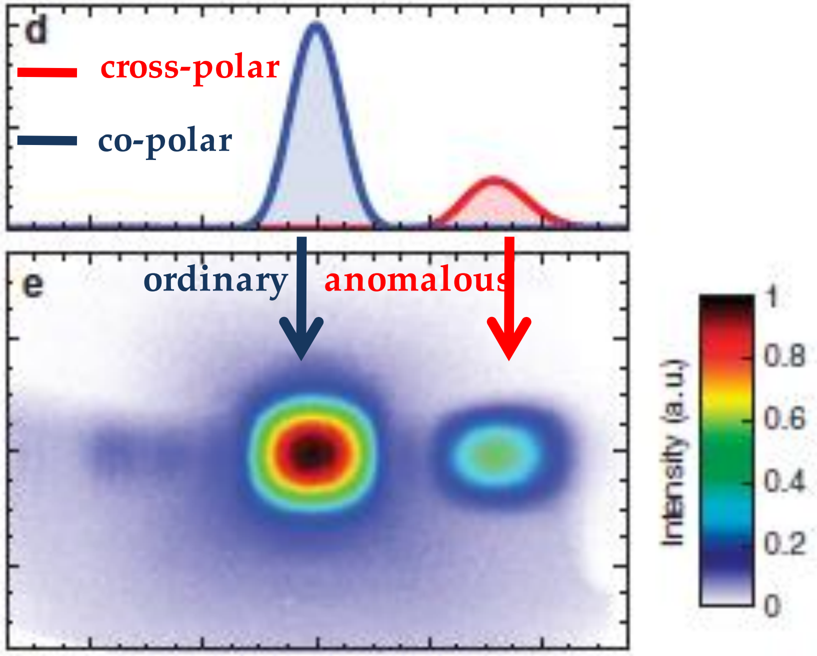
$$\sin \vartheta_r = \frac{1}{n_{fiber}} \frac{\lambda}{2\pi} \gamma_x$$

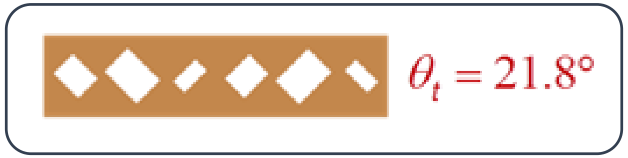
$$\sin \vartheta_t = \frac{1}{n_{ext}} \frac{\lambda}{2\pi} \gamma_x$$

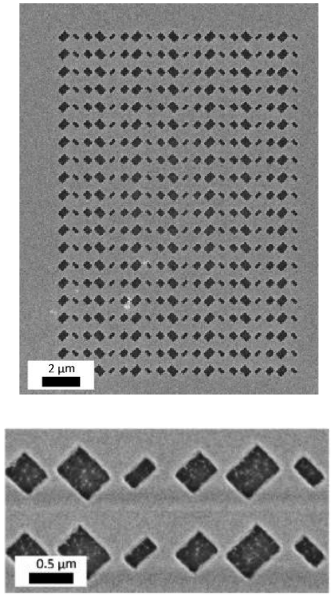
BABINET-INVERTED MS:

- easier to fabricate on fiber tip
- better efficiency

BEAM STEERING



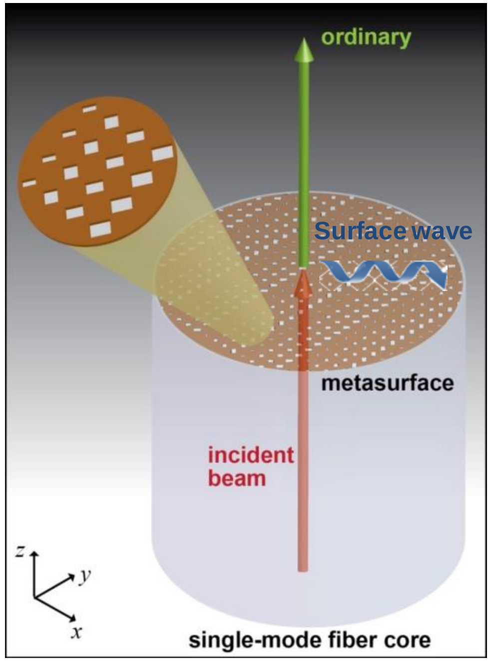


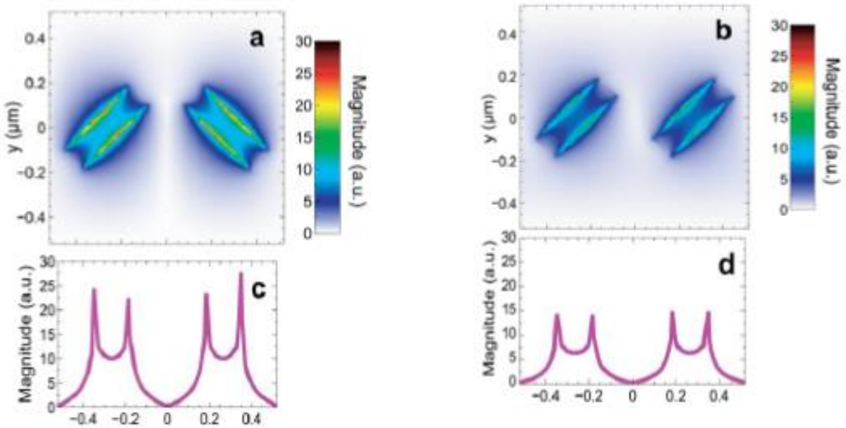


SEM images of an OFMT

M. Principe, M. Consales et al., "Optical fiber meta-tips"
Light: Science and Applications (2017), 6 (3)

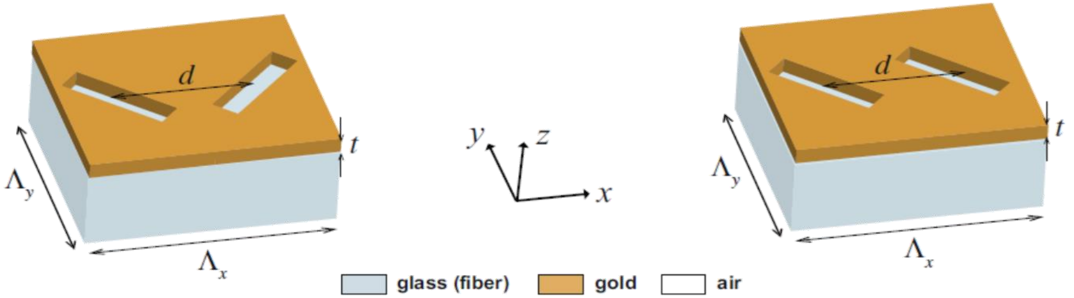
OFMTs AS ADVANCED PLATFORMS FOR SENSING

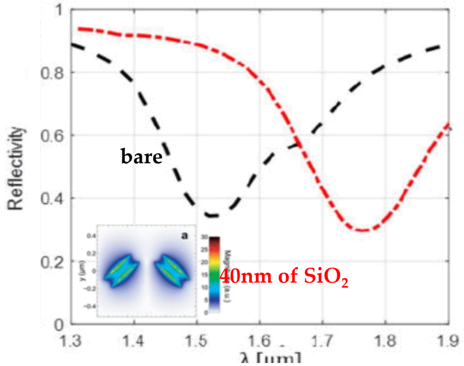


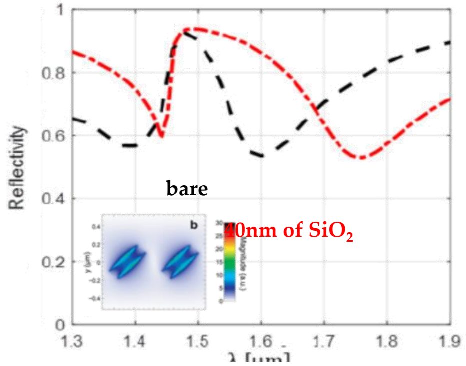


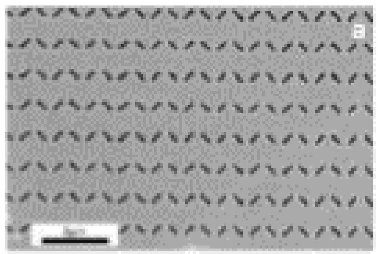
PHASE-GRADIENT OFMT

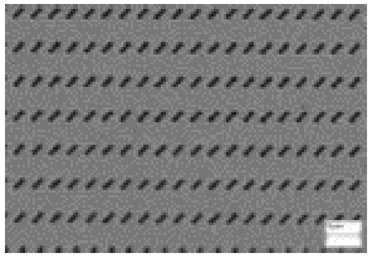
GRADIENT-FREE BENCHMARK











A. Cusano et al., "Optical fiber meta-tips" **Light: Science and Applications** (2017)

A. Cusano et al. "Evaluation of Fiber-Optic Phase-gradient Meta-tips for Sensing Applications", **Nanomat. and Nanotech.** (2019)

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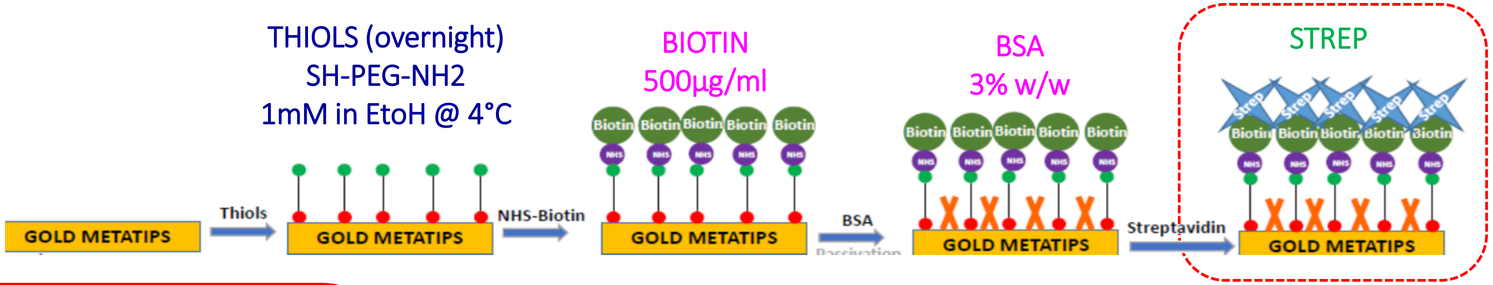
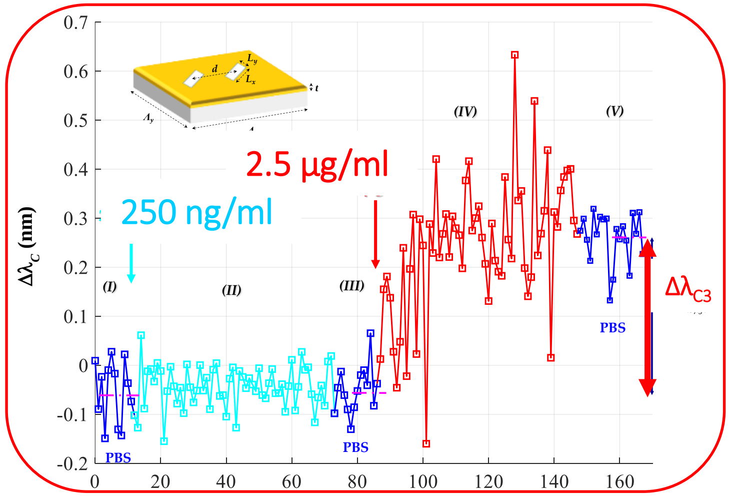
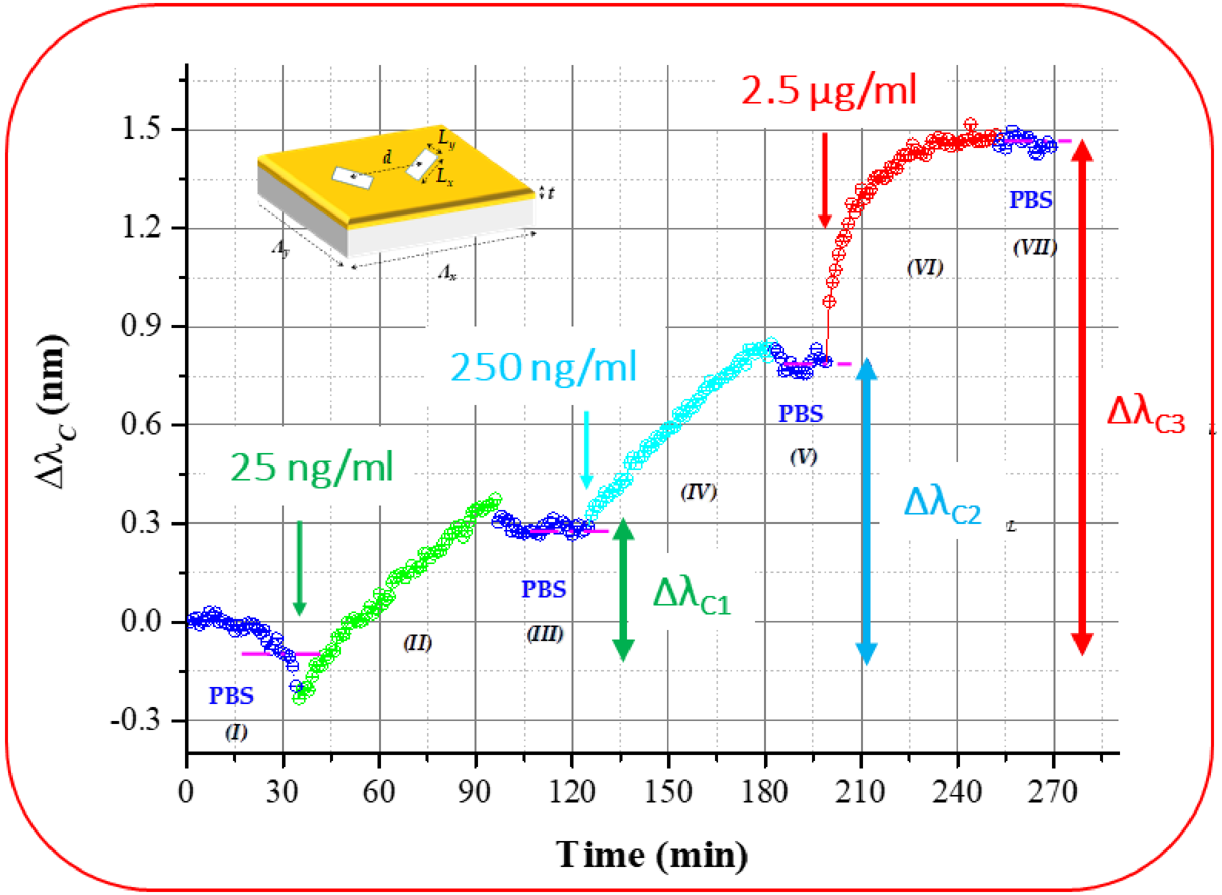


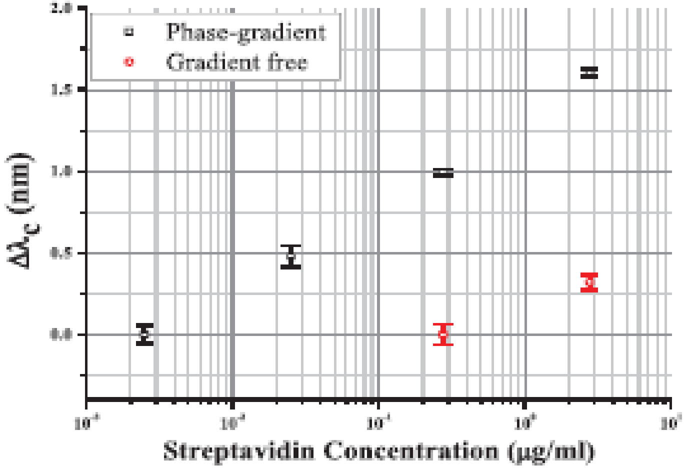
Bovine Serum Albumin (BSA)

Phosphate Buffer Saline (PBS), pH 7.4





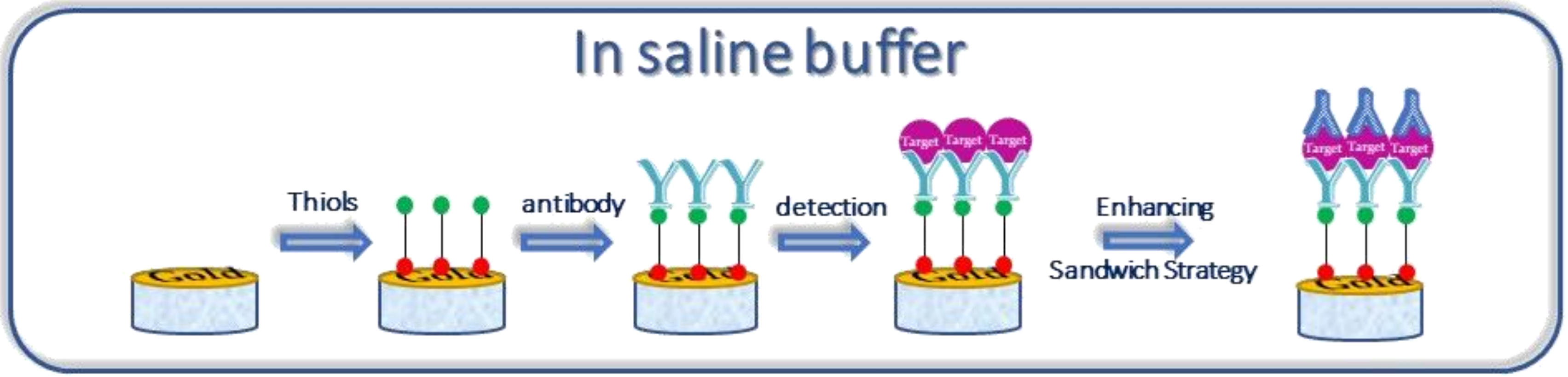
LIMIT OF DETECTION
≈50 pM



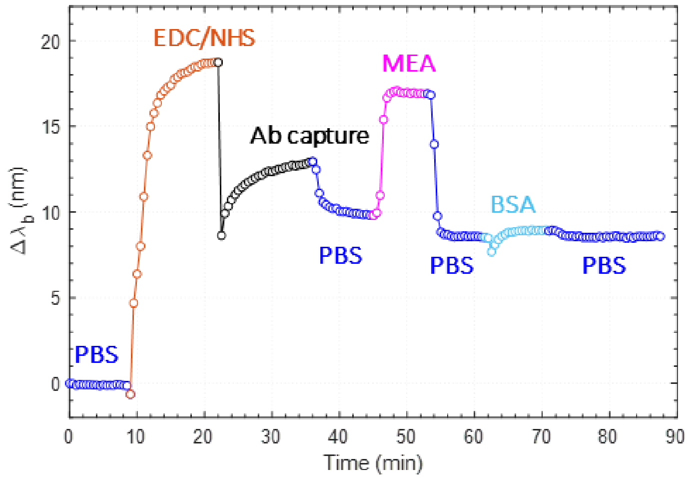
M. Consales, M. Principe et al, "Metasurface-Enhanced Lab-on-Fiber Biosensors", **Laser Photonics Rev.** 2020, 2000180.

HEPATOCELLULAR CARCINOMA

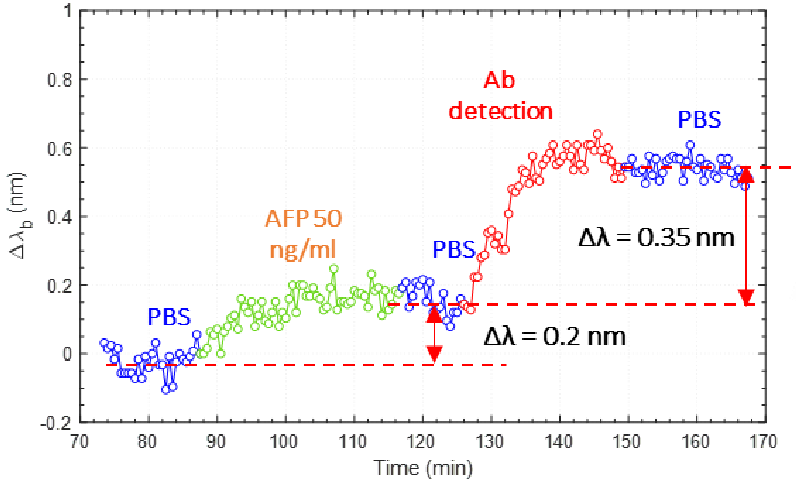
OPTICAL FIBER METATIPS: AFP DETECTION



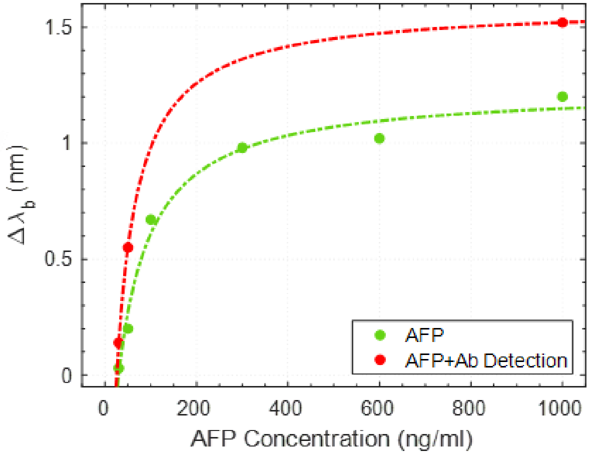
Functionalization



Detection



Dose-response curve

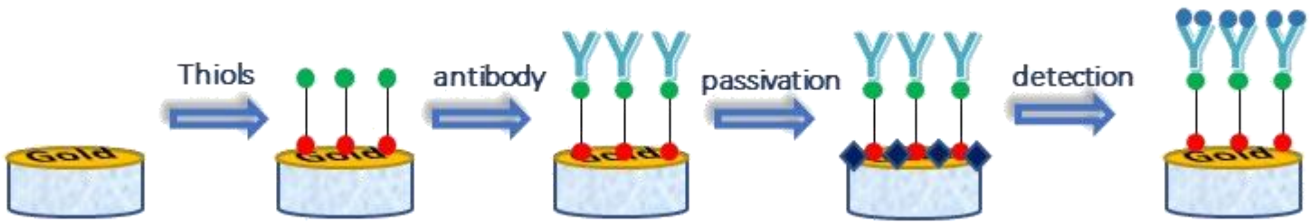


LIMIT OF DETECTION <30 ng/ml

THE SANDWICH STRATEGY ALLOWS TO REDUCE THE LOD OF A FACTOR OF ABOUT 3

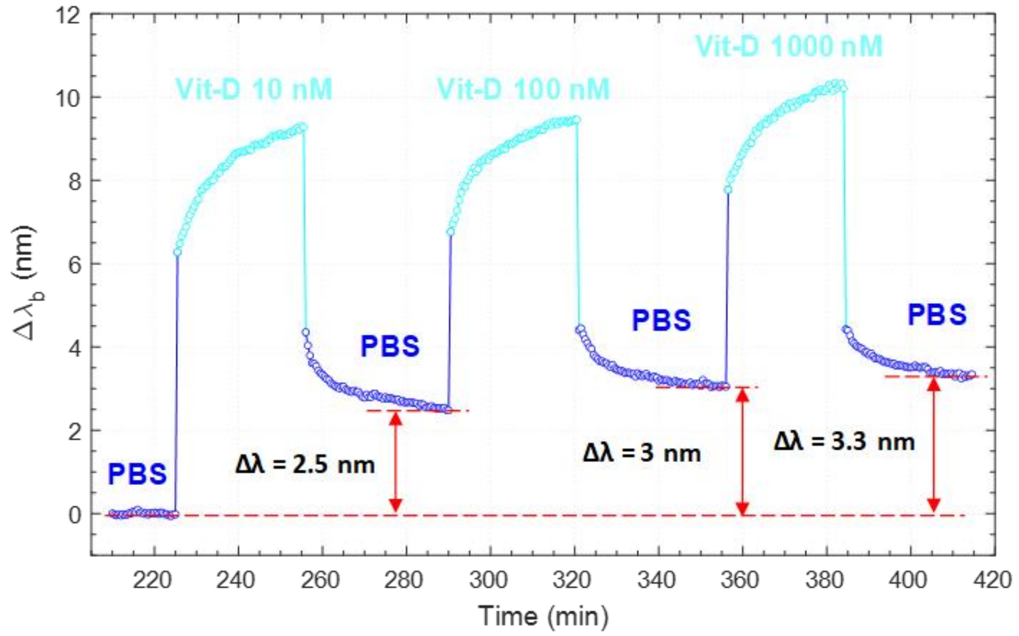
OPTICAL FIBER METATIPS: *VITAMIN D* DETECTION

In complex matrix*

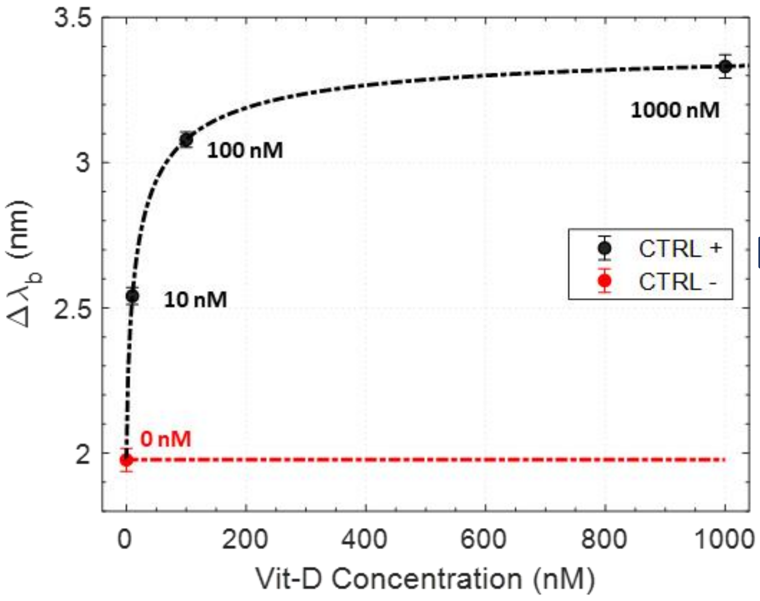


*saline phosphate buffer supplemented with 40mg/ml human IgG and 30mg/ml human Albumin

Detection



Dose-response curve



LIMIT OF DETECTION
4 ng/mL

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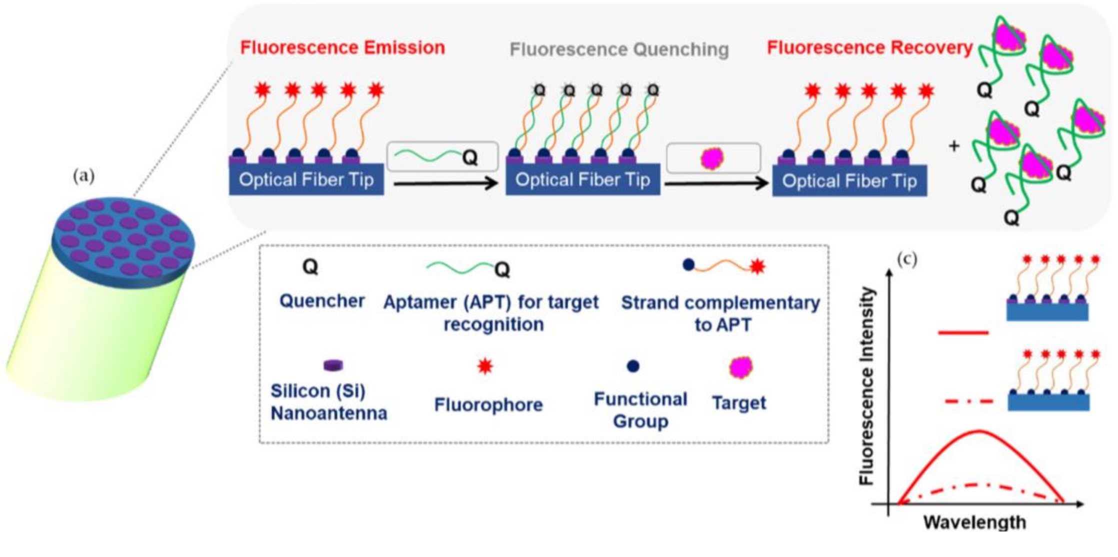
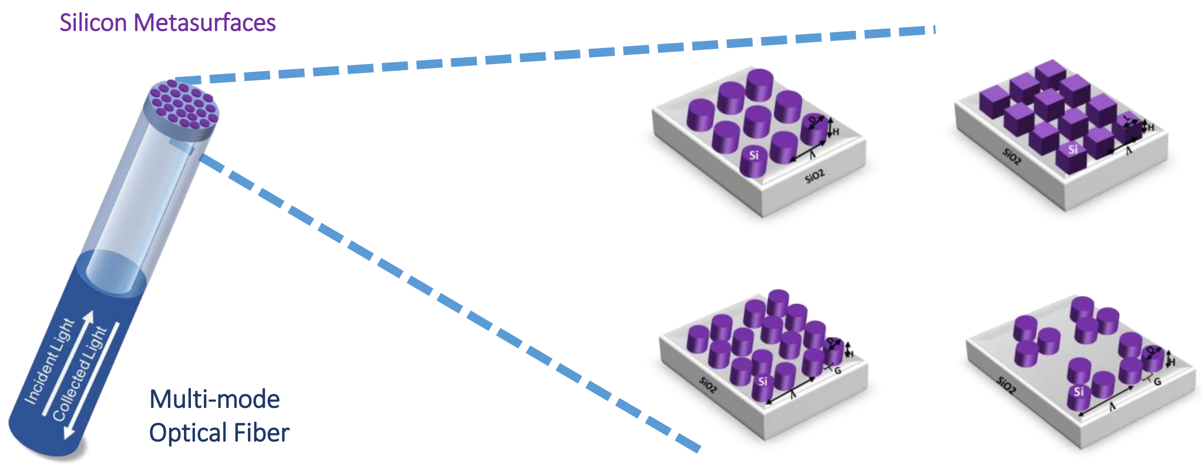
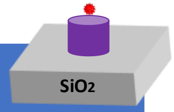
All-Dielectric Fluorescence Enhancing Metasurfaces: Towards Advanced MS-Assisted Optrodes



Different geometries of all dielectric metasurfaces have been analyzed



A FEM-based numerical environment has been developed in order to optimize the dielectric MS to maximize the fluorescence enhancement factor:



Fluorescence enhancement of Dipole at a distance 7 nm from the Structure				
	Cylindrical (D=160,H=120)	Square (L=150,H=90)	20 nm Gap Dimer (D=120,H=85)	Trimer (D=100,H=105)
Average Fluorescence Enhancement	163	147	1020	880

Fluorescence Enhancement Factors **of two/three orders of magnitudes** can be obtained.

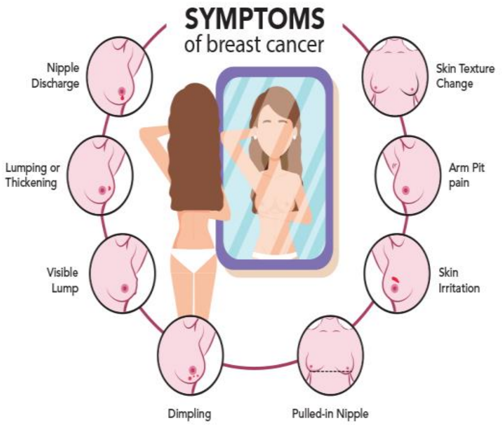
Alhalaby, H. et al., ''Enhanced Photoluminescence with Dielectric Nanostructures: A Review''. **Results in optics** 2021, 3, 100073.

Alhalaby, H. et al., ''Design and Optimization of All-Dielectric Fluorescence Enhancing Metasurfaces: Towards Advanced Metasurface-Assisted Optrodes''. **Biosensors** 2022, 12, 264.

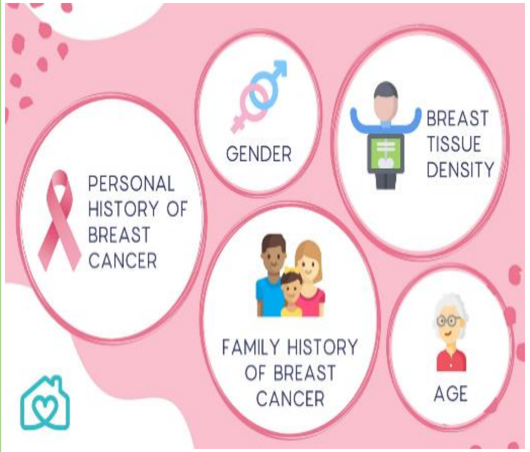
A VIEW TOWARDS FIBER ASSISTED DRUG DELIVERY

BREAST CANCER

COMMON SYMPTOMS

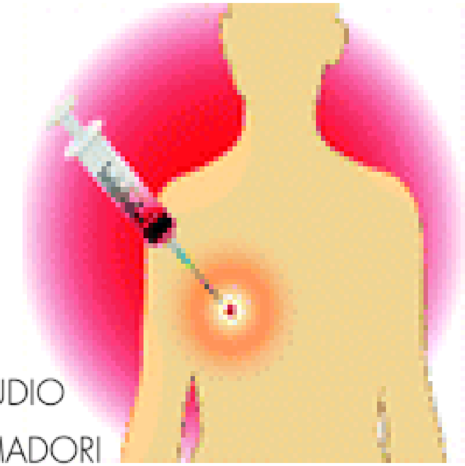


RISK FACTORS



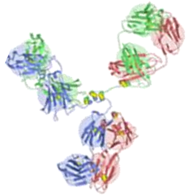
CARRIERs FOR BREAST CANCER

- THERMORESPONSIVE MICROGELS FOR DOXORUBICIN RELEASE
- PLGA NANOPARTICLES FOR TRASTUZUMAB DELIVERY



ISTITUTO ROMAGNOLO PER LO STUDIO DEI TUMORI DINO AMADORI

THERAPY

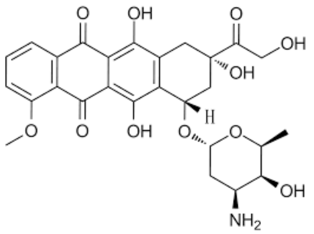


TRASTUZUMAB (140KD)

Trastuzumab is a mAb that binds the domain IV of HER-2. It is used to treat breast cancer patients (~=30%) in which HER-2 is overexpressed and spontaneously homodimerizes or forms heterodimers with other HER

Doxorubicin (MW 543 Da)

Doxorubicin is used widely for managing intermediate-to-high-risk breast cancer patients and is mainstays of treatment for triple-negative breast cancer.



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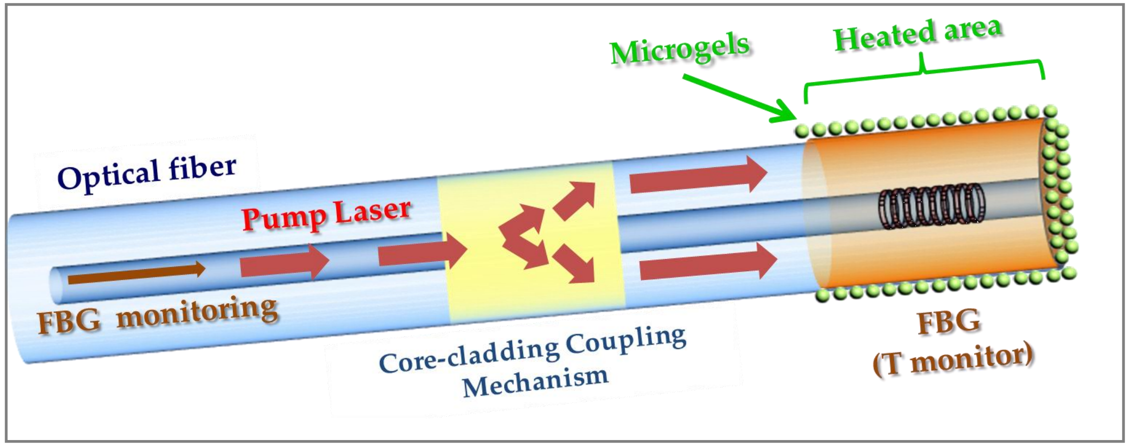
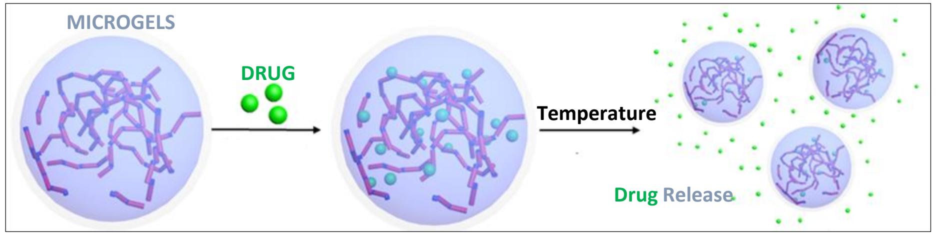
OPTOELECTRONICS group University of Sannio

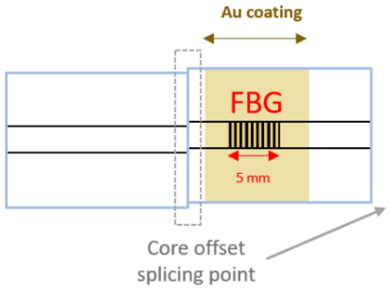
A LAB-ON-FIBER PLATFORM FOR LIGHT-TRIGGERED DRUG DELIVERY

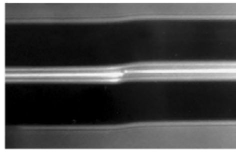


- MGs integration along the lateral surface of a thermal heating device, based on a gold-coated optical fiber
- Light-triggered drug release by inducing surface heating



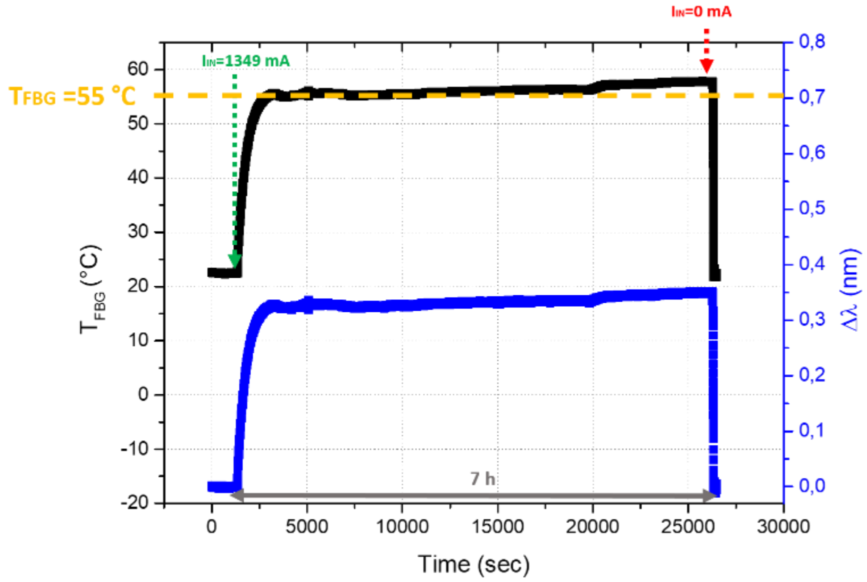
CORE-CLADDING LIGHT COUPLING MECHANISMS





Dong, Xinyong, et al. IEEE Photonics Journal 4.5 (2012): 1381-1386.

- SMF-28e optical fiber
- Core offset of ~ 6 µm
- 150 nm Au layer
- 6340 ComboSource from Arroyo Instrument) @ 1485 nm with an output power of 500 mW



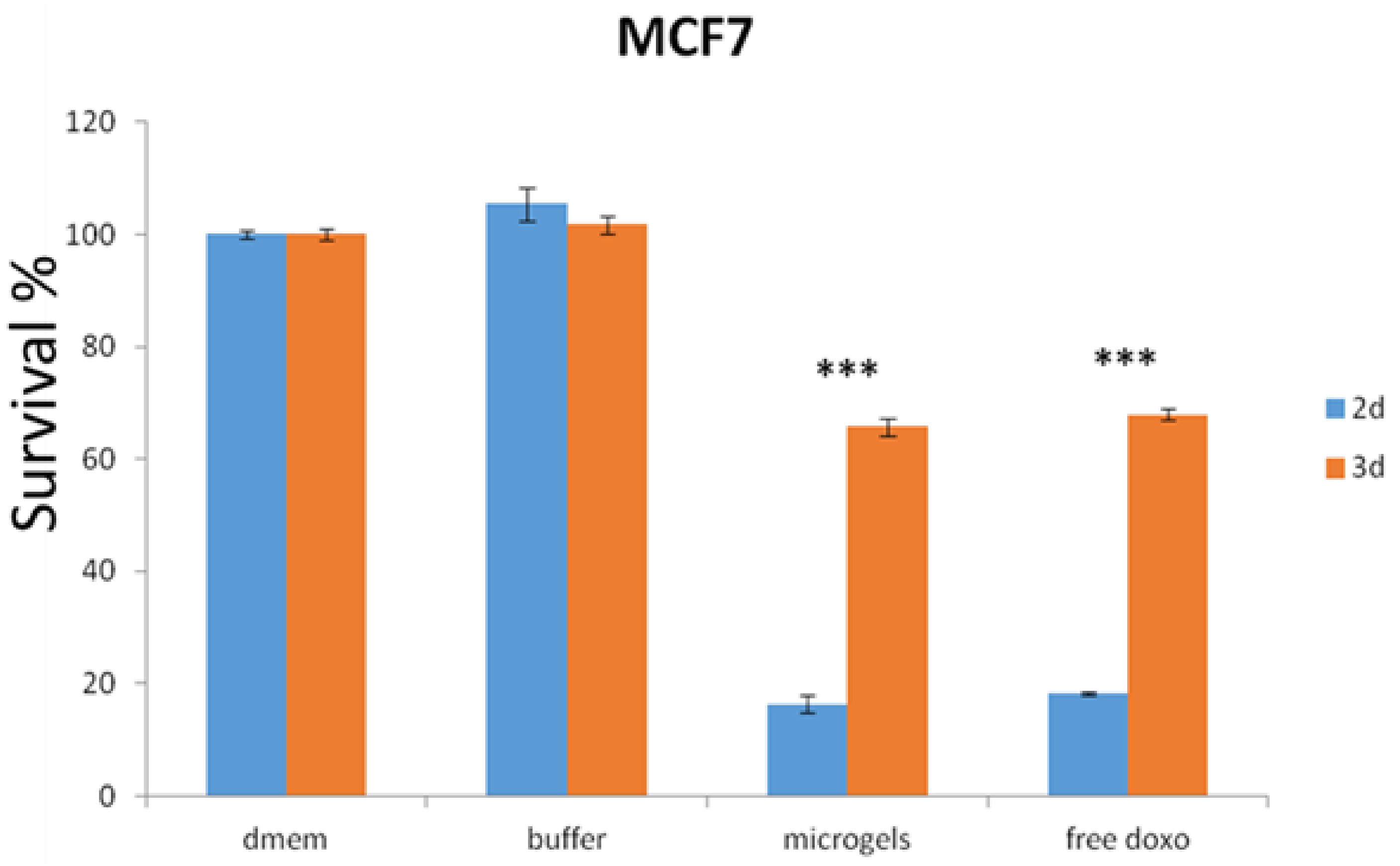
Optical actuation

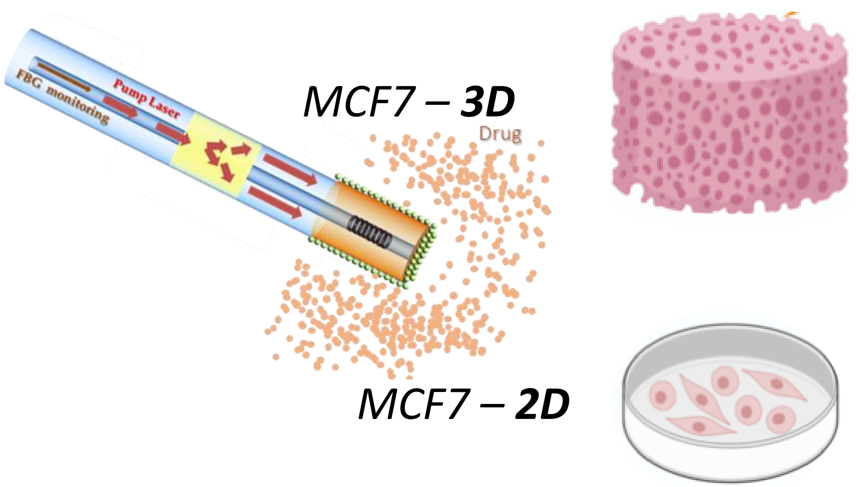
LIGHT TRAVELLING IN THE FIBER CORE IS TRANSFERRED TO THE CLADDING REGION AND HEATS THE METALLIC COATING WHERE THE MGS ARE INTEGRATED

Berruti et al. Journal of Lightwave Technology, 2021.

Locoregional Light-Controlled Doxorubicin Release

Cytotoxicity assays on MCF7 2D and 3D cell culture

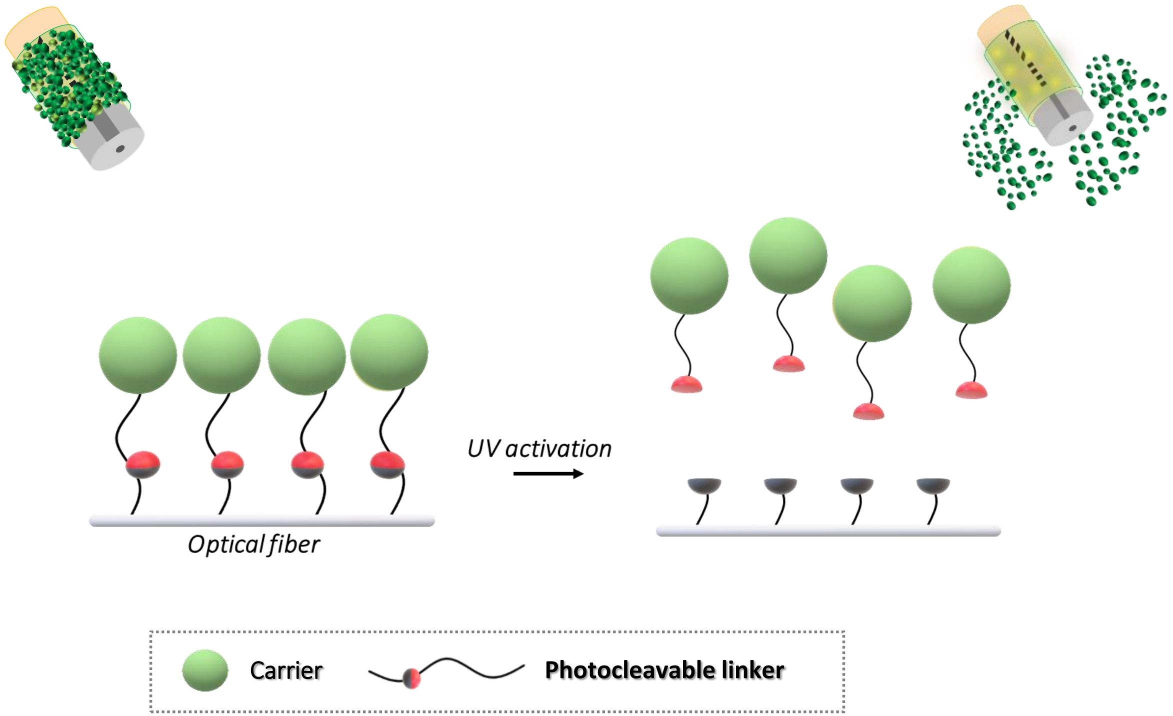




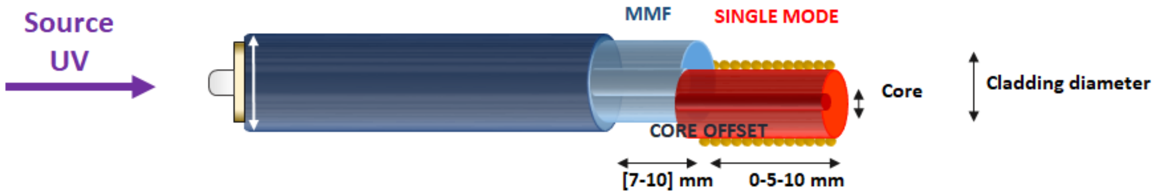
<u>Doxorubicin released from optical fiber show cytotoxicity comparable to free doxorubicin in 2D and 3D tests</u>

OPTICAL-FIBER PLATFORM FOR UV-TRIGGERED TRASTUZUMAB-BASED CARRIER DELIVERY

PHOTOACTIVATION MECHANISM



CORE OFFSET PLATFORM



- **Core offset:** 10 µm
- **Source High Power LED Light Sources 365 nm**
  Typical Radiant Flux (with a 1000µm 0.39NA fiber) 360 mW
- **Input power:** 735 µW
- **Multimode Fiber:** Core diameter 105 µm; Cladding diameter 125 µm
- **Single mode fiber SMF-28**: Core diameter 8.2µm; Cladding diameter 125 µm

CORE-OFFSET MEDIATED DRUG DELIVERY

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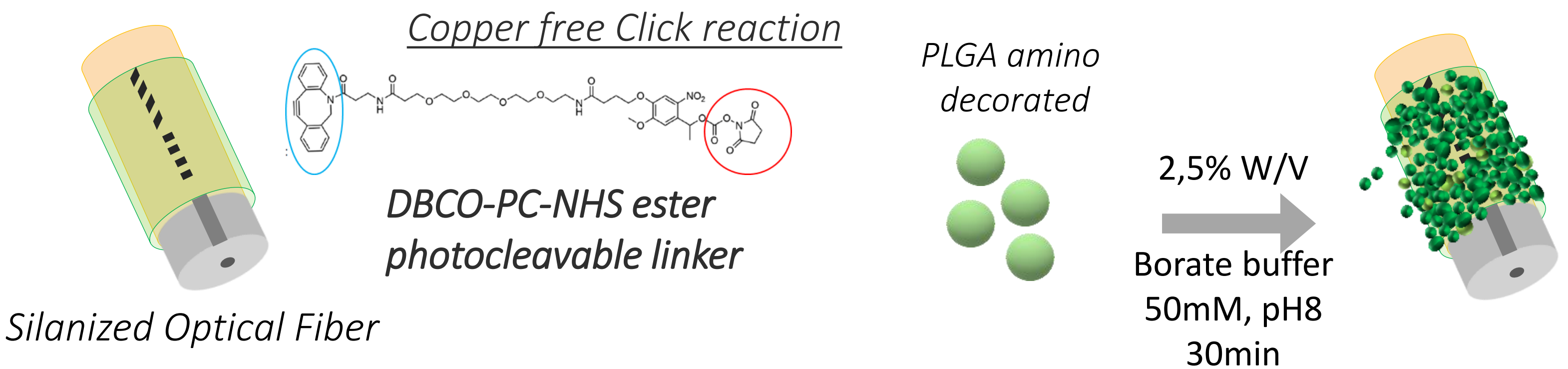
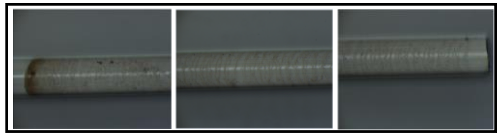
OPTOELECTRONICS group University of Sannio

CORE-OFFSET INTEGRATION WITH PLGA LOADED CARRIER

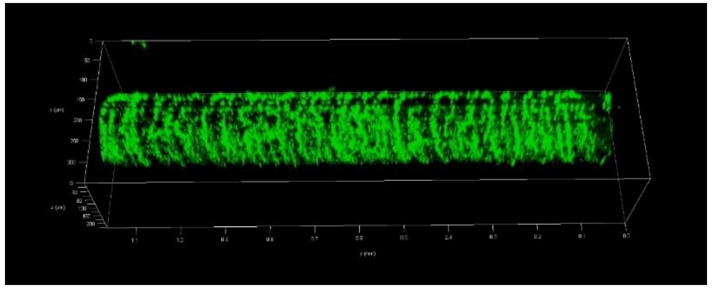


OF functionalized with C6-PLGA particles

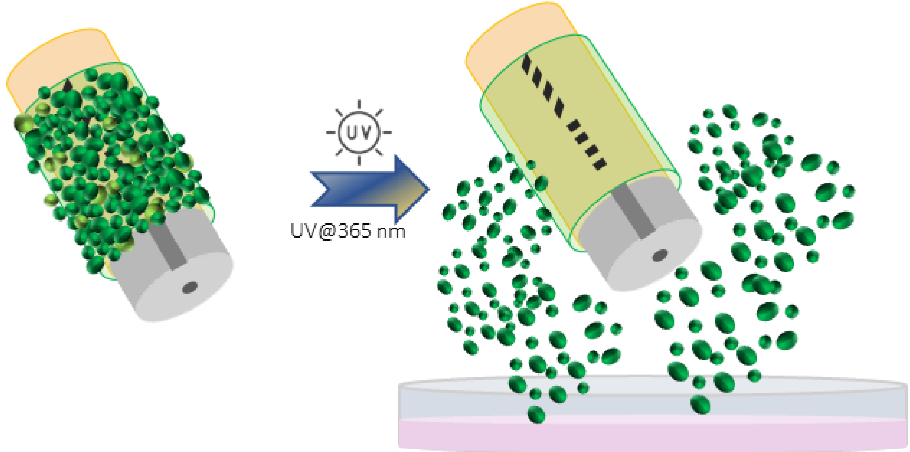
OPTICAL MICROSCOPY

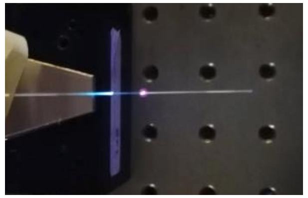


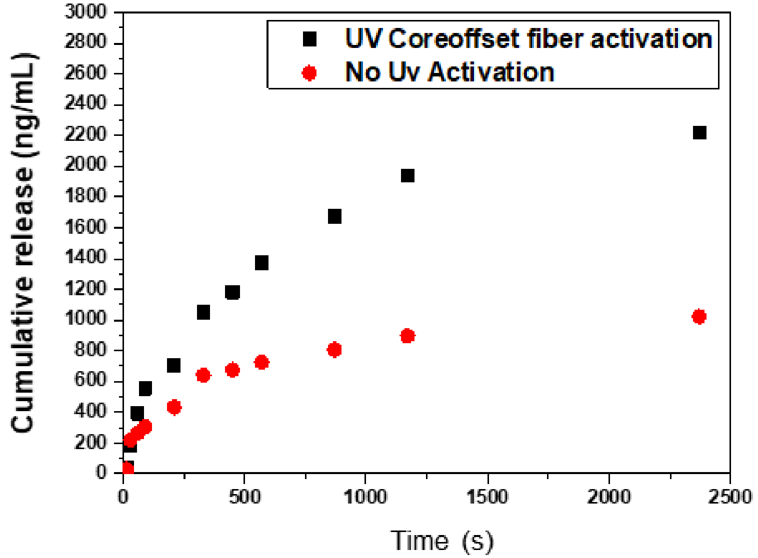
CLSM



CORE-OFFSET MEDIATED TZ REALEASE

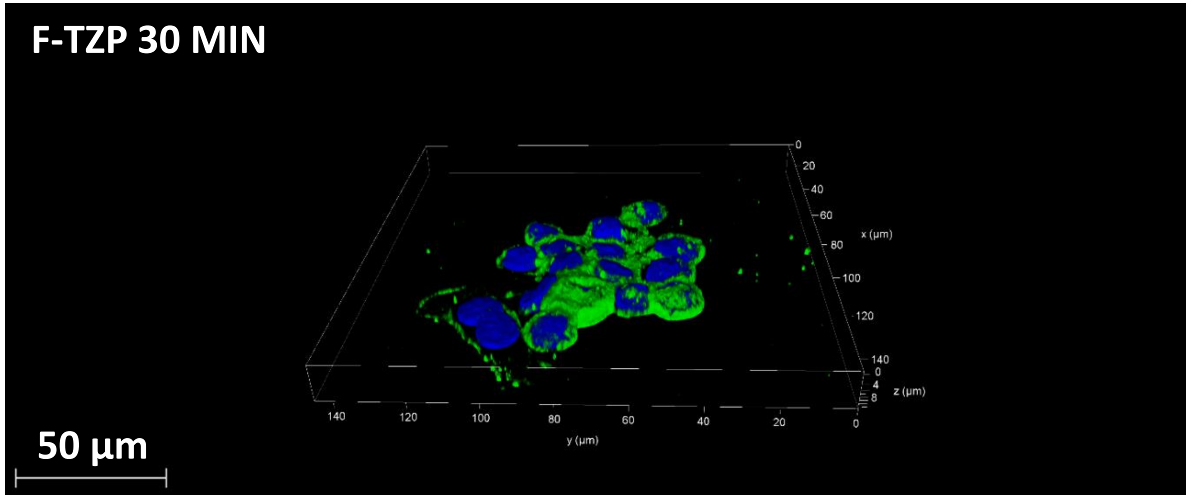


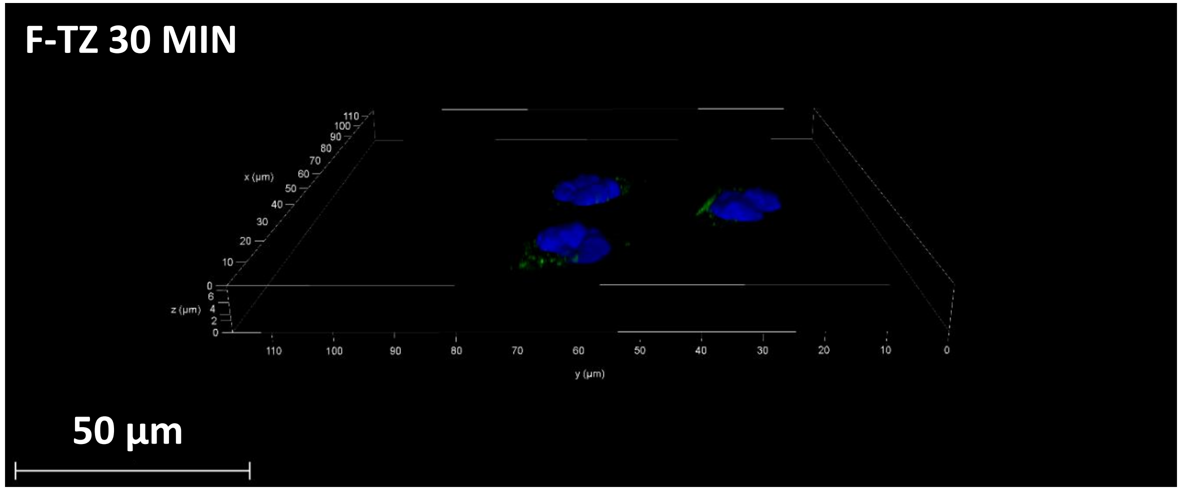


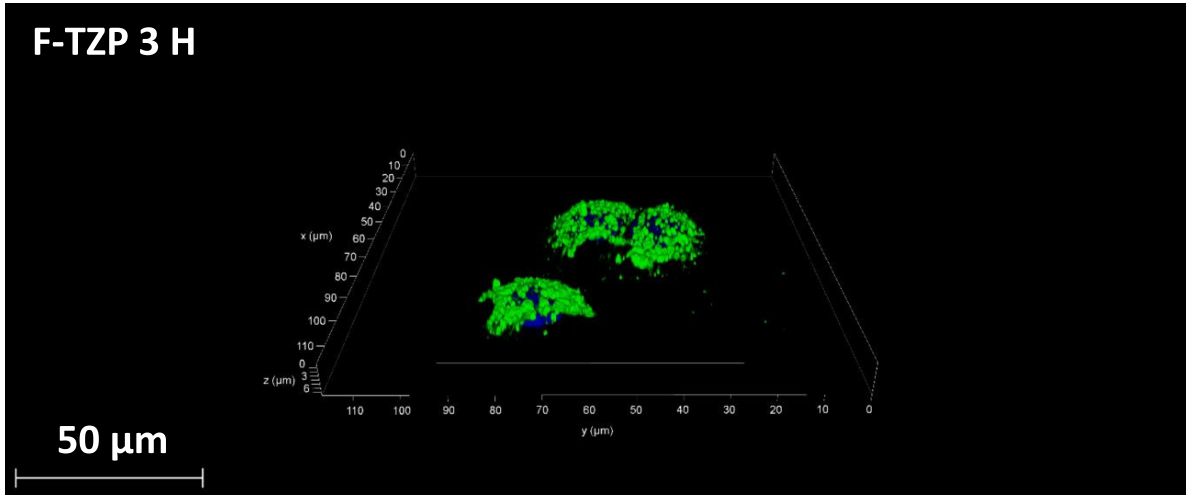


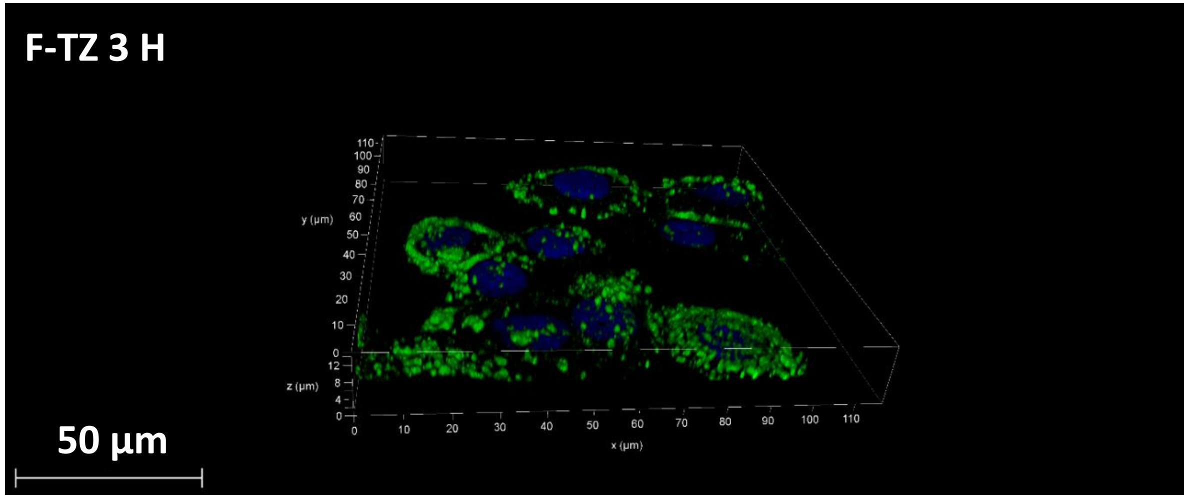
Polymeric particles for Trastuzumab release

TZ-FITC PLGA particles internalization by CLSM in SKBR3 cell line: z-stack

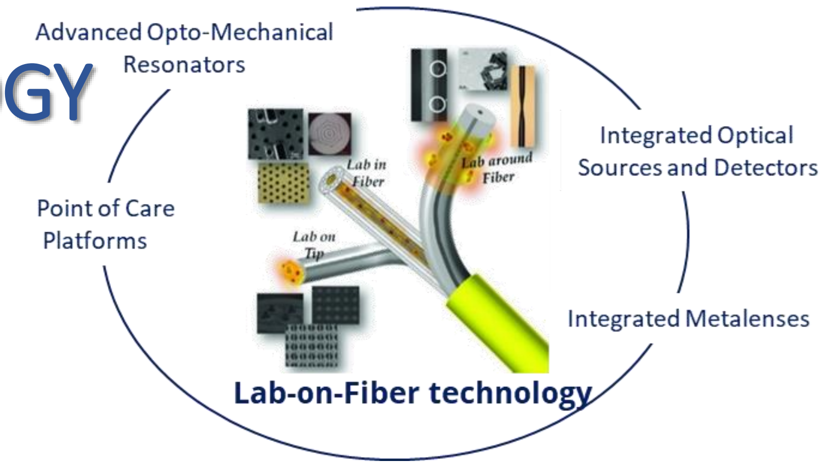


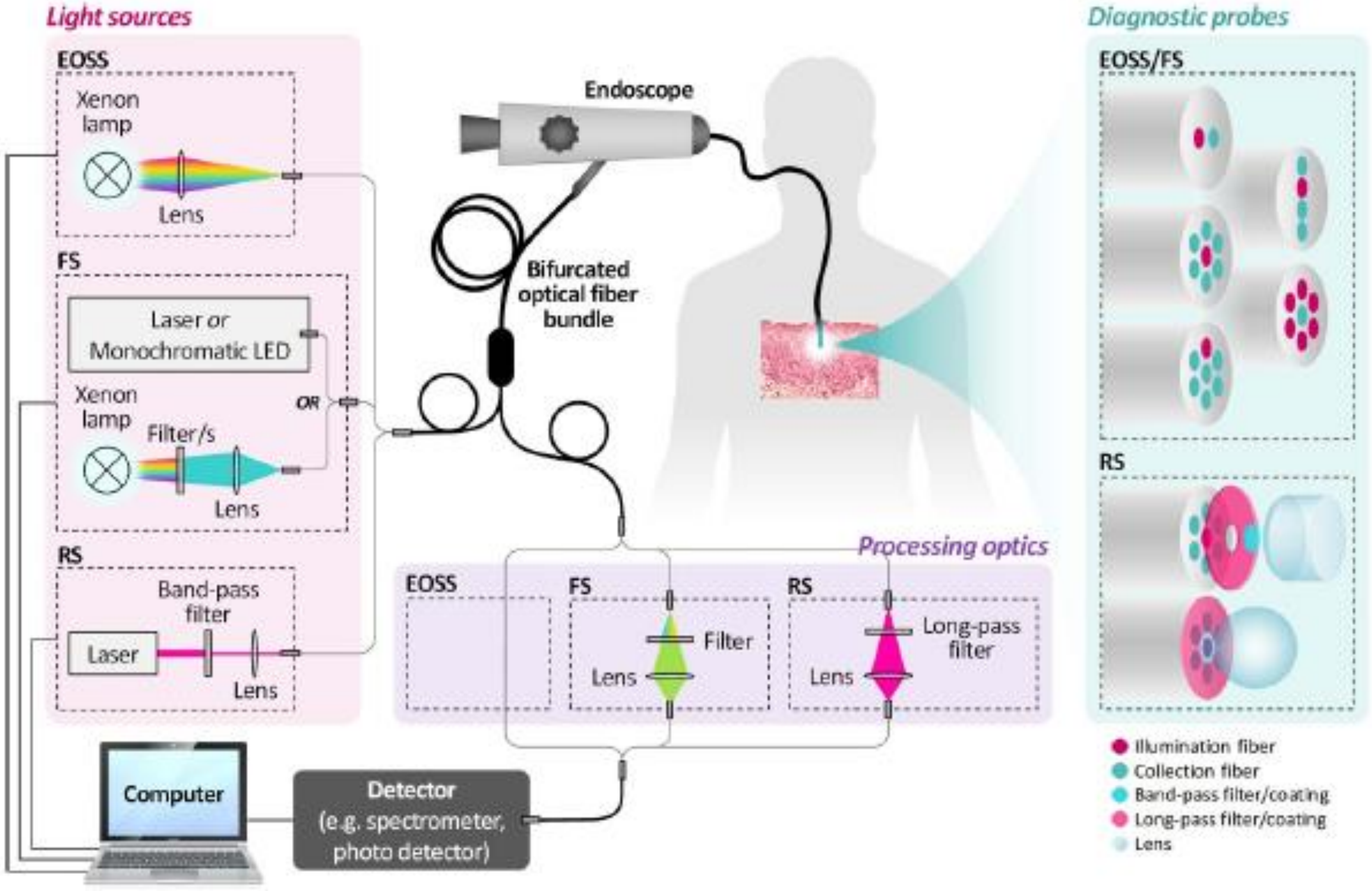


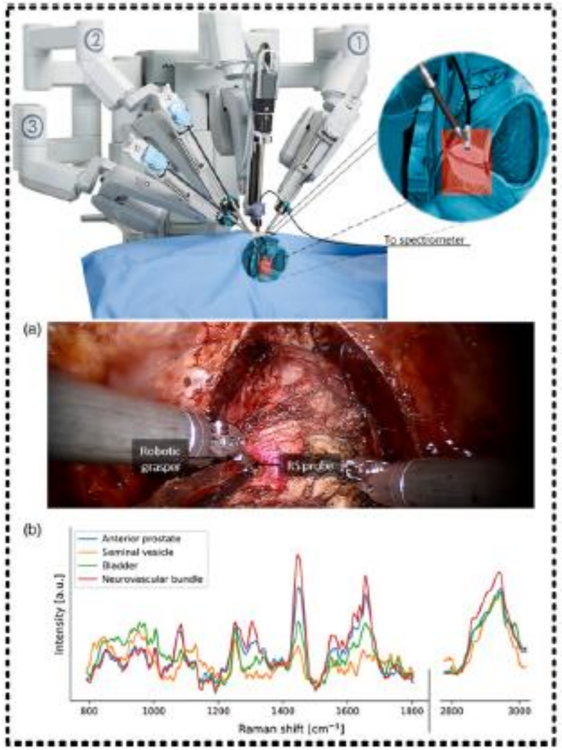


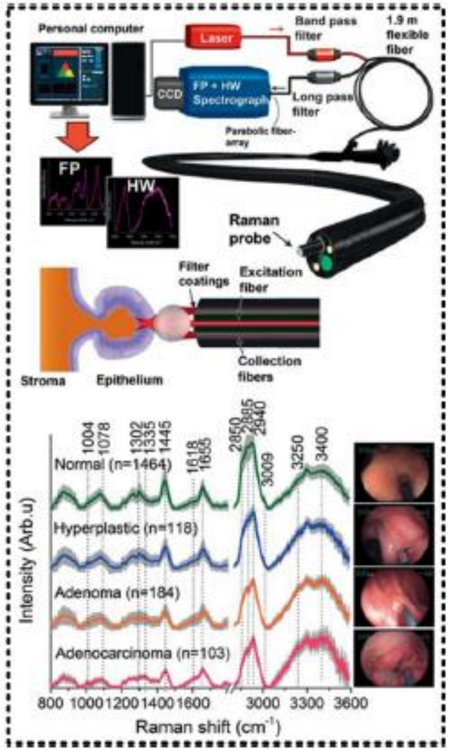


MULTIMODAL IMAGING FOR TISSUE BIOPSY: AN OPPORTUNITY FOR LAB-ON-FIBER TECHNOLOGY

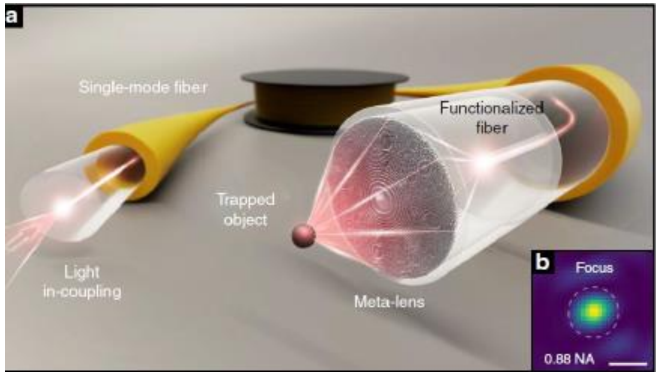






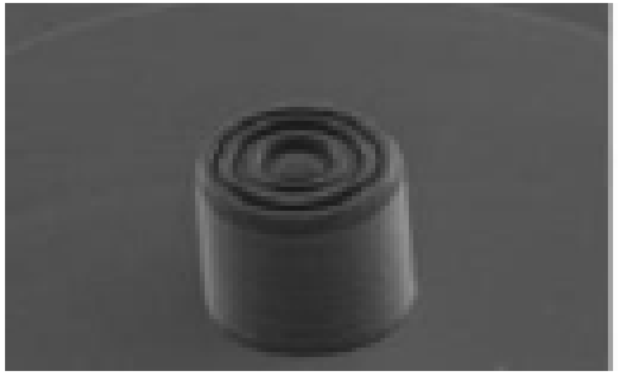


LAB-ON-FIBER: A STEP-AHEAD INTEGRATED FLAT OPTICS

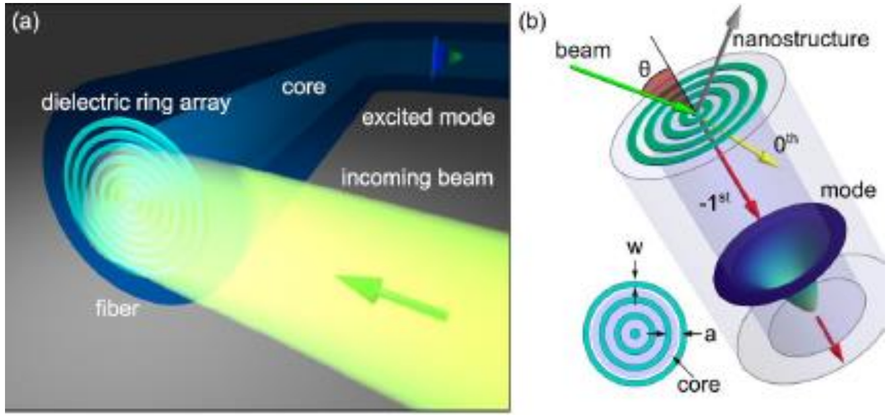


M. Plidschun Light Science & Applications 2021

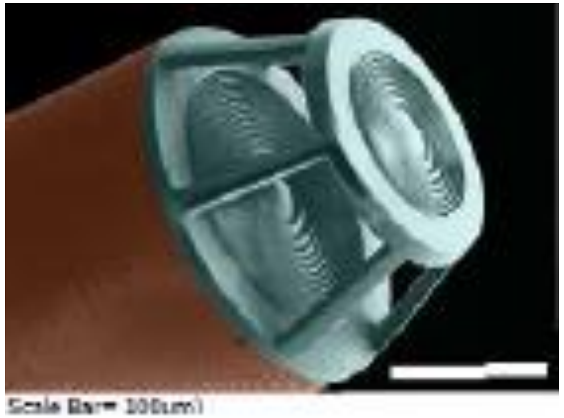
METALENSES ON OPTICAL FIBER



W. Hadibrata et al. Nano Letters 2021



O. Yermakov ACS Photonics 2020



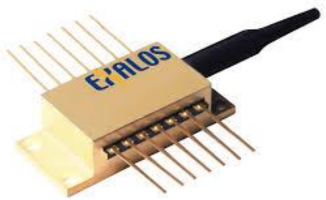
A. Asadollahbaik et al. ACS Photonics 2020

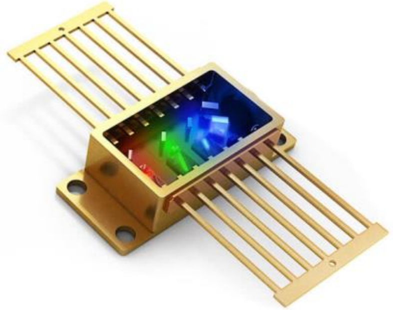
LAB-ON-FIBER: A STEP-AHEAD

INTEGRATED LIGHT SOURCES AND PHTODETECTORS

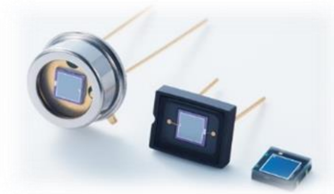
Bulk optoelectronic devices

LED, LASERs





Photodetectors

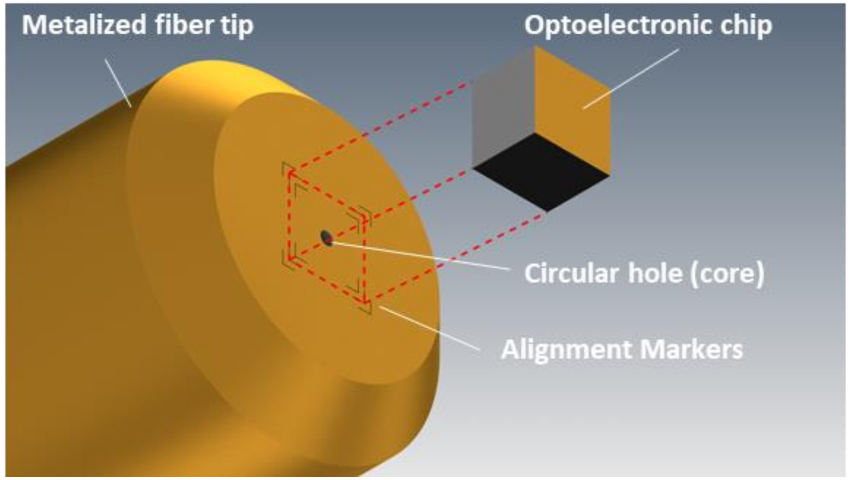


Miniaturization & Integration

OPTOELECTRONICS-ON-FIBER TECHNOLOGY

Full Control Over The Flow Of Light, From Generation To Detection With A Single Compact Platform

THE DEVELOPED PROCESS



1) Optoelectronic Chip is fabricated on a planar substrate and cleaved

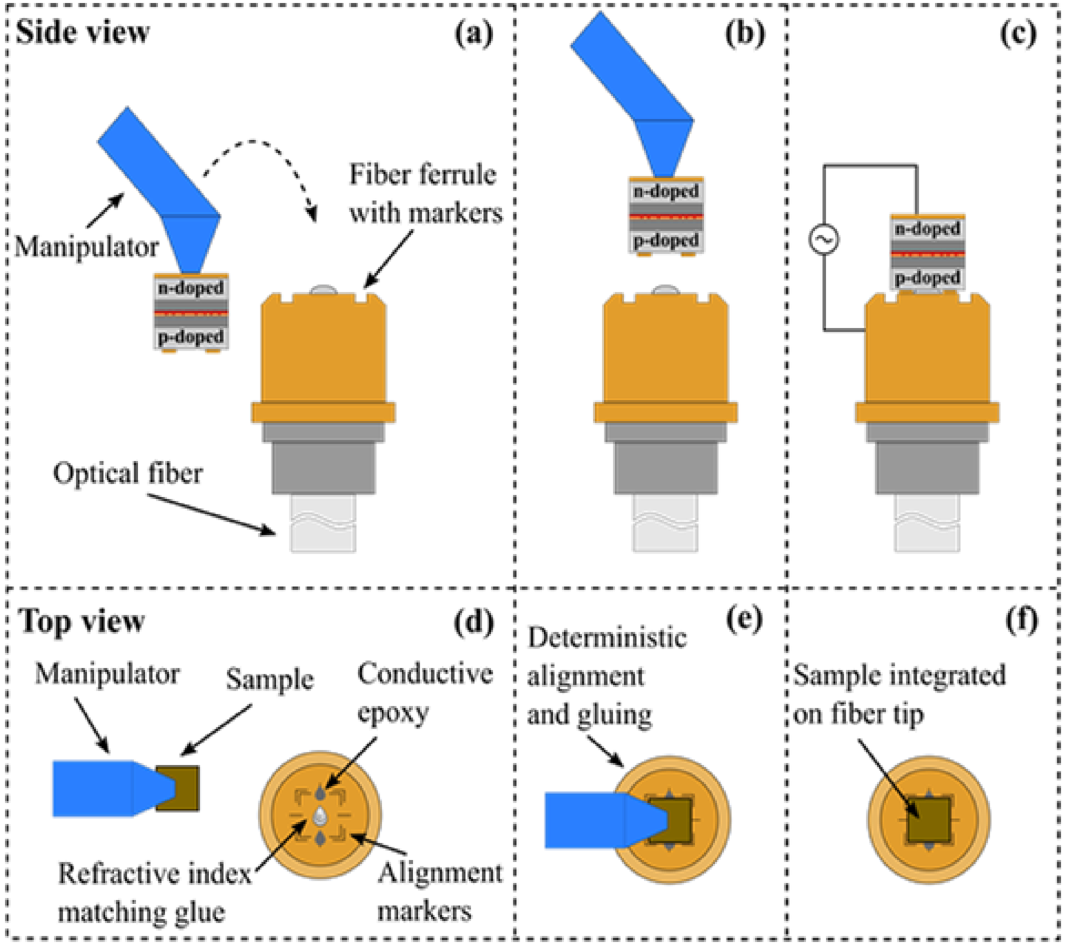
2) Fiber is metalized and circular holes and alignment markers are written

3) The chip is transferred and bonded onto the fiber tip (after depositing conductive and refractive index matching glues)

PATENTED

Procedure for the manufacturing of a monholitic connection between a light source and an optical fiber. *102020000010336 (2020)*
equally shared by University of Sannio and Stuggart University

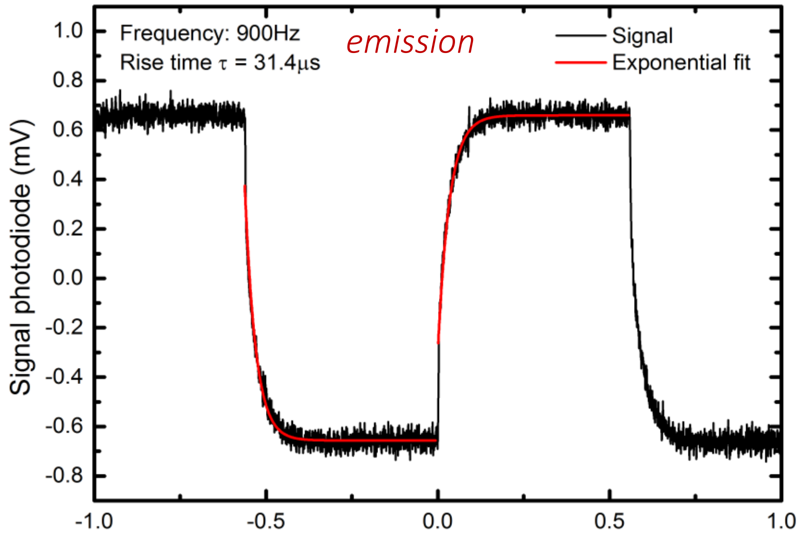
THE INTEGRATION

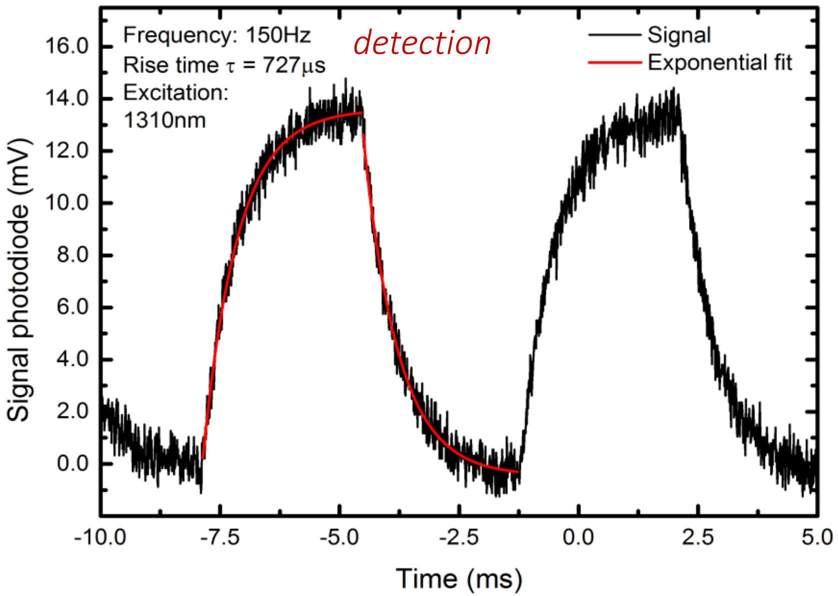


Ricciardi, A., Zimmer, M., Witz, N., Micco, A., Piccirillo, F., Giaquinto, M., Kaschel, M., Burghartz, J., Jetter, M., Michler, P., Cusano, A., Portalupi, S. L., Integrated Optoelectronic Devices Using Lab-On-Fiber Technology. Adv. Mater. Technol. 2022, 2101681.

QD-LED

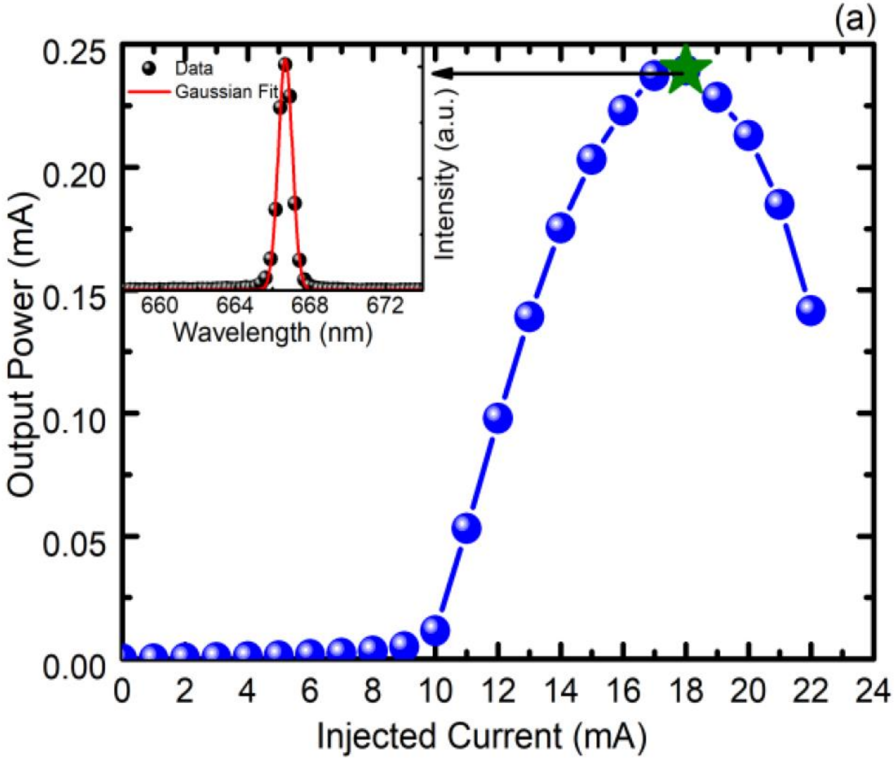
Light Emission And Detection Performances

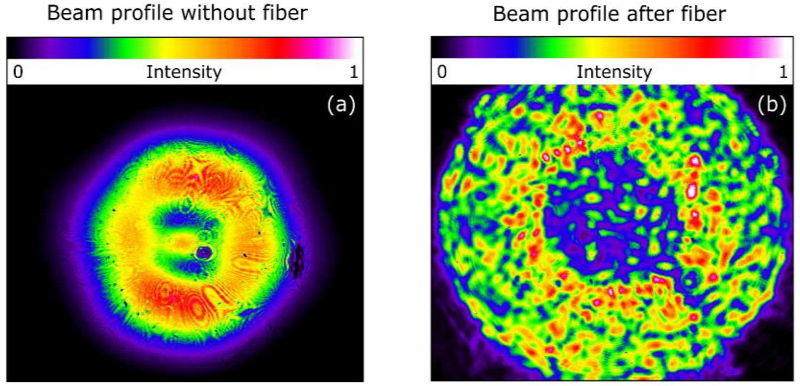




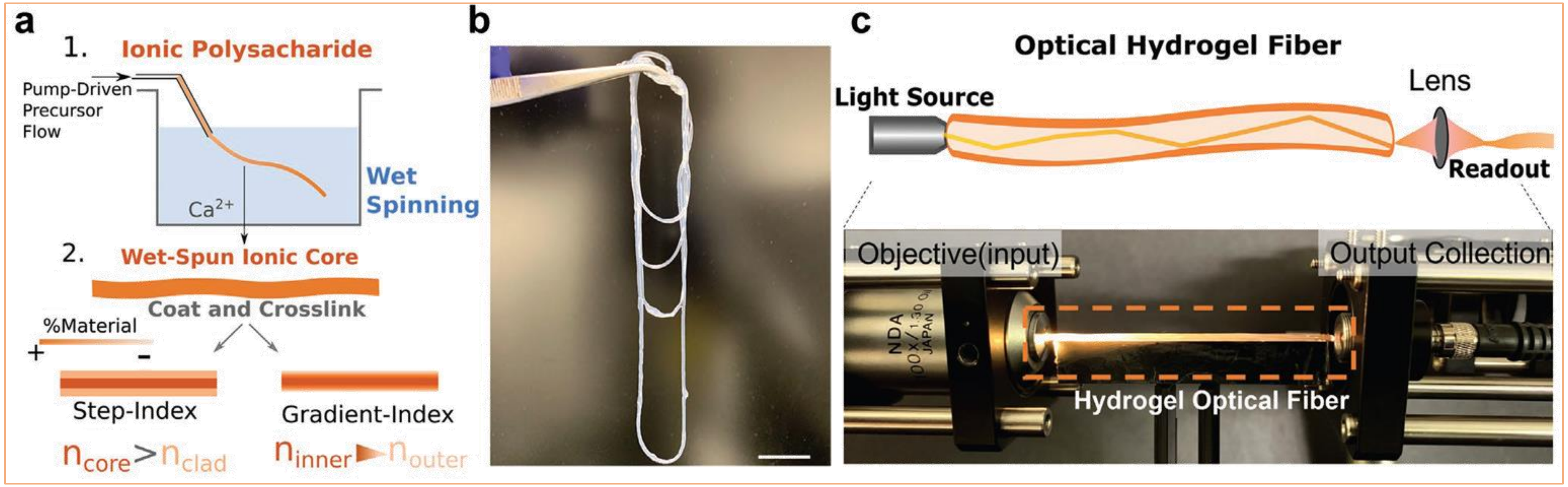
VCSEL

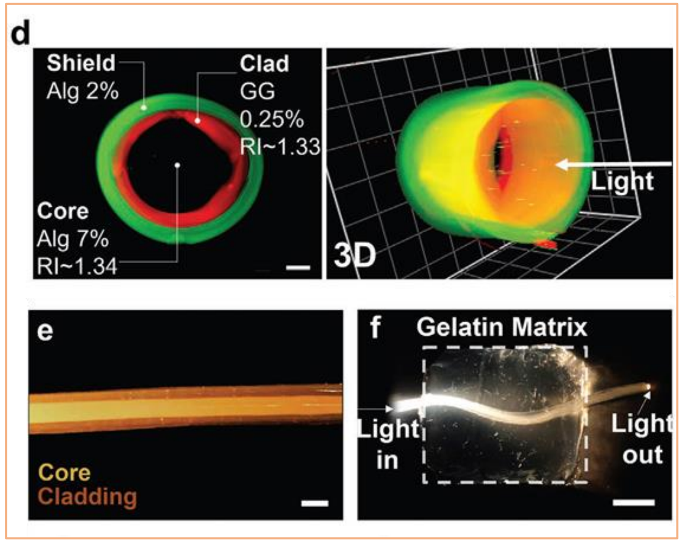
Estimated Coupling Efficiency ~25%

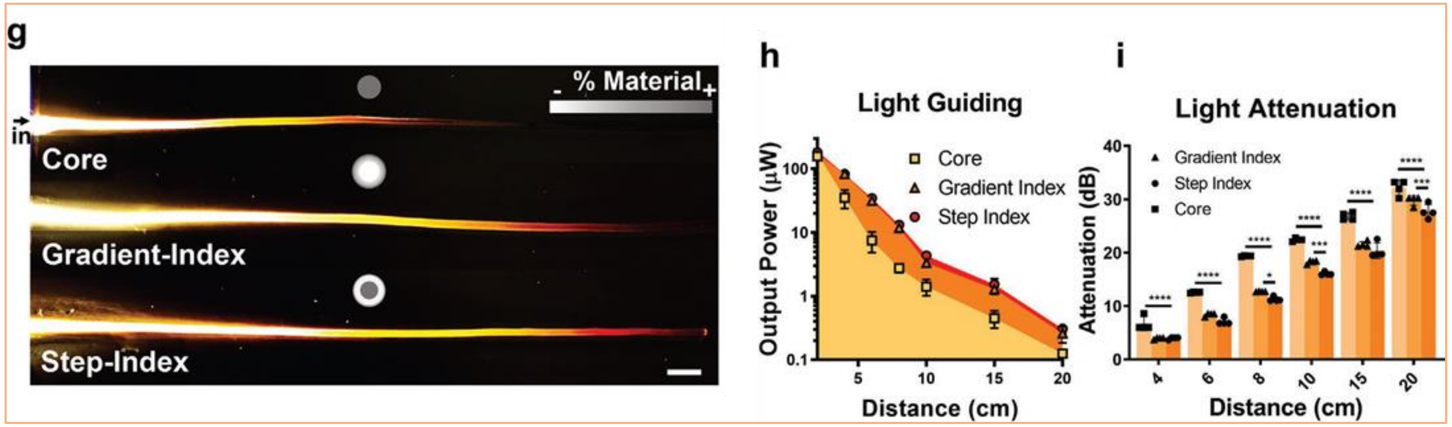




TOWARDS MULTILAYERED *LIVING* OPTICAL FIBERS







Adv. Mater. 2021, 2105361

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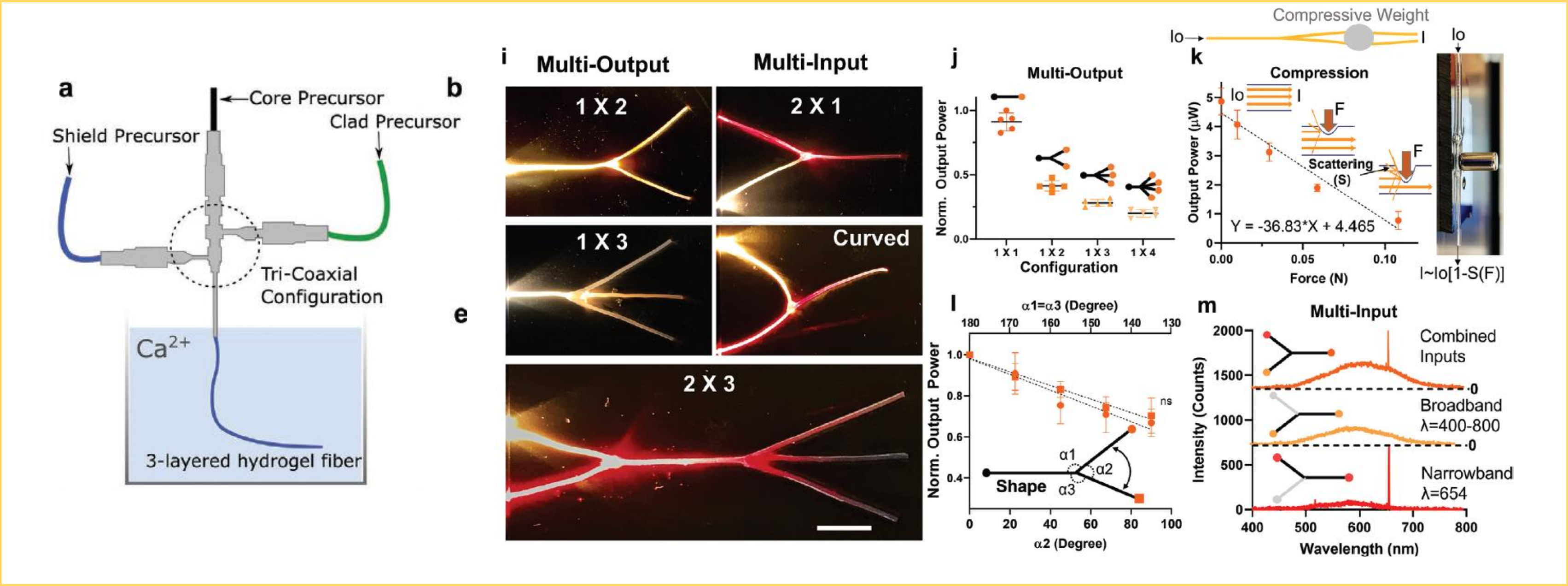
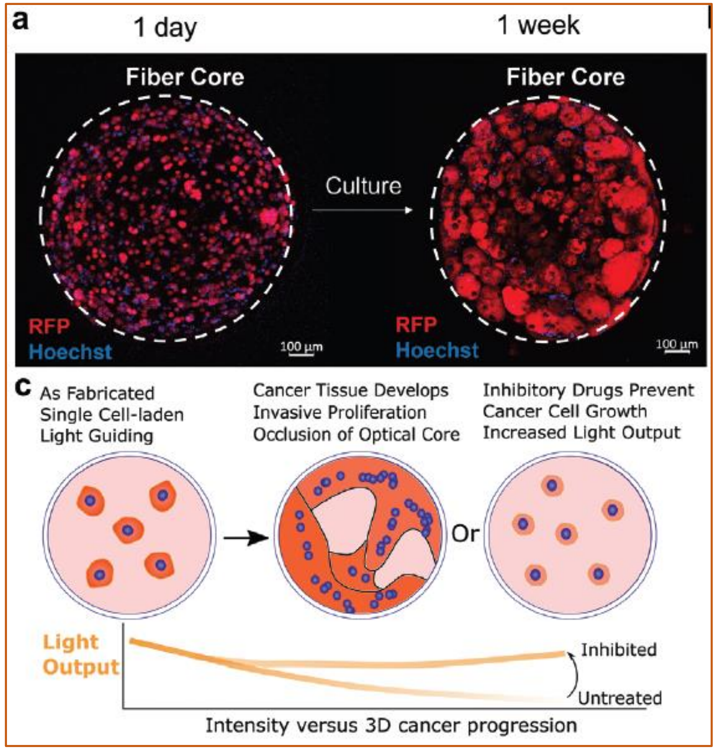
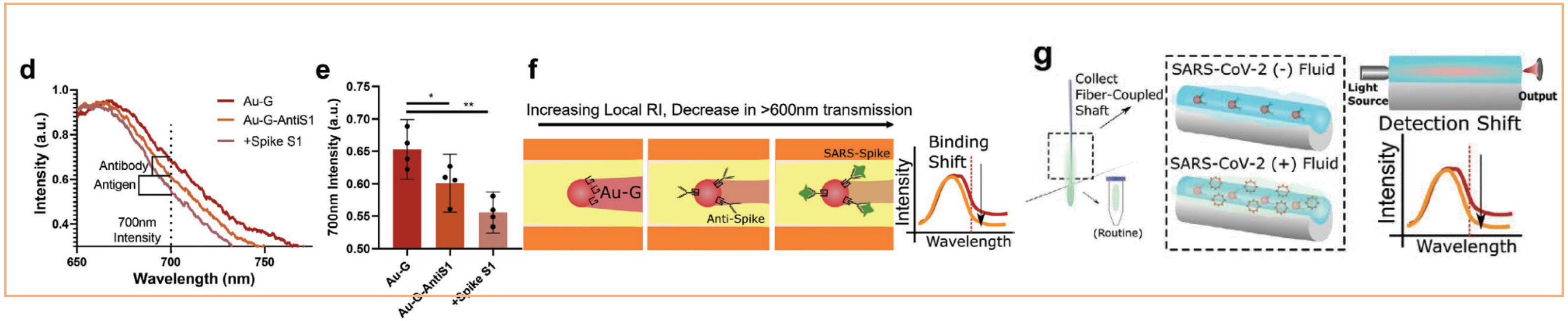
ADVANCES IN BIOMATERIAL-BASED PHOTONICS AND BIOSENSING PLATFORMS

OPTOELECTRONICS group University of Sannio







CONCLUSIONS

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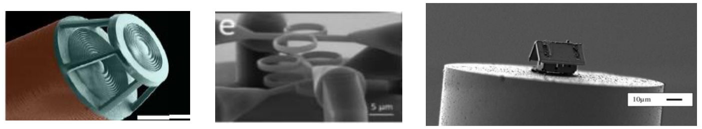
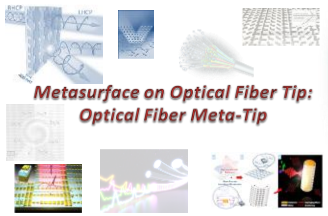
OPTOELECTRONICS group University of Sannio

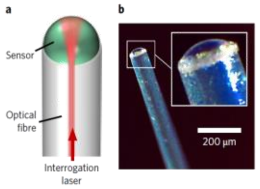
FABRICATION PROCESSES HAVE REACHED AN ADEQUATE MATURITY LEVEL



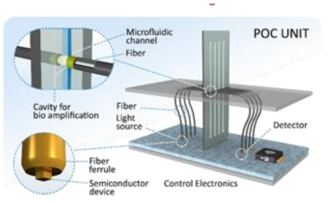
FIRST EVIDENCE OF LOF DEVICES WITH NEW FUNCTIONALITIES AND UNPRECEDENTED PERFORMANCES



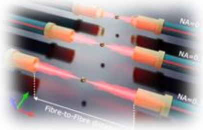
CONCERNING APPLICATIONS…IT IS ONLY THE BEGINNING. THE TECHNOLOGY SOUNDS PROMISING BUT … AT THIS STAGE WE ARE STILL AT PROOF-OF-CONCEPT DEMONSTRATIONS ….



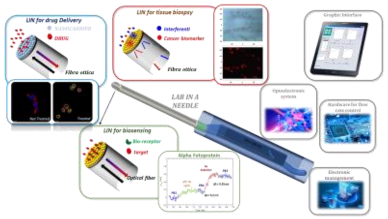
DEVELOPMENT OF RELIABLE AND PLUG&PLAY LOF PLATFORMS FOR POC APPLICATIONS



TRANSLATION OF FABRICATION PROCESSES TOWARDS SUSTAINABLE AND HIGH THROUGHPUT PRACTICES



INTEGRATION OF LOF DEVICES IN NEEDLES, CATHETERS AND MEDICAL DEVICES FOR IN VIVO ADVANCED DIAGNOSTICS



THANK YOU FOR YOUR KIND ATTENTION!