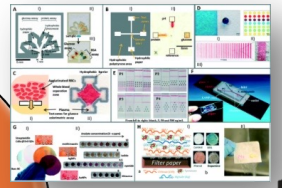
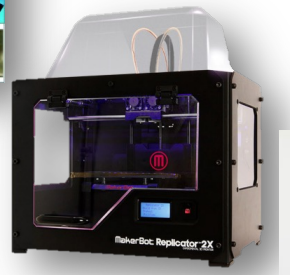
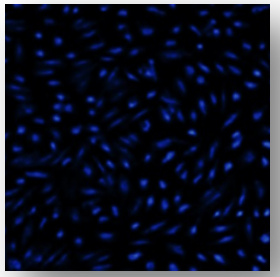
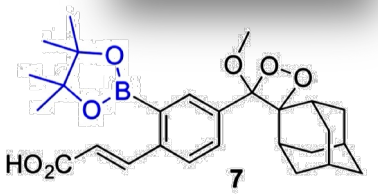
Research activity

Paper chemistry e 3D-printing technology per smartphone-based biosensors





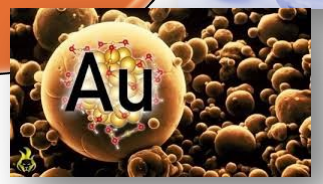




Biosensori cellulari chemiluminescenti

Sviluppo di biosensori ottici per applicazioni in nutraceutica, medicina e astrobiologia

Nanomateriali Biomimetici (Nanoparticelle, idrogels, aptameri)

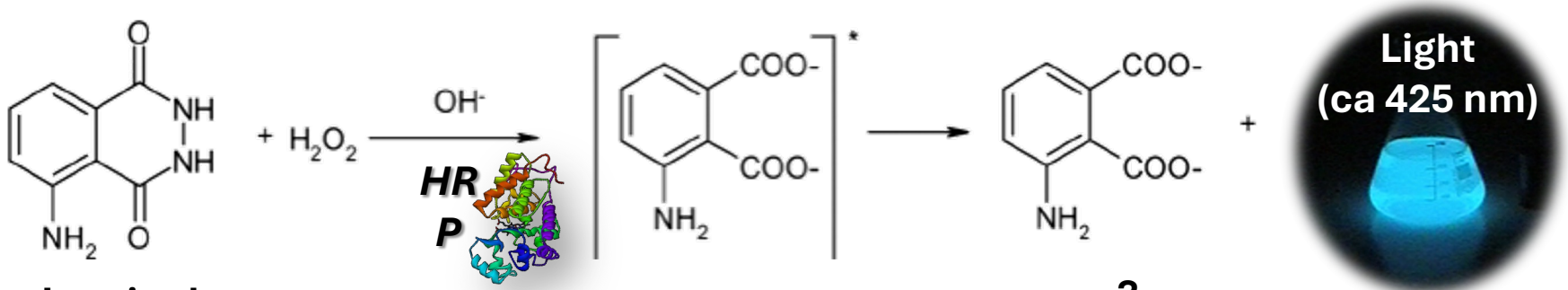


In-silico modeling e metodi computazionali per lo sviluppo di biosensori

Chemiluminescence as detection method

Chemiluminescence (CL) is defined as the production of electromagnetic radiation (ultraviolet, visible or infrared) observed when a chemical reaction yields an electronically excited intermediate or product, which either luminesces (direct CL)

$$A + B \rightarrow P^* \rightarrow P + h\nu$$

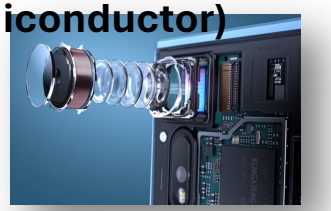


Luminol

3-aminophthalate

CCD
(Charge Coupled Device)

CMOS
(Complementary Metal Oxide Semiconductor)



Advantages of Chemiluminescence:

- High sensitive detection (pM)
- High dynamic range
- Simple analytical procedures
- Low cost technique
- Simple and low-cost instrumentation (no need of a source of light)

D. Calabria et al. Anal. Biochem., 2020. 600, 113760.

PAPER-BASED SMARTPHONE CHEMOSENSOR FOR REFLECTOMETRIC ON-SITE TOTAL POLYPHENOLS QUANTIFICATION IN OLIVE OIL

Sensors & Actuators: B. Chemical 305 (2020) 127522

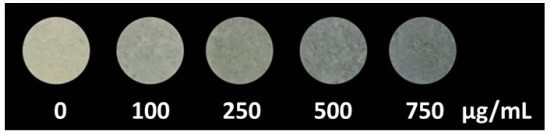
Contents lists available at ScienceDirect

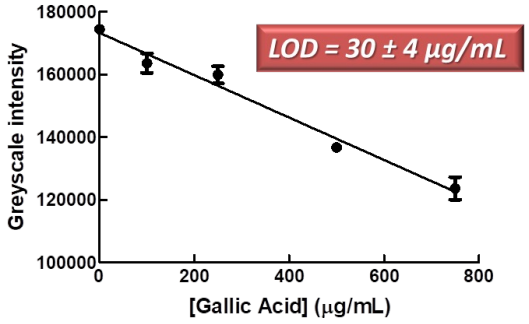
Sensors and Actuators B: Chemical

journal homepage: www.elsevier.com/locate/snb

Paper-based smartphone chemosensor for reflectometric on-site total polyphenols quantification in olive oil

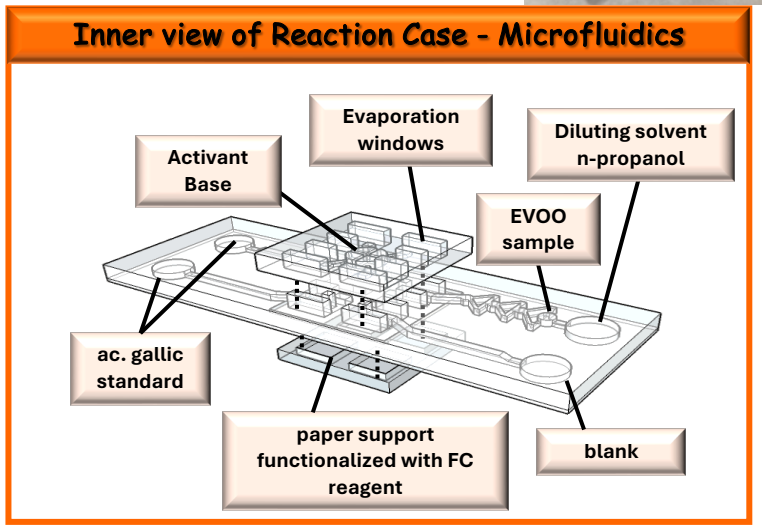
D. Calabria[a], M. Mirasoli[a,b], M. Guardigli[a,b], P. Simoni[c], M. Zangheri[a], P. Severi[a], C. Caliceti[d,e], A. Roda[a,b,e,f,*]

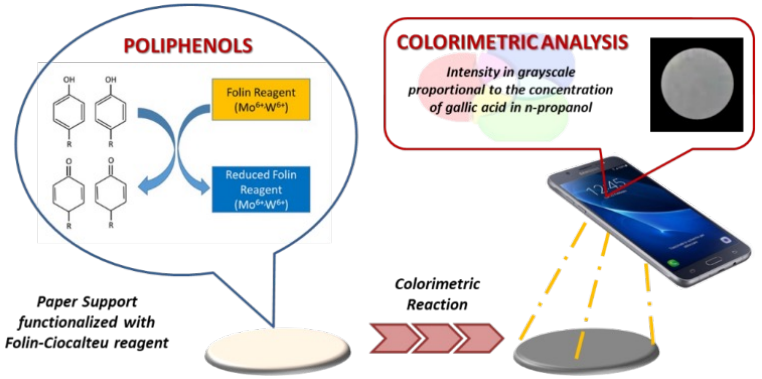


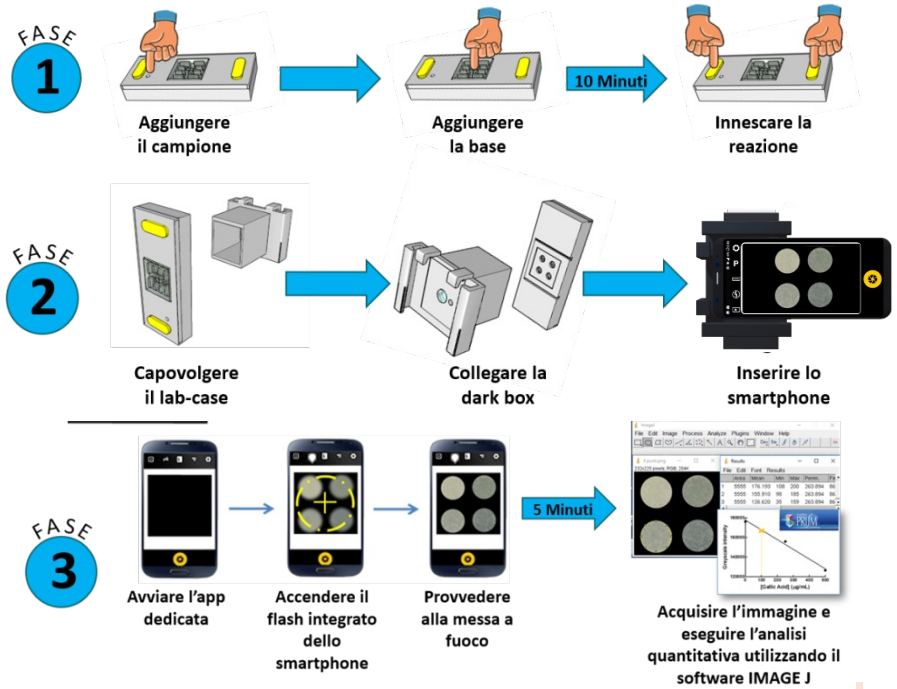


$y = (-68 \pm 5)x + (173300 \pm 2217)$

$R^2 = 0{,}98$

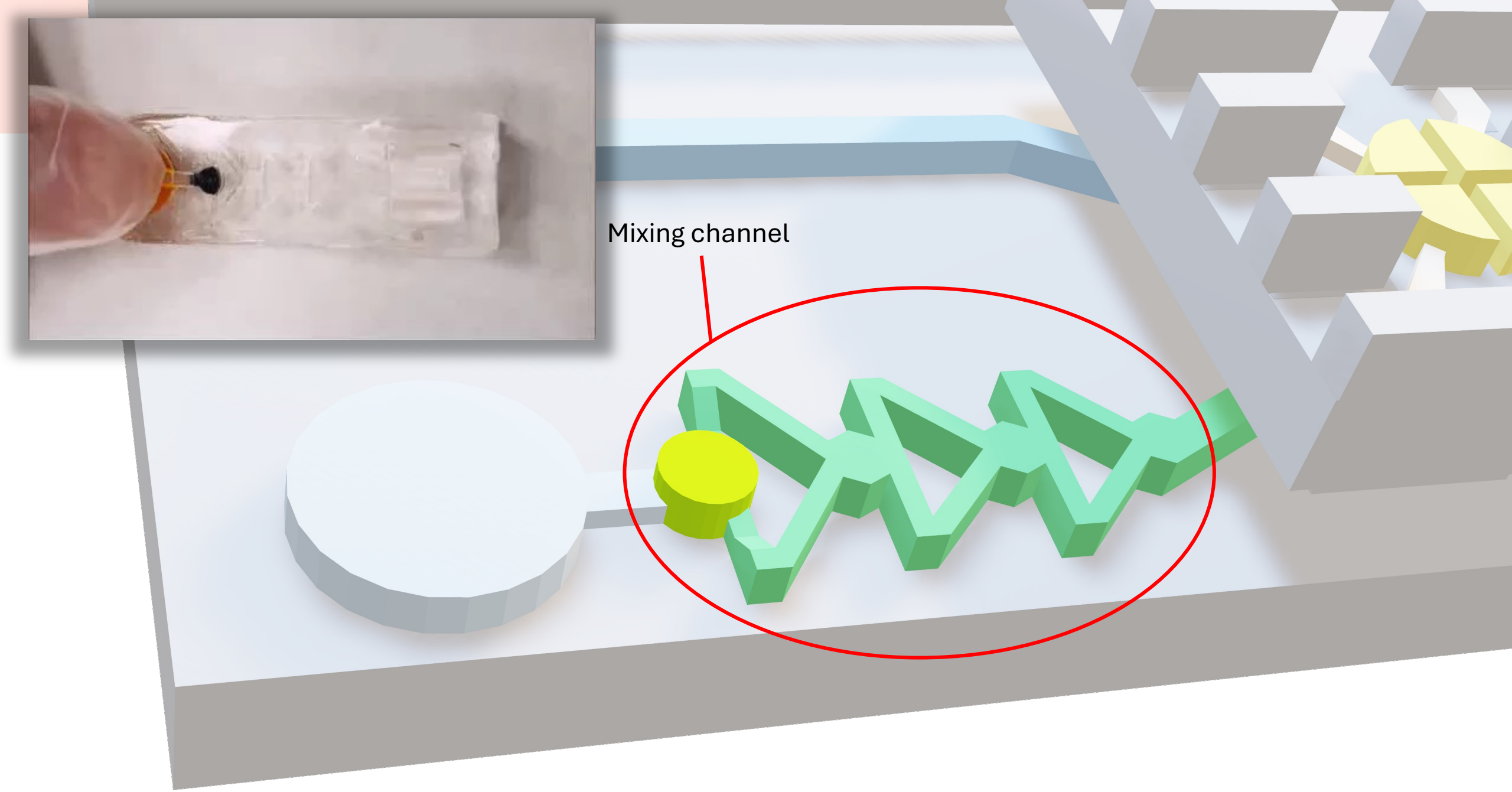






Acknoledgements

The project was funded by Cariplo Foundation within the "Agroalimentare e Ricerca" (AGER) program. Project AGER2 - Rif. 2016-0169, "Valorizzazione dei prodotti italiani derivanti dall'oliva attraverso Tecniche Analitiche Innovative - VIOLIN".


Mixing channel

Biosensors and Bioelectronics 227 (2023) 115146

Contents lists available at ScienceDirect

Biosensors and Bioelectronics

journal homepage: www.elsevier.com/locate/bios

Smartphone-based 3D-printed electrochemiluminescence enzyme biosensor for reagentless glucose quantification in real matrices

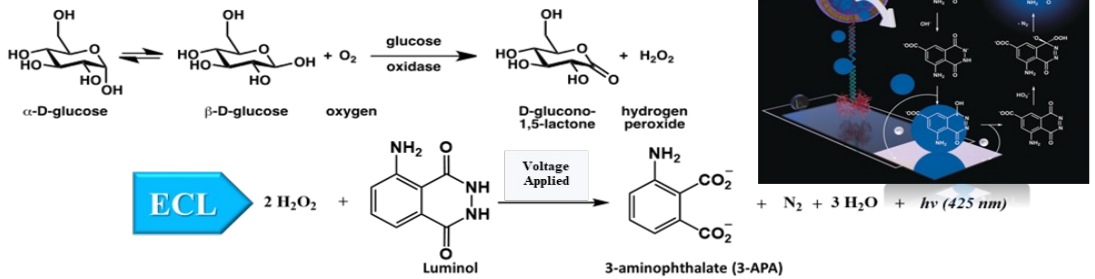
Donato Calabria [a,b], Elisa Lazzarini [a], Andrea Pace [a], Ilaria Trozzi [a], Martina Zangheri [a,c,d], Stefano Cinti [e,f], Marinella Difonzo [a], Giovanni Valenti [a], Massimo Guardigli [a,b,g], Francesco Paolucci [a,*], Mara Mirasoli [a,b,g,**]

SMARTPHONE-BASED 3D-PRINTED ELECTROCHEMILUMINESCENCE ENZYME BIOSENSOR FOR REAGENTLESS GLUCOSE QUANTIFICATION IN REAL MATRICES

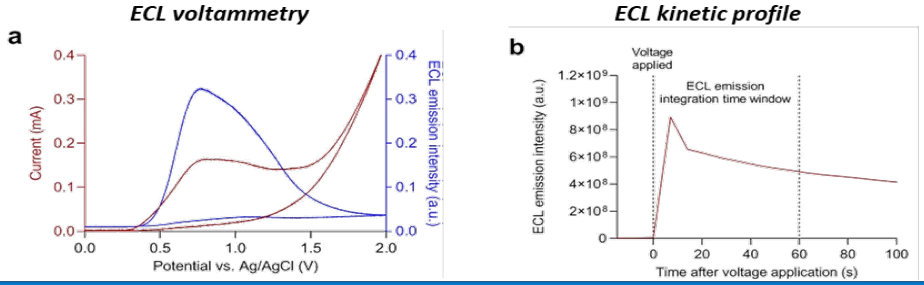
Acknowledgements

This research was funded by the Italian Ministry of University and Research: PRIN2017 project "Cutting edge analytical chemistry methodologies and bio-tools to boost precision medicine in hormone-related diseases", Prot. 2017Y2PAB8; and **PRIN2017** project "Functional 3D architectures for electrochemiluminescence applications", Prot. 2017FJCPEX.

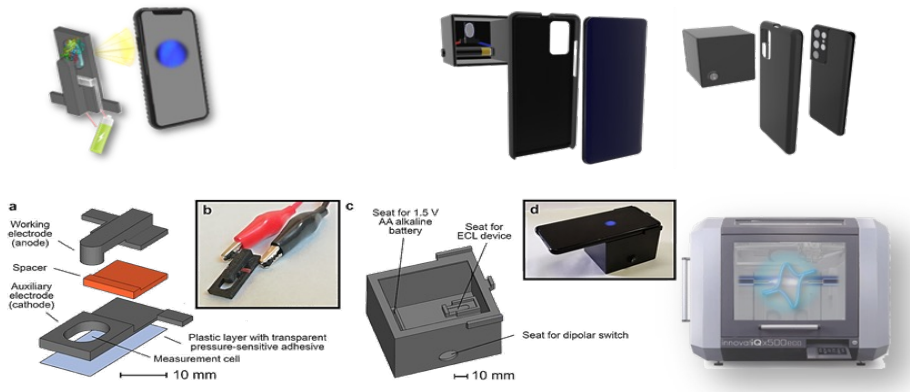
Principle of method



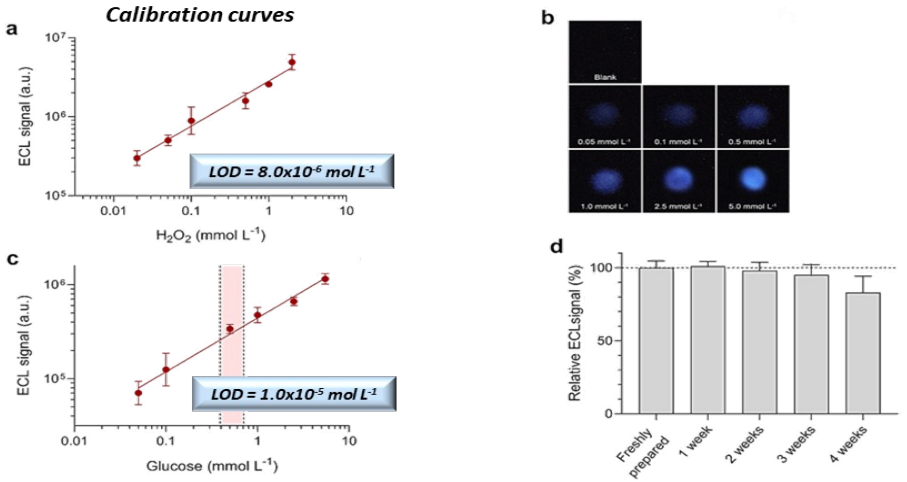
Physical-chemical characterization of ECL emission



3D printed device



Analytical methods and stability



Calabria Donato et al. Biosensors and Bioelectronics 227 (2023): 115146.

biosensors

MDPI

Article

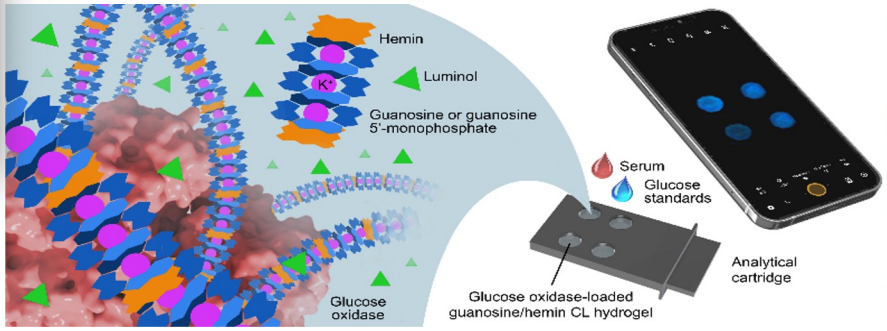
Smartphone-Based Chemiluminescence Glucose Biosensor Employing a Peroxidase-Mimicking, Guanosine-Based Self-Assembled Hydrogel

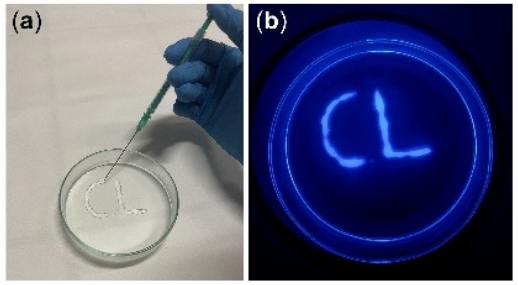
Donato Calabria [1,2], Andrea Pace [1], Elisa Lazzarini [1], Ilaria Trozzi [1], Martina Zangheri [1,3,4], Massimo Guardigli [1,2,5], Silvia Pieraccini [1], Stefano Masiero [1] and Mara Mirasoli [1,2,5,*]

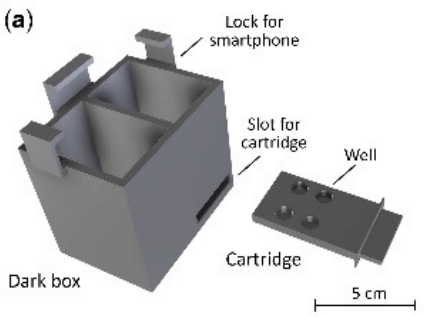
Funding

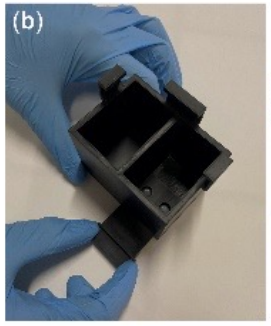
This research was funded by the Italian Ministry of University and Research: **PRIN2017** project "Cutting edge analytical chemistry methodologies and bio-tools to boost precision medicine in hormone-related diseases", Prot. 2017Y2PAB8; and **PRIN2017** project "Development of novel DNA-based analytical platforms for the rapid, point-of-use quantification of multiple hidden allergens in food samples", Prot. 2017YER72K; S.M. thanks the EU funding within the **MUR PNRR "National Center for Gene Therapy and Drugs based on RNA Technology"** (Project No. CN00000041 CN3 RNA).

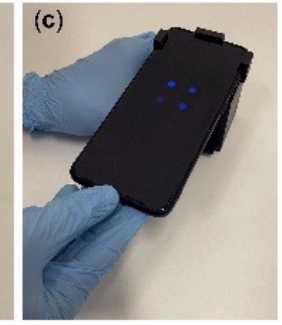
SMARTPHONE-BASED CHEMILUMINESCENCE GLUCOSE BIOSENSOR EMPLOYING A PEROXIDASE-MIMIKING, GUANOSINE-BASED SELF-ASSEMBLED HYDROGEL

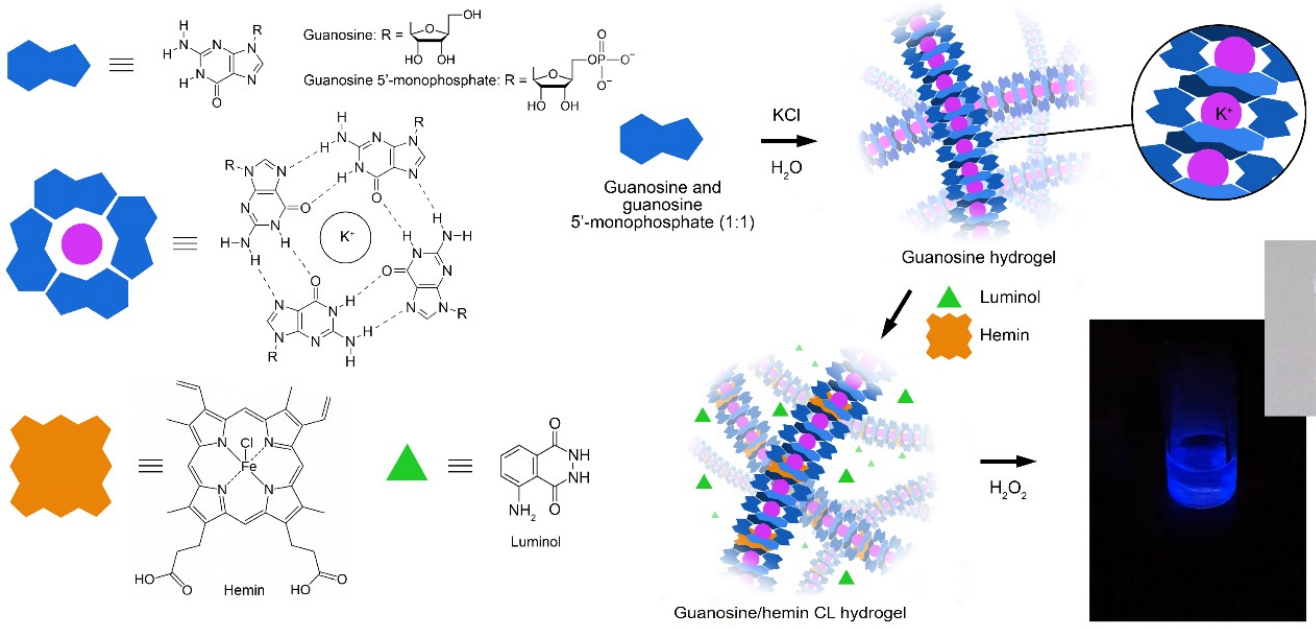


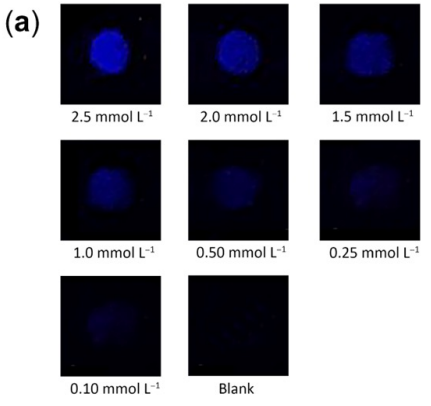


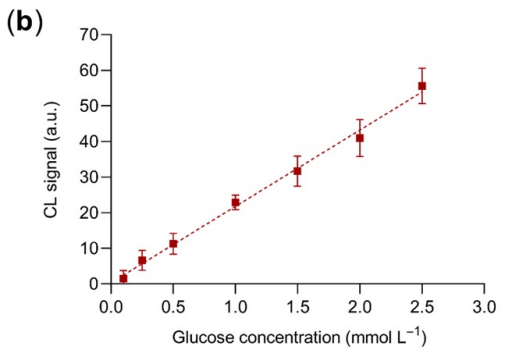












SMARTPHONE-BASED CHEMILUMINESCENT ORIGAMI µPAD FOR THE RAPID ASSESSMENT OF GLUCOSE BLOOD LEVELS

biosensors

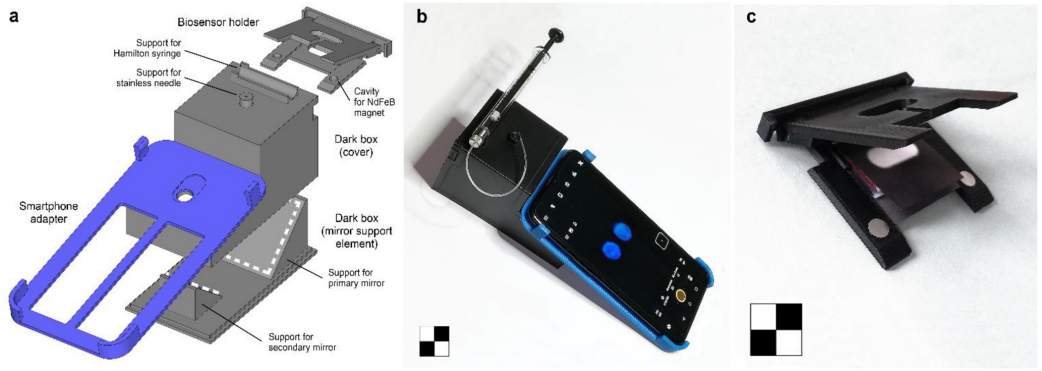
MDPI

Article

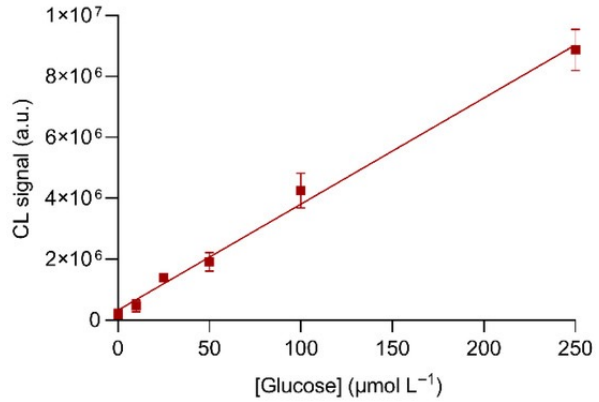
Smartphone-Based Chemiluminescent Origami µPAD for the Rapid Assessment of Glucose Blood Levels

Donato Calabria [1], Martina Zangheri [1,2,3], Ilaria Trozzi [1], Elisa Lazzarini [1], Andrea Pace [1], Mara Mirasoli [1,4,5] and Massimo Guardigli [1,4,5,*]

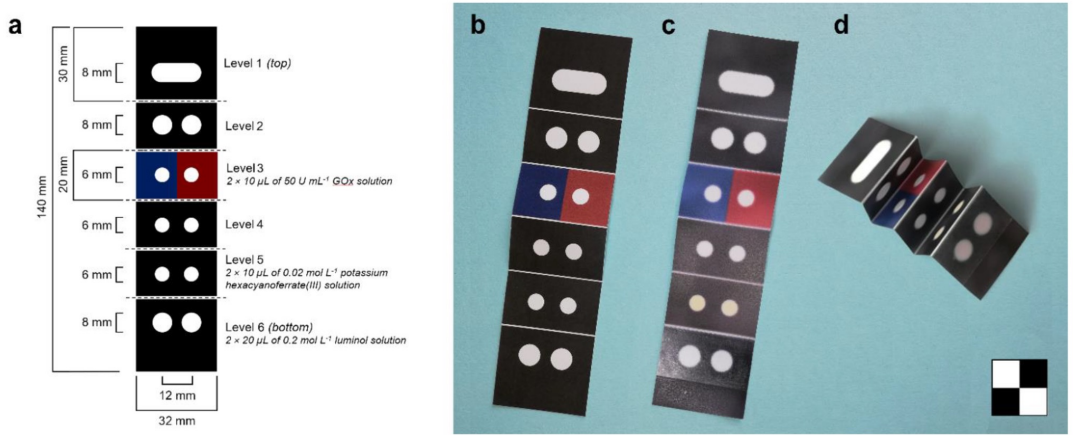
3D smartphone based device



Calibration curve for glucose obtained in the optimized experimental conditions. The equation of the calibration curve is Y = (3.51 × 10^4 ± 2.5 × 10^3)X + (3.3 × 10^5 ± 3.9 × 10^5), R^2 = 0.989



Origami Paper Biosensor



Funding: This research was funded by the Italian Ministry of University and Research (**PRIN2017** project "Cutting edge analytical chemistry methodologies and bio-tools to boost precision medicine in hormone-related diseases", Prot. 2017Y2PAB8).

AN ORIGAMI PAPER-BASED BIOSENSOR FOR ALLERGEN DETECTION BY CHEMILUMINESCENCE IMMUNOASSAY ON MAGNETIC MICROBEADS

biosensors MDPI

Article

An Origami Paper-Based Biosensor for Allergen Detection by Chemiluminescence Immunoassay on Magnetic Microbeads

Elisa Lazzarini [1,†], Andrea Pace [1,†], Ilaria Trozzi [1], Martina Zangheri [1,2,3], Massimo Guardigli [1,4,5], Donato Calabria [1,5,*] and Mara Mirasoli [1,4,5,*]

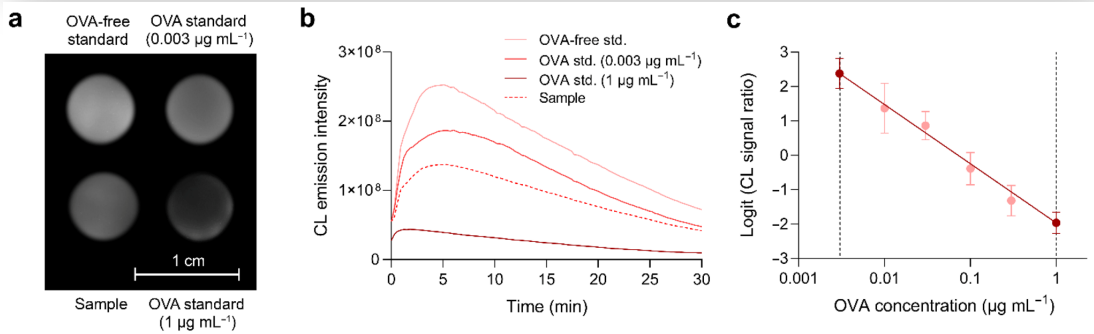
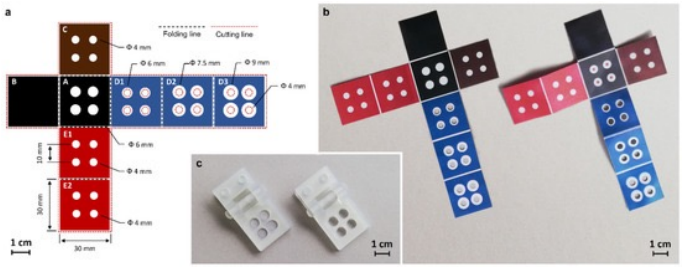
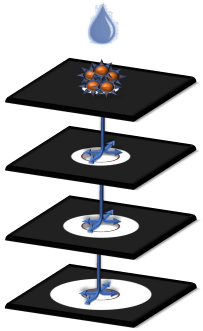
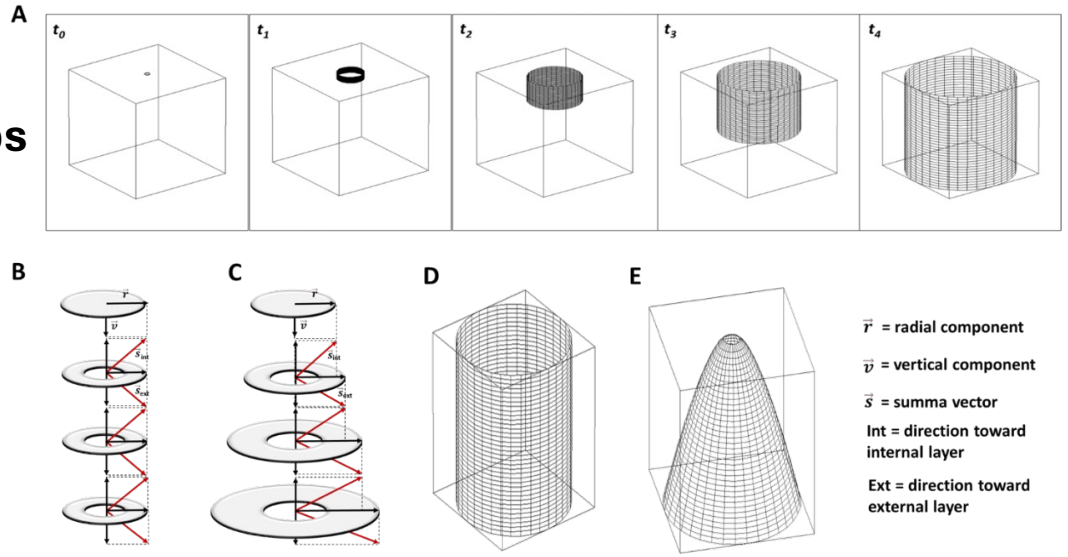


Figure 7. (a) CL image of the origami µPAD acquired during the assay. The scale bar represents 1 cm. (b) CL emission intensity kinetic profiles obtained by the analysis of the CL images acquired during the assay. (c) Application of the two-standard calibration approach to the calibration data of Figure 6. The readings obtained for concentrations that correspond to the upper and lower limits of the assay working range (dark points) were used to obtain the two-point calibration curve, while the other readings (light points) were simply plotted on the graph.



Washing steps

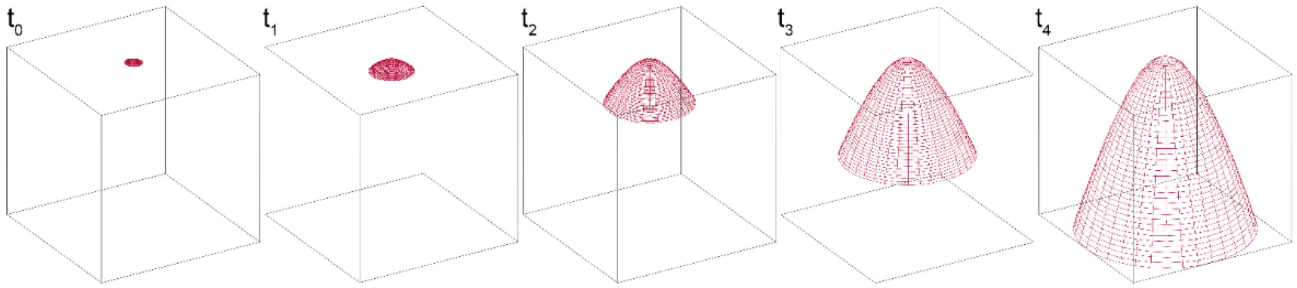




Vertical flow surface equation system (Figure 4)

3D-surface is described by x(u,t), y(u,t), z(u,t)

$$\begin{cases} x(t,u) = (n_1 + nt^{0.7})cos(2u) \\ y(t,u) = (n_1 + nt^{0.7})sin(2u) \\ z(u) = -n_2 sin(n_3 t) \end{cases} \qquad n_{i\text{-}th} > 0\,;\ 0 < t < 2\,\pi;\ 0 < u < \pi$$



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Biosensors and Bioelectronics
Volume 226, 15 April 2023, 115110

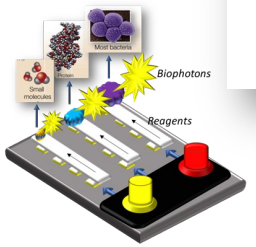
AstroBio-CubeSat: A lab-in-space for chemiluminescence-based astrobiology experiments

Donato Calabria [a b 1], Ilaria Trozzi [a 1], Elisa Lazzarini [a], Andrea Pace [a], Martina Zangheri [a], Lorenzo Iannascoli [c], Nithin Maipan Davis [c], Sagar Sarvad Gosikere Matadha [c], Thiago Baratto De Albuquerque [c], Simone Pirrotta [d], Marta Del Bianco [d], Gabriele Impresario [d], Liyana Popova [e], Nicola Lovecchio [f], Giampiero de Cesare [f], Domenico Caputo [f], John Brucato [g], Augusto Nascetti [c], Massimo Guardigli [a b], Mara Mirasoli [a b]

ASTROBIO-CUBESAT: A LAB-IN-SPACE FOR CHEMILUMINESCENCE-BASED ASTROBIOLOGY EXPERIMENTS

Searching for signs of past or present life is a high-priority task for the astrobiological exploration of our Solar System. Following a bioanalytical approach, a variety *in-situ* microfluidic analytical devices have been proposed for detecting target life biomarkers through an array of biospecific recognition reactions.

Extraterrestrial traces and origin of life researches by astrobiological biosensors

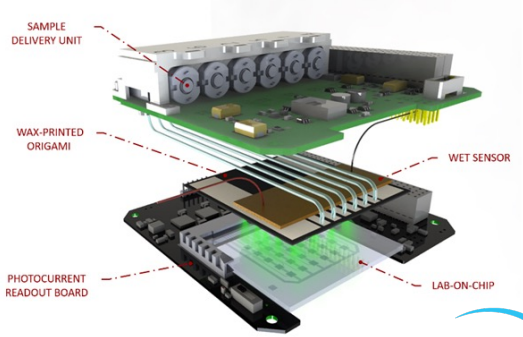


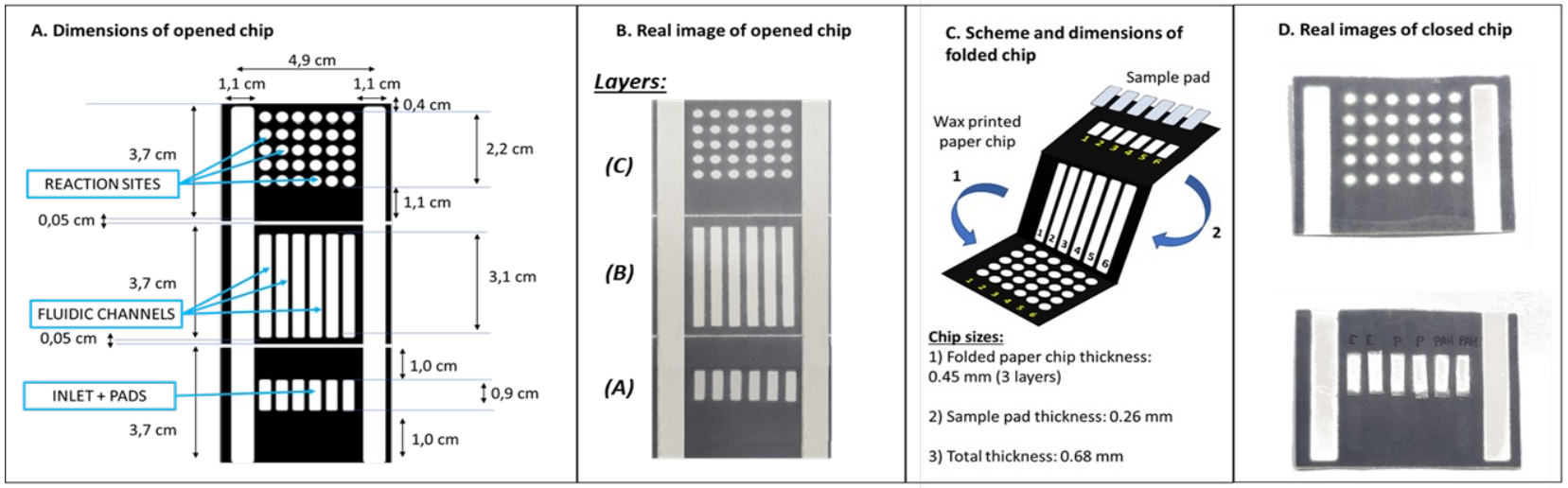
The ABCS project aims at the development of a CL-based fully autonomous analytical platform for the execution of multiple enzyme-based bioassays in a nanosatellite platform.

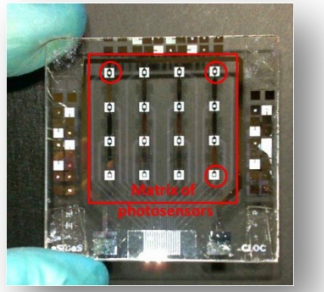
ABCS hosts a **micro laboratory** based **on Lab-on-Chip technology** able to provide a platform for an automatic bioanalytical experiments in space.

The **target applications** are:

- Search for signs of life in planetary exploration missions;
- Space biolabs without human support;
- Health monitoring in manned missions.







Agenzia Spaziale Italiana

Acknowledgments: ABCS AstroBio-CubeSat is supported by ASI - Italian Space Agency ASI/INAF Agreement n. 2019-30-HH.0

ASTROBIO-CUBESAT: A LAB-IN-SPACE FOR CHEMILUMINESCENCE-BASED ASTROBIOLOGY EXPERIMENTS

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Biosensors and Bioelectronics
Volume 226, 15 April 2023, 115110

AstroBio-CubeSat: A lab-in-space for chemiluminescence-based astrobiology experiments

Donato Calabria [a b 1], Ilaria Trozzi [a 1], Elisa Lazzarini [a], Andrea Pace [a], Martina Zangheri [a], Lorenzo Iannascoli [c], Nithin Maipan Davis [c], Sagar Sarvad Gosikere Matadha [c], Thiago Baratto De Albuquerque [c], Simone Pirrotta [d], Marta Del Bianco [d], Gabriele Impresario [d], Liyana Popova [e], Nicola Lovecchio [f], Giampiero de Cesare [f], Domenico Caputo [f], John Brucato [g], Augusto Nascetti [c], Massimo Guardigli [a b], Mara Mirasoli [a b]

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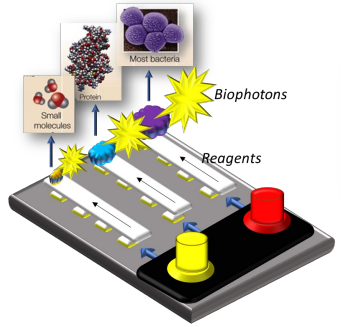
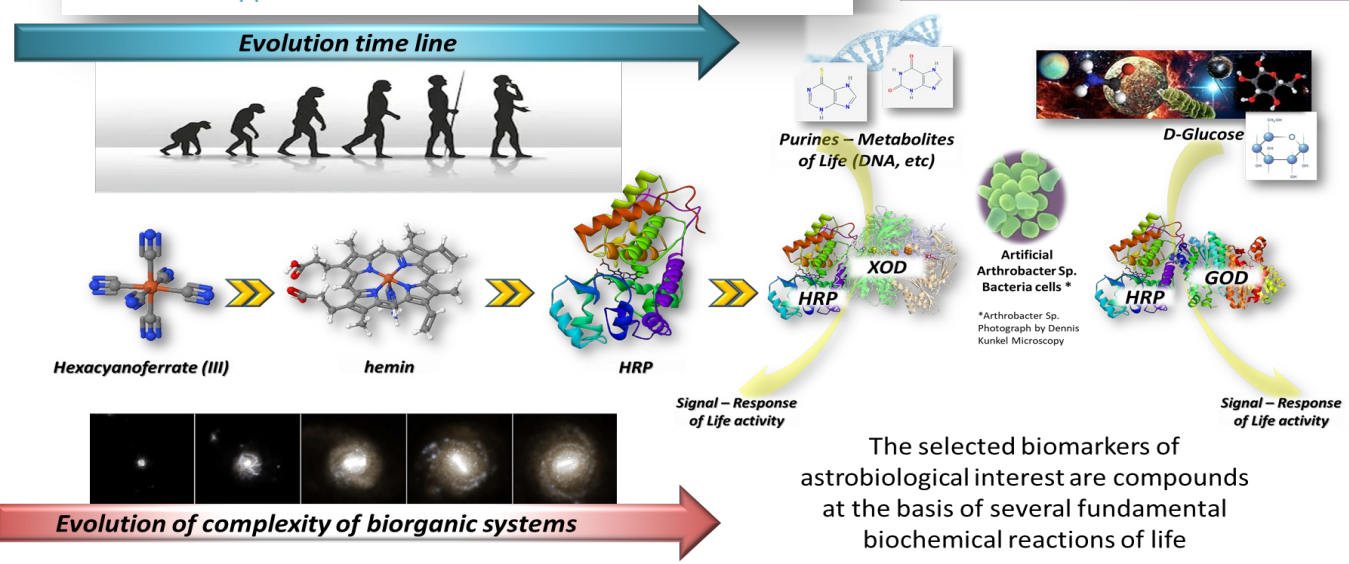
Extraterrestrial traces and origin of life researches by astrobiological biosensors





The selected biomarkers of astrobiological interest are compounds at the basis of several fundamental biochemical reactions of life

The ABCS project aims at the development of a CL-based fully autonomous analytical platform for the execution of multiple enzyme-based bioassays in a nanosatellite platform.

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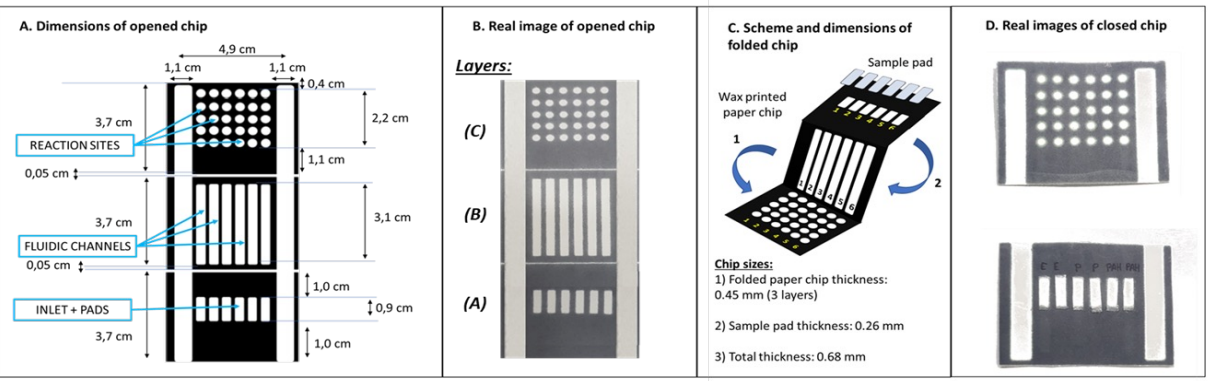
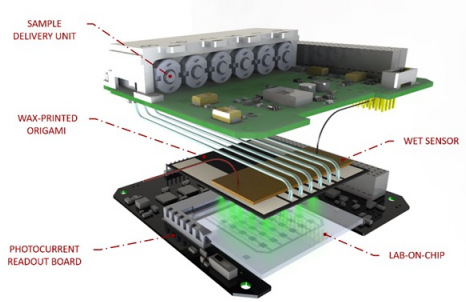
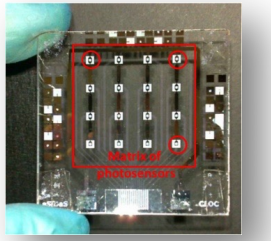
- Space biolabs without human support;
- Health monitoring in manned missions.





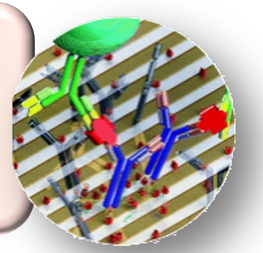


Acknowledgments: ABCS AstroBio-CubeSat is supported by ASI - Italian Space Agency ASI/INAF Agreement n. 2019-30-HH.0

Biosensori per applicazioni nello Spazio

MEDICINA NELLO SPAZIO

APHRODITE
Autonomous **PH**otosensing **R**eusable **O**nboard **D**evice for **I**mmunological **T**ests **E**xecution



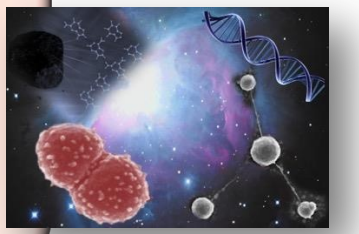
WEAR-ME!
sistema integrato miniaturizzato indossabile per il monitoraggio non invasivo del wound healing nell'astronauta

Beatrice Fraboni – Dipartimento di Fisica,Università di Bologna

ASTROBIOLOGIA

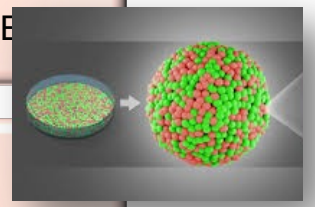
BESIDES
Biomol**E**cular **SI**gnature **DE**tection **S**ystem

"Attività relative al supporto allo sviluppo di progetti/esperimenti scientifici nell'ambito dell'Astrobiologia"



VALUTAZIONE EFFETTI RADIAZIONI SU SISTEMI BIOLOGICI

ALCYONE
Autonomous **L**iving **C**ell anal**Y**sis **ON**-chip for **E**valuation of space **E**nvironment **E**ffects:
low-power integrated lab-on-chip for the assessment of radiation damage on living systems in nanosatellite missions nell'ambito del Programma Quadro HORIZON EUROPE



BOREALIS
Biofilm **O**nboard **R**adiation **E**xposure **A**ssessment **L**ab **I**n **S**pace

migliorare le tecniche di design degli schermi da radiazioni e le valutazioni dosimetriche in vari scenari di missione.

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA
CIRI AEROSPACE
esa European Space Agency
asi Agenzia Spaziale Italiana
KAYSER ITALIA