| GROUP

ENZYME ENGINEERING BIOMIMETIC MEMBRANES AND SUPRAMOLECULAR ASSEMBLIES (GEMBAS)

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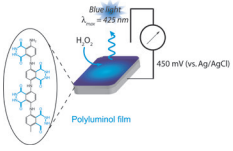
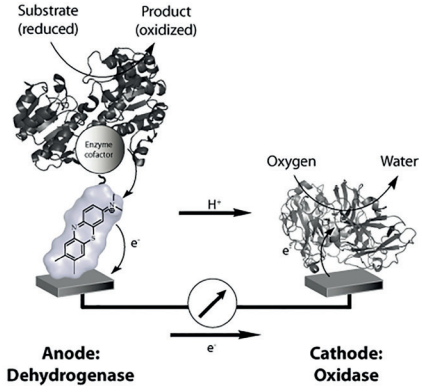
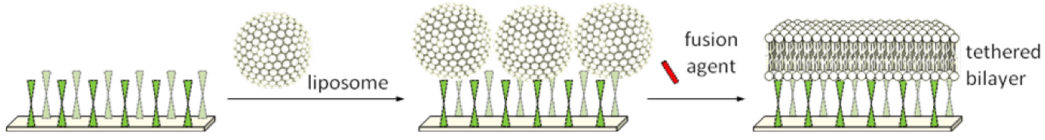
LOÏC BLUM

Professor at Université Claude Bernard Lyon 1



GEMBAS





The main activity of the laboratory is the study of enzymes and biomolecules in structured media. These interdisciplinary works are developed in the field of nanosciences and nanotechnologies and are oriented towards four main directions: Biochips and nanosystems for biology – Optical biosensors - Biomimetic membranes -Enzymatic biofuel cells.

TOPICS

Biosensors - Biochips - Cellular bioengineering - Micro-fluidics - High-throughput screening - Enzymatic biofuel cells - Biomimetic membranes - Supported and tethered bilayer lipid membranes (SLB and tBLM) – Bio- and chemi-luminescence - Electro-chemiluminescence.

BIOCHIPS AND NANOSYSTEMS FOR BIOLOGY

The Biochip group is working on electrochemical and optical biosensor/biochip technologies and biomolecule immobilization strategies. During the last 10 years, innovative works have led to the publication or patenting of technologies such as electro-addressing of diazonium-protein adducts, soft lithography material functionalization with biomolecules and adhesive surface modification for rapid production of microarrays. The team is using surface functionalization based on electrochemistry, adhesives and polymers such as silicon and hydrogels.

OPTICAL BIOSENSORS

Optical biosensors based on the chemi- and electrochemiluminescence of luminol have been developed. The main research activity involves the immobilization of electropolymerized luminol. It enables the design of autonomous and inexpensive biosensors which do not require the addition of luminophore in the reaction media.

BIOMIMETIC MEMBRANES

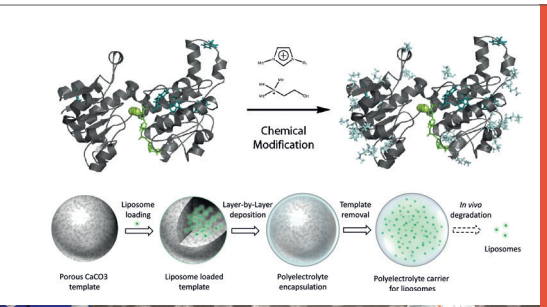
The group's work is mainly focused on the design of experimental models of the biological membrane and on the development of the concept of membrane microarrays. These activities include the study of interactions of various molecules (drugs, toxins, probes, vectors...) with biomimetic membranes. Supported lipid bilayers were developed initially by the Langmuir-Blodgett (LB) technique. Oriented insertion of functional proteins is possible in these lipidic bilayers. Langmuir monolayers represent a membrane model to study the interaction ability of membranotropic molecules (peptides, proteins, molecular probes). Tethered bilayer lipid membranes that can mimic the natural composition of biological membranes are also designed and allow the study of the insertion of integral membrane proteins.

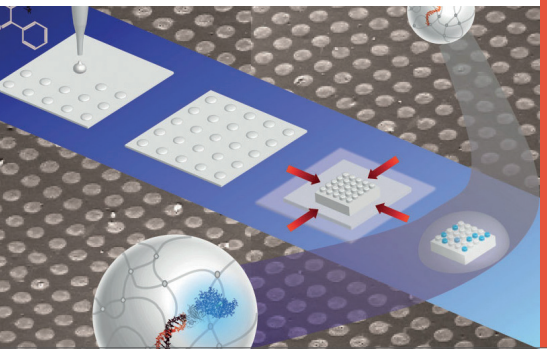
ENZYMATIC BIOFUEL CELLS

In order to develop enzymatic biofuel cells, ionic liquids (IL) are used both as an electrolyte and as a non-conventional stabilizer medium for redox enzymes. To obtain a functional and reliable device, the work is focused on: minimizing the electrode assemblies, simplifying the electron transfer reactions (direct or using redox mediators) and enzyme stabilization. Formate dehydrogenase (DH) and laccase have been chosen for the anode and cathode design, respectively. The chemical modification of DH by IL-inspired cations combined with directed evolution is investigated in order to obtain efficient biocatalysts and to identify the parameters responsible for such activity in IL. Electro-chemical screening methods for redox enzyme selection are also investigated.

| Figures

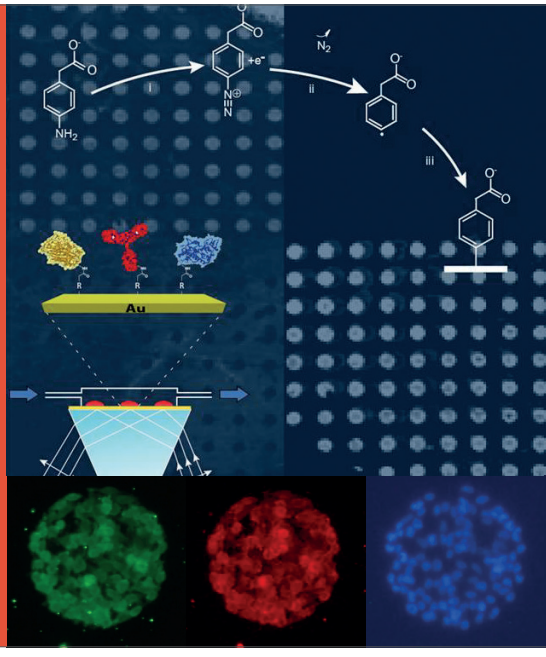
Left: Electrochemiluminescence with polyluminol. Center: Biochip microarray for clinical analysis. Right: biofuel cell. Bottom: tethered biomimetic membrane.





| EQUIPMENT

› Piezoelectric microarray spotters
› Pipetting robot
› 3D printers
› Cell culture laboratory
› Surface Plasmon Resonance imaging systems
› Screen printing equipement
› Spin coater
› 4 and 8 channel potentiostats
› 96 channel potensiostat for 96 well plate
› CCD cameras
› Luminometrers
› Fluorescence + absorbance microplate reader
› Luminescence microplate reader
› Optical profilometer
› Digital microscope
› Atomic Force Microscope
› Brewster Angle Microscope (BAM)
› PMIRRAS spectroscopy (outside facility)



COLLABORATIONS

The GEMBAS Laboratory has a strong networking activity and numerous scientific exchanges through several previous or current European and national (ANR) programs involving both academic and private partners. The GEMBAS laboratory is also one of the founder of IMBL (Institut Multidisciplinaire de Biochimie des Lipides). A strong partnership exists with AXO Sciences, a startup company stemmed from the biochip and microarray activities developed in the laboratory.

EXPERTISES

› Biocatalysis
› Bioanalysis
› Enzyme and Biomolecules immobilization
› Microsystems for biology
› Microarrays
› Biomimetic membranes
› Surface functionalization
› Luminescence reactions

STAFF

Loïc Blum, *Professor*
Agnès Degiuli, *Research Assistant*
Frédérique Depierre, *Secretary*
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Christophe Marquette, *Senior Researcher*
Ofelia Maniti, *Associate Professor*
Guillaume Octobre, *Associate Professor*

2-4 Post-Docs
4-6 PhD Students
2-4 Master Students
2-4 Graduate Students

| Figures

Left (from top to bottom): Chemical modification of dehydrogenase by ionic liquid-inspired cations; Liposome encapsulation in polyelectrolyte microcapsules; Shrinking hydrogel-DNA spots for 3D microdots microarrays.

Right: Top, Biomolecule electrogratfting on SPRi biochip; Bottom, Optical microscope images of HeLA cells cultured onto 150 µm fibronectin spots of a cell biochip

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