Key micro/nano technologies for advanced molecular to organ biomonitoring

BIOMEDICAL APPLICATIONS GROUP

GAB
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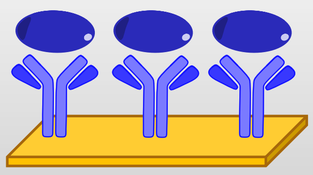
The primary mission of the Biomedical Applications Group at CNM-IMB is to take advantage of its own technological facilities and its scientific and technical know-how, to transform the innovation possibilities of micro-devices and related technologies into successful commercial biomedical products and advanced applications.

Research Areas

Molecular Biomonitoring

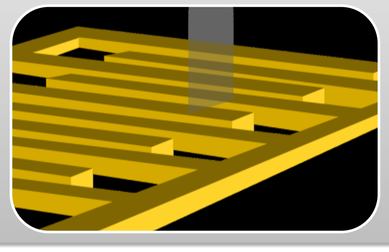
Electrochemical immunosensor based on impedimetric transduction has been performed using a 3D interdigitated electrode. This biosensor bases its response on changes of the electrical double layer , that is enhanced working at low conductivity solutions due to the appearance of the surface conductivity phenomenon.



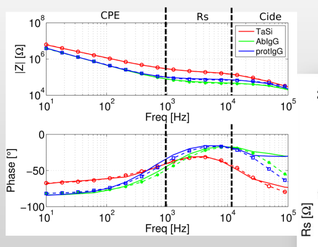
Protein Biomarker

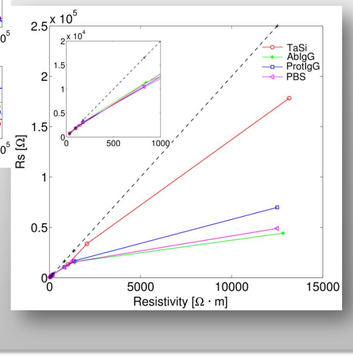
Antibody Capture

Bare Electrode Surface



Antibody immobilization for protein direct detection in 3D interdigitated microelectrodes (IDEs)

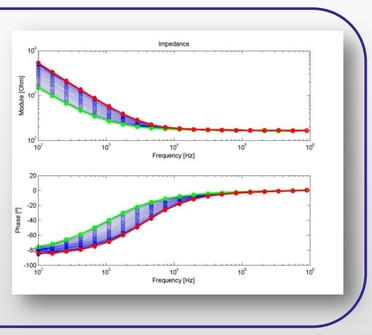




Celular Biomonitoring

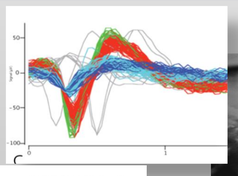
Bacterial Cell Cultures: Biofilms

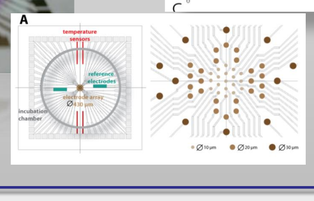
Micro technology based smart device for on-line monitoring of biologic structures such as biofilms.
Parameters that can be measured: cell adhesion by means of impedance measurement, pH, dissolved oxygen. Ions such as Na^+, K^+ and Ca^{2+} are now being developed

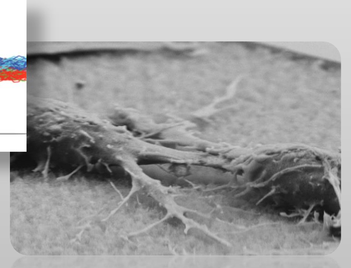


Neural Cell Cultures

Customized Multielectrode Arrays Systems (MEAs) can be developed for any specific study based on cell culture monitoring of neural cells.



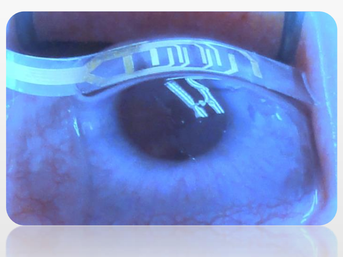


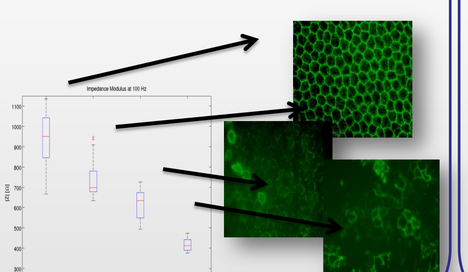


Organ Biomonitoring

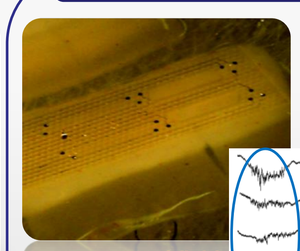
Corneal barrier function

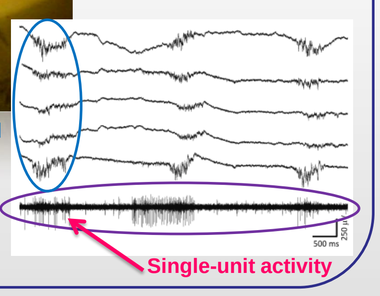
In vivo and *in vitro* assessment of corneal barrier function by means of non invasise impedance sensor.





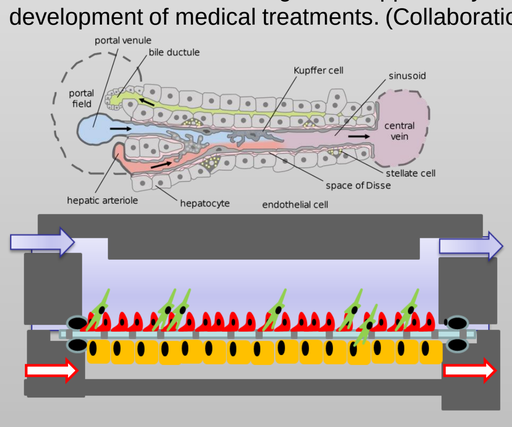
Brain recording/stimulation

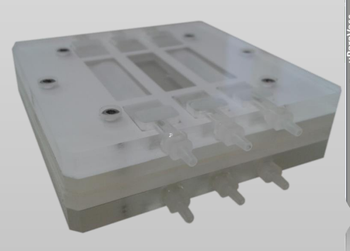


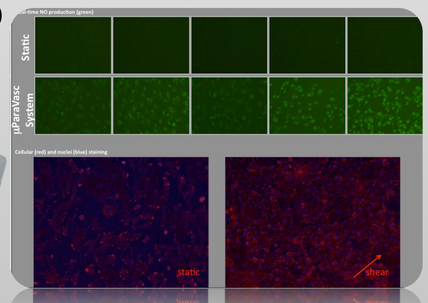


Organ On A Chip: In vitro model for liver or Blood Brain Barrier

In vitro microfluidic model give the opportunity to mimic complex organ physiology in a laboratory allowing the study and development of medical treatments. (Collaboration with Biomedical Research Centers)







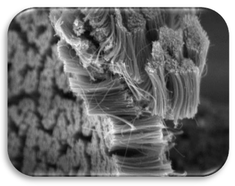
Microfluidic device for cellular co-culture ( ) of hepatic sinusoidal endothelial cells (red), stellates (green) and hepatocytes (yellow) that under a biomechanlical stimuli with shear stress produce more nitric oxide (NO).

Technology Capabilities

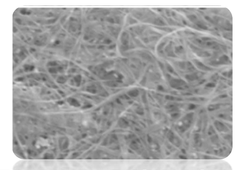
Electrode interfaces

Surface modifications investigated to improve the quality of the biosensors measurements, being able to improve the microelectrodes' performance.

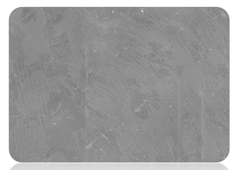
Electrodeposited Black Platinum



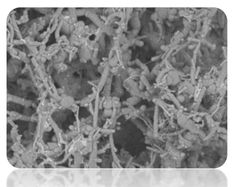
Grown Carbon Nanotubes



Drop casted Carbon nanotubes

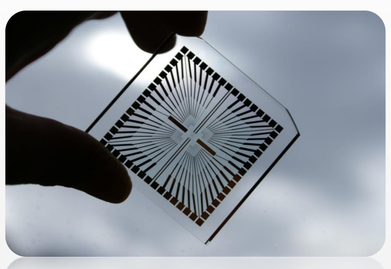


Graphene



Electrodeposited CNTs/ppy composite

Micro-nanofabrication

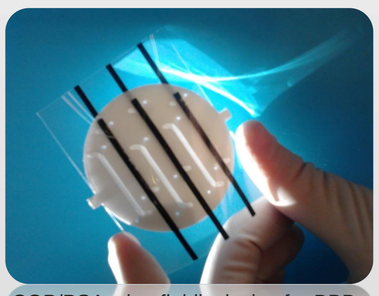


Standard Silicon microtechnology

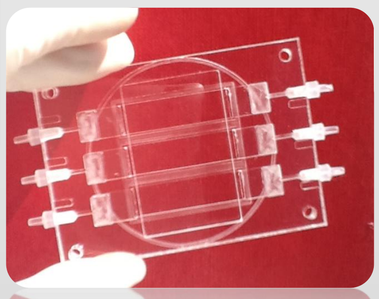
Flexible substrate technologies (SU8), devices of 25 µm width

Rapid prototyping tools

Techniques and methods for building prototypes or working models in a short time using 2D or 3D CAD data. The rapid prototyping tools allow us to make the connections and packaging to microfabricated chips to implement them in several devices, as microfluidic chamber for different research areas.



COP/PSA microfluidic device for BBB cellular co-culture



PMMA micromilled device for BBB cellular co-culture

Instrumentation

Small customized equipment for impedance analysis Zmeter (2 and 4 wire measurements) has been developed. Its main characteristic is to be portable and easy to use in the clinical and laboratory environment. The know-how acquired in the group would allow to develop a similar device for electrochemical measurements.

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Centre Nacional de Microelectrònica IMB

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