Institute of Microelectronics of Barcelona IMB-CNM CSIC

The **IMB-CNM** is the largest institute in Spain dedicated to the research and development of Micro and Nano Technologies and Microsystems and with unique capabilities in silicon technology. It belongs to CSIC since its foundation in 1985 and is distinguished as a María de Maeztu Unit of Excellence.

IMB-CNM aims to contribute to the advancement of knowledge and to the economic and social development of society, as well as to the training of researchers and engineers and to the advice to public and private entities.

The research activities of IMB-CNM are dedicated to Micro/Nano Integrated Systems: miniaturized electronic systems which include sensing and/or actuating capabilities in addition to electronic information processing, power management and external interfaces.

The IMB-CNM is located on the Autonomous University of Barcelona (UAB) Campus and contains the largest clean room facilities in Spain with full capability to process its own CMOS technologies and laboratories.

Project Type: TFM

Project Title: Design of a Smart Organ-on-Chip Platform for Advanced Medical Discovery

Research Group: Integrated Circuits and Systems (ICAS)

Project Description:

- "Organ-on-chip" (OoC) technology - understood as the microfabrication of cell culture devices to model functional units of human organs in vitro - has seen significant advancements in recent years. OoC is transforming biomedical research by replicating organ-level physiology within complex and controlled microenvironments. However, its progress is hindered by current knowledge gaps in the spatiotemporal dynamics involved in the development of organoids, which are three-dimensional cell tissue cultures with enormous potential to revolutionize the control over specific physiological and pathological responses of human organs in OoC.
- In this project, you will collaborate with a multidisciplinary team with expertise in neuroscience, microelectronics, and biochemistry, to develop the first smart OoC that incorporates our smart electrochemical imaging microchips for a precise interpretation of organoid biochemical activity.

Work Plan:

1. Literature review and spec definition (Weeks 1-3)
   - Review the state-of-the-art and the electrochemical imager microchip datasheet
   - Specificaction of OoC dependencies and operational requirements
2. Microfluidic Module Fabrication & Alignment (Weeks 3–10)
   - CAD design of candidate microfluidic modules
   - Prototyping in PDMS aligned to microchip sensing regions
   - Evaluation of microfluidic performance and candidate selection
3. Electronics PCB design and fabrication (Weeks 4-16)
   - Design of power & bias stable supplies for both the sensing microchip and actuators
   - Design of OoC control and communications interface based on MCU or small FPGA

Carrer dels Til·lers s.n., Campus UAB | 08193, Cerdanyola del Vallès
https://www.imb-cnm.csic.es | talent@imb-cnm.csic.es
+34 93 594 7700

- Design of actuator control drivers for elements such as pumps/valves
- Firmware implementation for live imaging, bias control, experiment scripting and data logging

4. Electrochemical and closed-loop characterization (Weeks 8–20):
   - Multipoint sensitivity and linearity characterization of microchip performance in OoC
   - Estimation of limits of detection, dynamic range, offset and drift
   - PID controller design attending to latency, settling time, overshoot, and steady-state error
   - Acellular tests on ion activity regulation and redox tracking under controlled injections
5. Organoid Integration & Biological Validation in collaboration with medical partners (Weeks 12–22)
   - Sterile workflow design with asseptic assembly, and integration with organoids
   - Characterization of baseline Ionic/redox patterns.
   - Characterization of monitoring patterns under concrete perturbations and pathogenic conditions of cell culture
   - Closed loop control of critical environmental factors such as pH
6. Analysis and reporting (Weeks 1–24; emphasis 20–24)
   - Benchmarking and reporting of methodology and results
   - Completion and submition of TFM manuscript

Candidate desired studies:

- ✓ MSc in Semiconductor Engineering and Microelectronic Design
- ✓ MSc in Nanoscience and Nanotechnology
- ✓ MSc in Physics of Complex Systems and Biophysics
- ✓ MSc in Modelling for Science and Engineering

Application Process:

Before applying, please **check with your TFG/TFM program supervisor,** as he/she may already be coordinating with us to assign the project.

If there is no such coordination**, complete this form and send your CV and a motivation letter** to **Talent@imb-cnm.csic.es**, with the **subject: "TFG/TFM at IMB-CNM"**

Your CV will be forwarded to the Researcher leading the project who will contact you directly if interested.

Check our website for more information about the IMB-CNM and our research activities

https://www.imb-cnm.csic.es/en

Take the next step in your research career with us!

*By applying, you accept our data protection policy.

**IMB-CNM (CSIC) adheres to the European Charter and Code of Conduct for Researchers, ensuring full alignment with their principles and requirements, including equal opportunity, transparency, merit and ability, caring for an open, fair, and excellence-based hiring processes.

IMB-CNM holds the HR Excellence in Research award, which acknowledges CSIC's commitment to continuous improvement in HR strategies for researchers.