

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: Development and Characterisation of a Photonic Integrated Circuit for quantum and bio-sensing Applications

Research Group: Radiation Detectors Group (RDG)

Project Description:

- ❖ This project proposes the development and characterisation of a photonic integrated circuit recently fabricated at the IMB-CNM. The circuit has been designed to efficiently transmit light from an optical source along a silicon nitride waveguide to a photodetector. The design integrates photodetectors developed within the RDG group at the IMB-CNM, based on Low Gain Avalanche Detector (LGAD) technology, with a wedge cladding that enables efficient coupling from the waveguide to the detector.
- ❖ The aim of the project is to characterise the waveguides and the wedge cladding design. The work will focus on building a simulation model, using TCAD tools, to accurately predict the wedge angle under different fabrication conditions. In parallel, the student will contribute to the fabrication of new wedge cladding structures with a range of wedge angles, which will be used to verify the simulation results. Finally, the optical coupling performance will be experimentally measured for the different designs using a tunable laser in the RDG laboratory.
- ❖ The project will be carried out in collaboration with international partners at INAOE, Puebla, Mexico, who have developed the initial simulation models.

Work Plan:

The project combines simulation, fabrication, and experimental characterisation to evaluate the performance of silicon nitride waveguides with a wedge cladding design for efficient optical coupling.

The methodology will proceed as follows:

- Simulation Modelling

Institute of Microelectronics of Barcelona IMB-CNM CSIC

- Develop and refine a TCAD-based simulation model of the wedge cladding.
- Investigate how fabrication conditions (e.g., etching parameters, gas conditions) influence the wedge angle.
- Generate predictions of optical coupling efficiency for different wedge geometries.

Fabrication of Test Structures:

- Assist in the fabrication of new wedge cladding structures at IMB-CNM.
- Produce a set of test devices with varying wedge angles to validate simulation predictions.
- Ensure process documentation for reproducibility and comparison with models.

Experimental Characterisation:

- Perform optical coupling measurements using a tunable laser in the RGD laboratory.
- Record transmission data across different wedge geometries.
- Compare experimental results with TCAD predictions and simulation models developed in collaboration with INAOE.
- Analysis and Interpretation.
- Assess the agreement between simulated and experimental data.
- Identify design or fabrication factors that lead to deviations.
- Provide recommendations for optimising wedge cladding design for efficient light coupling.

Work Plan:

- Weeks 1–2: Literature review on photonic integrated circuits, wedge cladding designs, and simulation methods. Training on TCAD tools and laboratory safety.
- Weeks 3–6: Development of TCAD models. Simulation of wedge angle variation under different fabrication conditions.
- Weeks 7–9: Participation in fabrication of wedge cladding structures with varying geometries at IMB-CNM.
- Weeks 10–12: Experimental setup calibration and optical characterisation of fabricated devices.
- Weeks 13–14: Comparative analysis of simulation and experimental results. Refinement of models if needed.
- Weeks 15–16: Writing of thesis, including methodology, results, discussion, and conclusion. Final revisions and preparation for submission.

Institute of Microelectronics of Barcelona IMB-CNM CSIC

Candidate desired studies:

- ✓ MSc Semiconductor Engineering and Microelectronic Design
- ✓ MSc Quantum Science and Technologies
- ✓ MSc Photonics

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.