

COLLABORATIVE IBEC INTERNATIONAL PhD PROGRAMME

Position

1. Project Title:
Engineering Biohybrid Devices Based on the Optogenetic Control of Epithelial Cells
2. Research project/ Research Group description

Biohybrid devices are systems that integrate biological and artificial components to achieve a specific function that neither could accomplish alone. These devices leverage the unique properties of biological elements—such as self-replication, self-propulsion or adaptability—combined with the precision, durability, or programmability of synthetic materials or technologies. In this project, we will develop a new type of biohybrid device based on epithelial tissues under optomechanical control. The building blocks of the technology will be channels of epithelial cells micropatterned into precise size and geometry. The cells will be engineered with optogenetic technology to control their contractility with light. This approach will enable the development of basic hydraulic components, including pinch valves, peristaltic pumps, and mixers. Leveraging the natural sensing capabilities of epithelial cells, these circuits will detect mechanical and chemical changes, translating them into mechanochemical readouts. We expect this project to set the stage for a new generation of biohybrid devices based on epithelial tissues. The long-term applications of the PhD results include the development of ultrasoft micro-robots built with hydrogels and epithelial layers of tunable shape, mechanics and cellular identity.

3. Job position description

The PhD student will be co-supervised by Xavier Trepats at the Institute for Bioengineering of Catalonia (Barcelona, Spain) and Jaap den Toonder at the Institute for Complex Molecular Systems (Eindhoven, the Netherlands). This co-supervision will allow the student to be trained in technologies and concepts in mechanobiology (Trepats) and microfabrication (den Toonder). The student will participate in the following tasks. (1) Engineer epithelial cells with optogenetic tools to modulate contractility. (2) Design and fabricate micropatterned cell channels with controlled size and geometry. (3) Develop and test cell-based hydraulic components. (4) Characterize the mechanical, chemical, and functional properties of biohybrid devices. (5) Collaborate with a multidisciplinary team of biologists, engineers, and physicists. (6) Disseminate research findings through publications and conference presentations. We are seeking students with a strong interest in interdisciplinary research at the interface of biology and engineering. Applicants should hold or be in the process of obtaining a Master's degree in bioengineering, biology, physics, materials science, or a related field. A creative and self-motivated mindset, along with a strong ability to work collaboratively, is essential.

Group Leader at IBEC

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4. Research Group: Integrative Cell and Tissue Dynamics

Collaborator at ICMS

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