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Supervisor Expression of Interest
MSCA - Marie Sklodowska Curie Action - (PF) Postdoctoral Fellowship 2024

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Link "Pagina docente":
https://www4.ceda.polimi.it/manifesti/manifesti/controller/ricerche/RicercaPerDocentiPublic.do?evn_didattica=evento&k_doc=191834&polij_device_category=DESKTOP&__pj0=0&__pj1=cf861ab0407dfab00d296e5ab678cd2b
Department Name: Department of Chemistry, Materials and Chemical Engineering

Research topic:

MSCA-PF Research Area Panels:

- ☐ ECO_Economic Sciences
- X ENG_Information Science and Engineering
- ☐ ENV_Environmental and Geosciences
- X LIF_Life Sciences
- ☐ MAT_Mathematics
- ☐ PHY_Physics
- ☐ SOC_Social Sciences and Humanities
- ☐ CHE_Chemistry

Brief description of the Department and Research Group (including URL if applicable):
The project will be situated within the Department of Chemistry, Materials, and Chemical Engineering "Giulio Natta." This department hosts scientists specializing in various fields, with particular relevance to the project's objectives. Notably, the department boasts expertise in tissue engineering, biomaterial sciences, and material engineering, aligning closely with the project's focus areas.

The hosting group within the department is dedicated to advancing the field of tissue engineering and specializes in the development of complex in-vitro engineered models tailored for disease modeling and personalized medicine applications. This collaborative environment promises to provide invaluable resources and support for the successful execution of the project's goals.

TITLE of the project: In-Vitro Disease Modeling: Engineering Hydrogel-Based Models for Tissue Stiffening

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Brief project description:

(max 1 page)

In recent years, personalized medicine has emerged as a cornerstone in therapeutic approaches, catalyzing extensive research into advanced in-vitro models as alternatives to animal testing. This surge in interest has led to exploration across various fronts, including whole organ models, organoids, and microfluidic systems. Despite promising advancements, existing models grapple with technical constraints, particularly in fully replicating the complex microenvironment of native tissues, such as accurate extracellular matrix composition, biomechanical properties, and tissue vascularization. Moreover, ensuring these models effectively mimic pathological conditions in a controlled manner remains a critical challenge.

The envisioned project seeks to address these limitations by developing a tissue-engineered, vascularized organoid-based model focused on mimicking pathologies associated with extracellular matrix stiffening, with the liver serving as a proof-of-concept model. This innovative approach aims to leverage pathology-specific extracellular matrix proteins, controlled mechanical properties, and an automated, high-throughput microfluidic platform.

The initial phase of the project will involve a comprehensive proteomic analysis of healthy and pathological hepatic tissue to identify a repertoire of extracellular matrix proteins indicative of tissue stiffening. These proteins will inform the design of a hydrogel formulation, supplemented with synthetic polymers to modulate mechanical properties, optimized for 3D bioprinting. Various gel formulations will undergo rigorous testing to ensure printability and desirable rheological characteristics.

Selected gel formulations will be utilized to print diverse matrices representing distinct pathological conditions, such as varying degrees of fibrosis and cirrhosis. Cultures will be established using human hepatic organoids and endothelial cells, with growth and transcriptomic profiles serving as key evaluation metrics. Additionally, the efficacy of selected standard-of-care drugs will be assessed within the model.

In the final phase, the hepatic fibrosis gel model will be integrated into a high-throughput microfluidic platform already available at the host, facilitating automated printing and culture of three-dimensional constructs. This integration aims to provide compelling evidence of translational potential toward clinical applications. Through these concerted efforts, the proposed project aspires to advance the frontier of in-vitro modeling, offering robust tools for disease modeling and drug testing in a clinically relevant context.