SEMINAR 2024

CIC biomaGUNE
MEMBER OF BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

Ane Urigoitia Asua

Hybrid Biofunctional Materials - CIC biomaGUNE

Dynamic in vitro 4D bioprinted models

Thursday, 18th July
12.00 p.m.

CIC biomaGUNE - Seminar Room

3D *in vitro* tissue models are a valuable tool in biomedical research for elucidating certain biological processes, disease modeling and high-throughput drug screening. They offer greater complexity than 2D cell cultures and have the potential to reduce animal testing due to ethical concerns, while recreating human tissue more realistically1. The development of such sophisticated models requires advancements in cell engineering techniques, creation of new materials, and advanced imaging tools for accurate characterization. In this context, 3D bioprinting is a powerful technique for recreating the complex structure of tissues, enabling a reproducible, layer-by-layer deposition of bioink in predetermined patterns. Our work in the Hybrid Biofunctional Materials group focuses on the 3D bioprinting of cardiovascular and pulmonary models, tissues that are particularly dynamic due to the contracting and expanding movements associated with heart beating and lung breathing. These physiological motions have been shown to promote cell differentiation and tissue maturation2, highlighting the importance of reproducing them in *in vitro* models, which is highly challenging.

To address this, we aim to 3D-print dynamic tissue models that replicate physiological motions over time, a concept known as 4D printing3. We achieve this by employing hybrid biomaterials that combine nanoparticles (NPs) with biocompatible, stimuli-responsive polymers. Depending on NPs composition, these NPs can exhibit different responses. We have specifically explored the use of plasmonic NPs as photothermal actuators within thermoresponsive polymers to generate cyclic expansion-contraction movements imitating heartbeat or breathing in cardiovascular or pulmonary models4,5. Additionally, the incorporated NPs can also serve as contrast agents for imaging, contributing to the characterization of these models.

In summary, the Hybrid Biofunctional Materials lab is dedicated to the 4D bioprinting of dynamic human in vitro models. These models serve as proof-of-concept for the development of advanced tissue models for studying disease mechanisms or evolution and drug testing.

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3 Y. Dong, S. Wang, Y. Ke, L. Ding, X. Zeng, S. Magdassi and Y. Long, *Adv Mater Technol,* 2020, **5**.

4 U. Aizarna-Lopetegui, C. García-Astrain, M. Henriksen-Lacey, D. Jimenez de Aberasturi, C. Renero-Lecuna, P. González-Callejo, I. Villaluenga, M. A. del Pozo, M. Sánchez-Álvarez, M. Henriksen-Lacey and D. Jimenez de Aberasturi, *J. Mater. Chem. B*, 2023, **11**, 9431.

5 S. Yu, N. Sadaba, E. Sanchez-Rexach, S. L. Hilburg, L. D. Pozzo, G. Altin-Yavuzarslan, L. M. Liz-Marzán, D. Jimenez de Aberasturi, H. Sardon and A. Nelson, *Adv Funct Mat*er, 2023, **34**, 2311209.