Hybrid inorganic-organic biofunctional materials for biofabrication

Uxue Aizarna,[1] Ane Urigoitia,[1,2] Malou Henriksen Lacey,[1,3] Cristina de la Encarnación,[1] Clara Garcia-Astrain,[1,3] Luis M. Liz-Marzán,[1,3,4] **Dorleta Jimenez de Aberasturi**[1,3,4]
[1]CIC biomaGUNE, Basque Research and Technology Alliance (BRTA), Donostia-San Sebastián, Spain.
[2]POLYMAT, Basque Center for Macromolecular Design and Engineering, 20018 Donostia, Spain.
[3]Centro de Investigación Biomédica en Red de Bioingeniería Biomateriales, y Nanomedicina (CIBER-BBN), Donostia; Spain.
[4]Ikerbasque, Basque Foundation for Science, 48009 Bilbao, Spain.
Contact@E-mail: djimenezdeaberasturi@cicbiomagune.es

Biofunctional materials can be designed to offer an stimuli-responsive behaviour presenting several advances and alternatives to mimic as realistic as possible biological systems. The exact reproduction of the forces and stimuli that occur in the human body is still a challenage, however by the combination of hybrid inorganic-organic materials similar effects can be achieved.[1] Moreover, understanding what happens in a complex biological system over timem, is of great interest. By the incorporation of inorganic nanoparticels (NPs) into the system that can respond to externally applied physical changes, some of these goals can be achieved. Our focus is therefore, on the synthesis of hybrid inks containing NPs and functional polymers, which can be printed with high resolution 3D printing techniques and provide a desired response upon activation. This enables us not only to control spatial resolution on a micro-scale and deposit multiple different inks in close proximity, but also fabricate responsive in vitro models of pathological interests.[2] Thus, we aim to create different models capable of reproducing different fisiologically relevant events. For example, we have developed different scaffolds to support tumor growth and evaluated their evolution thanks to hybrid materials.[3,4] We are also working on the fabrication of an artery model, which consists of 3D printed layers including endothelial and smooth muscle cells. In addition, we are working on the fabrication of pulmonary models, specifically on the fabrication of an alveoli wall model representing the air-blood interface which can remodel breathing forces.
Developing these advanced hybrid materials implies improvements in cell engineering techniques, in material designs, as well as advanced imaging tools to accurately characterize them. To address this, we are exploring methods to improve imaging resolution and speed, using the hybrid NPs included into the model which can also act as contrast agents for correlative imaging techniques.[5–7]
These sophisticated models offer many advantages over current materials and techniques in biomedical applications.

References

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