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2D and 3D cell cultures systems in biomedical studies

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Development of cell culture systems are indispensable for advancing in basic biology and clinical translations. Breakthroughs have been discovered using 2D with defined and controlled physical properties such as stiffness and geometry, evidencing that signals that cells receive from the physicality of their microenvironment are absolutely essential for their survival and to direct their fate. These results go far beyond the limit of the classically preferred culture model, 2D cell monolayers cultured on adhesive rigid and flat plastic petri dish substrates. However, cells grown in vivo within a complex 3D soft microenvironment and 3D cultures have been more recently introduced for in vitro studies, showing structurally and functionally different behavior of embedded cell aggregates or organoids. At the meeting, I will introduce examples of engineered biomaterials and microenvironments to control cell-behavior using mechano-transcriptional regulators, YAP and TAZ, as molecular beacon of the cell response. The use of chemically defined biomaterials for the preservation of pancreatic progenitor traits ex-vivo, 2D hydrogels with controlled rigidity and micropatterned substrates to control cell behavior, will be presented. The engineering of in vitro 2D and 3D culture microenvironments still requires efforts to develop reproducible and chemically/physically defined biomaterials, in particular hydrogels, and to use microfabrication techniques to generate controlled shapes and microenvironment, which more closely mimics key aspects of the natural environment of cells. New opportunities in these directions will be discussed

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