Biomaterials and engineered microenvironments for biomedical studies

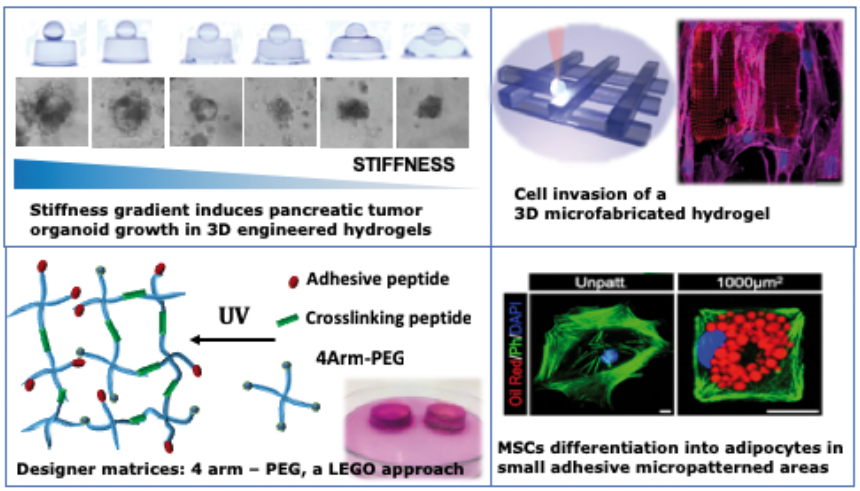
In our lab we engineer chemically and physically defined biomaterials, in particular hydrogels, and we develop advanced microtechnology tools to generate 2D and 3D culture microenvironments. These culture systems are designed for stem cells regeneration and expansion, with the aim of recreating in vitro models which more closely mimic the natural microenvironment of human cells for disease studies, in particular cancer.

This research deals with mechanobiology, a multidisciplinary science in which biology must necessarily interlace with engineering and material science. In fact, mechanical signals are increasingly recognized as overarching regulators of cell behaviour, controlling stemness, organoid biology, tissue development and regeneration. Moreover, aberrant mechanotransduction is a driver of disease, including cancer, fibrosis and cardiovascular defects. In order to apply mechanical challenges, cells need to be exposed to chemically- and physically-defined tissue niches, made of hydrogels having "ad hoc" designed rigidity, mechanical properties and architectural features, for both 2D and 3D in vitro cultures.

Breakthroughs have been discovered using 2D hydrogels and micropatterns with defined and controlled physical properties such as stiffness and geometry respectively. These results go far beyond the limit of the classically preferred cell culture model, 2D cell monolayers cultured on adhesive rigid and flat plastic petri dish substrates. Moreover, building tissues for regenerative medicine applications heavily relies on next-generation tissue-engineered approaches, that aim to develop a new platform by which the cells of an individual patient can be expanded and regenerated growing as organoids, 3D outgrowths of stem cells that self-organize into miniorgans, representing copies of real organs, in defined laboratory conditions. This expands the possibility to study normal and diseased tissues ex vivo, with promise to understand disease mechanisms, to test drugs and therapies in unprecedented personalized medicine approaches.

This highly interdisciplinary research is carried out in collaboration with the Molecular Medicine Department of Padova, MBI (Mechanobiology Institute of Singapore), IIT (Italian Institute of Technology) IFOM (IFOM Istituto FIRC di Oncologia Molecolare).

Nature Materials, 17, 1063-1075 (2018)
Nature, 563, 265-269 (2018)
Acta Biomaterialia, 55, 373-384 (2017)



Research topic:
Materials

DII research group

HyMat

Giovanna Brusatin
giovanna.brusatin@unipd.it
Phone: +39 049 8275723

Assisted by:
Alessandro Gandin, PhD
Anna Gambetta, PhD
Beatrice Crocco, felllow

www.hymat.dii.unipd.it

Main research topics:
- Synthetic and natural Hydrogel materials for biomedicine 2D and 3D
- Microfabrication of biomaterials