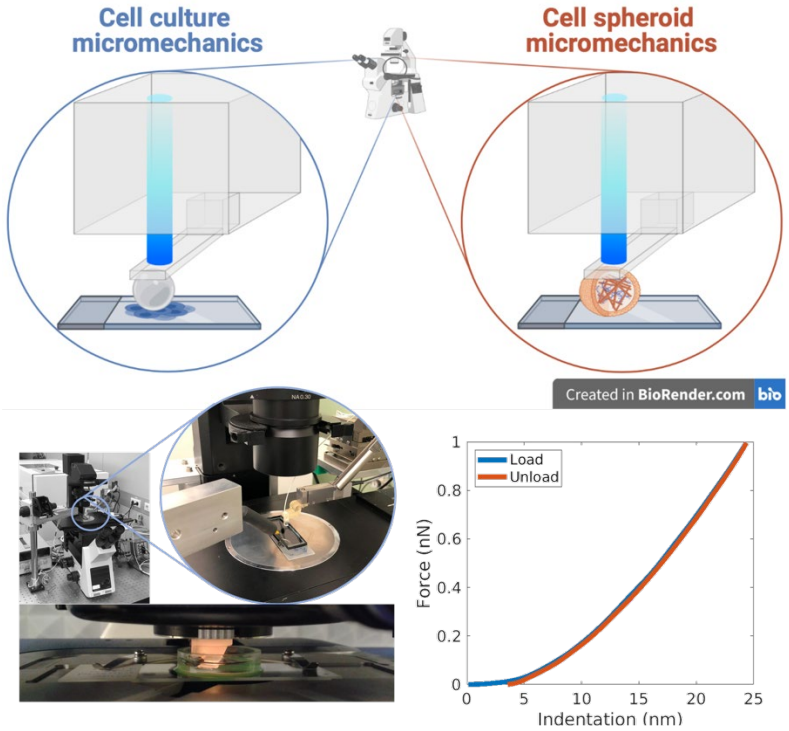
MICROMECHANICAL ASSESSMENT OF CELL CLUSTERS



Supervisory Team[1]

Primary Supervisor:

Orestis G. Andriotis, Institute of Lightweight Design and Structural Biomechanics

TU Wien project partners:

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External academic partners: -

External industry partners: *Optics11 (Jakob Pyszkowski)*

Project Description

Cell-ECM (ECM; extracellular matrix) interactions are dynamic in nature. Cells sense their microenvironment and response to it based on sensors responding to mechanical stimuli generated by cells probing the ECM. The microenvironment mechanics determine forces and displacements “felt” by the cells and therefore also cell fate (differentiation, apoptosis etc.). The elasticity or better stiffness, viscosity and plasticity of the ECM all are thought to play important roles and are affecting and stimulating cell response. This is relevant for several pathologies and their pathogenesis such as cancer, fibrosis whereby cell fate is altered, but also for physiological processes such as and wound healing.

[1] The Early Stage Researchers (ESRs) will be accompanied during their thesis by an individual “Thesis Advisory Committee” (TAC), which will guide the ESR through the graduate studies. The TAC will consist of the thesis primary supervisor, and two additional members of the Supervisory Team selected by the ESR.

Knowledge of the mechanics of the cell microenvironment is therefore fundamental to understanding cell-ECM dynamics i.e. mechanobiology. With the advent of organoids, that is 3D cell clusters replicating important hallmarks of macroscopic organs such interaction, as well as processes of physiology, pathology and pathogenesis can be studied in vitro. However, protocols are required for reproducible characterization of cell clusters / organoids with sufficient throughput. In fact, this will go far beyond a mechanistic understanding of cell clusters. Organoids-on-a-chip are the future platforms for personalized medicine as well as the development of novel therapeutic strategies i.e. drug development and testing.

To this end, this PhD project focuses on the micro- and nanomechanical assessment of cell clusters, by developing an instrument based on a recently established working prototype. The new instrument will be used to routinely test the mechanical properties of the cell microenvironment.

Key Goals and Tasks

The primary aim of this PhD thesis is to develop, build, validate and use an instrument for micro- and nanoscale mechanical characterization of cell clusters. The development and realization of the instrument will in a large part be based on a recently developed prototype for nanotensile testing. Yet, software development will be a key task to realize an instrument capable to characterizing samples reproducibly and with adequate throughput. Using the instrument, the PhD candidate will in the course of the PhD, and together with the supervisory team, define and conduct one or several scientific studies on the microenvironment mechanics of cell clusters/organoids and ECM. Ultimately the PhD candidate will summarize their achievements in a dissertation for the completion of a PhD on the topic of mechanical characterization of cell clusters.

Because of the novelty of this project, the PhD candidate will participate in and write scientific publications, and present research results at scientific conferences in the form of poster or podium presentations.

Project-specific Requirements

- Completed master studies in electrical engineering, mechanical engineering or biomedical engineering, physics or an equivalent university degree.
- Knowledge in the area of biomechanics or mechanical characterization of materials
- Experience and skills in computer programming
- Interest in working with biological tissues and developing new experimental setups for the mechanical characterization of cell clusters
- Enthusiasm for mechanobiology
- Affinity for collaborating in a large team of scientists
- Willingness to travel to project meetings and present your work to scientific conferences
- Excellent English language skills in scientific field
- Personal skills: independence, ability to work in a team, communication, problem-solving