Development of a three-dimensional in vitro model for real time drug screening

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Motivation and field of application
Osteoporosis is a systemic skeletal disorder characterized by low bone mass and altered bone microarchitecture, leading to an increase in bone fragility and fracture risk. With the increase in aging populations, osteoporosis is becoming a global health and economic problem. Monitoring the interactions of diseased bone tissues with drugs is fundamental for osteoporosis drug development and screening.

General and main activities
This project aims to develop an innovative three dimensional (3D) in vitro model of physio-pathological bone tissue for osteoporosis drug screening. The 3D in vitro system will better mimic the in vivo microenvironment of bone architecture and enable in situ monitoring of bone cell response to drugs in real time. 3D carbon microelectrodes will be designed and used as both scaffold and sensor simultaneously. The 3D microelectrodes will provide: 1) optimal properties to support bone cell adhesion, migration and proliferation, e.g. stiffness, porosity and mass transport and 2) electric conductivity to electrochemically monitor in situ and real time bone cell fate and responses to external stimuli (i.e. alkaline phosphates expression). This will be achieved by novel fabrication techniques for 3D microelectrodes using pyrolysis, where 3D conductive carbon structures are obtained through “burning” polymer templates (e.g. SU-8) at high temperatures in inert atmosphere.

Learning objectives (technical and analytical tools, experimental methodologies)
You will gain knowledge in various scientific areas: Electrodes design and fabrication (cleanroom facilities), Micromilling/Laser ablation/3D Printing, Cell culturing, Electrochemical techniques for surface characterization and cell-based assays, Staining and Microscopy, Data analysis, statistics and critical evaluation of the results. Moreover the student will get experience on summarizing and presenting scientific results.

Location
Department of Micro- and Nanotechnology, Technical University of Denmark

Maximum number of students
1

Financial support/scholarships
DTU will not provide any financial support/scholarship.