BIOMIMETIC MICRO-PATTERENED SURFACES FOR 3D COMPLETE HUMAN SKIN GROWING FOR BIOASSAYS

Proposers

Partner 1: Jana B. Nieder (jana.nieder@inl.int) Head of Nanophotonics Department (INL)

Partner 2: Abel G. Oliva (oliva@itqb.unl.pt) Head of Biomolecular Diagnostic Laboratory (ITQB-NOVA)

Introduction

The production of nanoscale patterned surfaces for tissue-engineering applications is an emerging area of research that provides new tools towards exploring interaction between cells during development. Micro- and nano-structured surfaces offer a wide range of alternatives to affect cells, from adhesion to differentiation or induction of response, providing alternatives for the biological studies in cell growing tissues and evaluation of pharmacological therapies.

The possibility of integrating vascularization structures in the 3D skin is an advantage to perform a closer approach of the real interaction of the delivery of nutrients to the basal cells at the dermis, resembling the natural organization of the skin tissue. Such microfluidic structures can be fabricated by including dedicated tailored nanostructures onto the support of tissue culture. Such fabricated structures can be used for growing 3D skin, perfusion of culture media, studies of delivery of therapeutic drugs or even feeding with human plasma of ill patients, towards induction of disease phenotypes.

An ultrafast femtosecond Laser shall be used for the 3D fabrication of the scaffolds via a two photon polymerization (TPP) process of a biocompatible polymer. Evaluation of tissue formation, its morphology and cell bioenergetics as well as drug delivery shall additionally be studied with deep tissue nonlinear multiphoton microscopy, and fluorescence lifetime imaging techniques.

Partner 1: 3D scaffold fabrication via TPP, fluorescence lifetime spectroscopy, multi-photon imaging for morphology and complementary toxicity and drug delivery and migration.

Partner 2: 3D Skin development, bioassays for toxicity and drug delivery and migration.

Project outline/goal

The support for growing skin has an important effect in the developed tissue, and the interaction of the microstructures and chemical groups present onto the surface in contact with the cells is determinant of the biological development. Treatment of biocompatible surfaces with ultrafast femtosecond laser shall be used for the 3D fabrication of biocompatible scaffolds that mimic biological components, for cell seeding. Those structures will be used to grow skin in vitro and to allow studies of physiology effect of drugs, delivery and migration of compounds as well as optimization of the 3D skin mimicking, integrating vascularization or other cell structure through stem cell insertion and differentiation. Evaluation of the biological phenomena will be performed in a non-destructive way, in real time by with deep tissue multiphoton microscopy.

Student profile

Profile sought: preference, but not limited, to students with a background in Biophysics, Biomedical Engineering or Biological Engineering or Physics with an interest in exploring nanostructured platforms interaction with cell and tissues for practical applications. Experience in Optics, Micro and Nanofabrication would be helpful.