Motivation and application domain

Parkinson’s disease is a late-onset long-term neurodegenerative disease that affects a growing number of people due to a growing human life-span. Animal models have been used to test potential therapies. However, there is a growing awareness that the results from these experiments translate poorly to humans. Therefore, there has been a need for in vitro models with increasing fidelity to human condition which are based on the recent advances in stem cell technology and fabrication methods.

General objectives and main activities

The hallmark of PD is the loss of dopaminergic neurons in the region of the brain called substantia nigra in the midbrain. These neurons extend projections into the forebrain region called striatum, creating a nigrostriatal pathway that plays an important role in movement control. The main goal of this project is to recreate nigrostriatal pathway in vitro by constructing a two compartment PDMS chip with human midbrain neural stem cells in one compartment, representing substantia nigra, and human forebrain neural stem cells in the other one, representing striatum. The two compartments will be connected via microgrooves allowing neurite extensions but stopping migration of cell bodies. Neural extensions will be guided by either chemical factors or flow regulation. Connections between the neurons coming from opposite compartments will be visualized and monitored to identify measurable outputs that can be later used for evaluating PD treatments in this in vitro model.

Training Objectives (technical/analytical tools, experimental methodologies)

- PDMS soft lithography for chip fabrication
- Stem cell culturing and differentiation
- Fluorescence imaging using confocal microscope
- Image processing and statistical analysis
- Immunocytochemistry
- Microfluidics
- Electrochemical analysis

Place(s) where the thesis work will be carried out: Nanotech Department at the Technical University of Denmark

Additional information

Maximum number of students: 1