
Two-Dimensional Brain-on-Chip Model

Towards Remodeling of the Nigrostriatal Pathway to study Parkinson's Disease

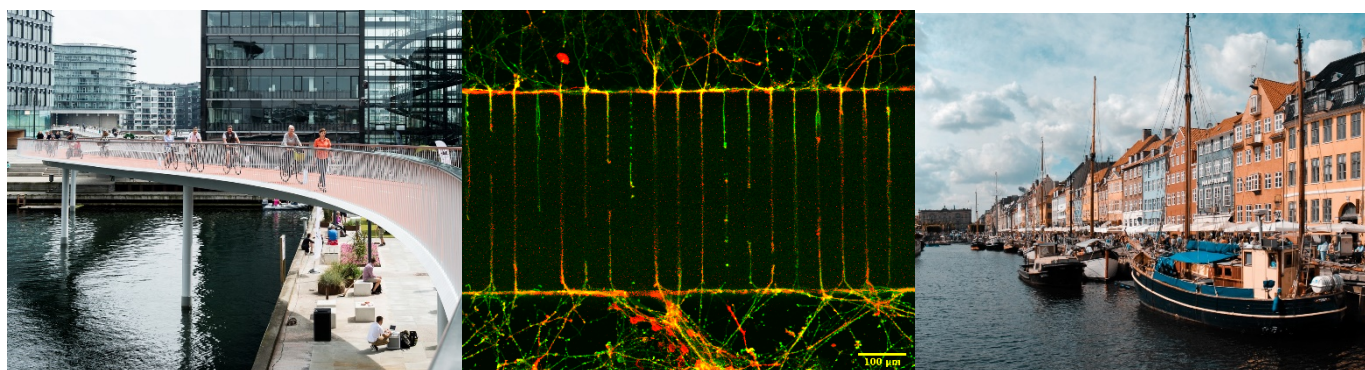
Master Thesis Project at the Technical University of Denmark by Sebastian Buchmann, Mai 2019

I had the opportunity to conduct my Master Thesis at the Technical University of Denmark at the department of Micro-and Nanotechnology in the group of Prof. Jenny Emnéus. In my project we aimed to mimic the nigrostriatal pathway using a so called neurite guidance microfluidic chip combined with neural stem cells. The Nigrostriatal pathway consists of neurons from the substantia nigra projecting to the striatum. In patients suffering from Parkinson's disease the nigrostriatal pathway is degenerated which causes impairment of motorfunctions. We used stem cell lines from the midbrain region and the forebrain region representing the two parts of the brain involved in the nigrostriatal pathway. The neurite guidance microfluidic chip consisted of two compartments which were connected by 5 micrometer wide and 450 micrometer long grooves. The cells representing the midbrain region differentiated into neurons and grew axons through the grooves into the other compartment containing cells of the forebrain region and therefore mimicking the Nigrostriatal pathway.

During my project I was able to learn a lot about different microfluidic chip fabrication methods as well as working with stem cells. The group and the department was very interdisciplinary and involved many students with an engineering, biological or chemical background, which matched very well with the background from the Nanoscience study program at the University of Basel. I especially enjoyed the work environment in the whole department. As typical for Scandinavian countries the hierarchy was very flat. All of the labs from the different groups were open to anyone and when needed it was possible to use anyone else's equipment. This open environment made it possible even for a master student to discuss problems with other people including master students, PhD students and also professors, to receive inputs from them and to try out different approaches to find a solution.

The University was located a bit outside of Copenhagen which in my opinion is a beautiful city with a very high life quality, despite the dark winter times. The combination of the Danish design/ architecture, the water channels and all the bikes driving through the city results in an unique atmosphere.

I was very happy to have the opportunity to do my master thesis abroad and would like to thank the SNI for the financial support during my stay in Copenhagen.



Left: Bicycle Bridge next to Fisketorvet near my flat. Middle: Neurons on the microfluidic chip growing from one compartment through the grooves into the other compartment. Right: Nyhavn in the center of Copenhagen