Controlling the deposition patterns of microtubules on a surface through self-assembly or fluid flows generated by substrate-integrated micro-electrode arrays

Contact Researcher: Fabrice Morin, Dr
Host Professor: Fujita Lab

Context

Microtubules (MTs) are cylindrical polymeric constructs that are present in most mammalian cells. MTs support active transport from the nucleus to distal parts of the cell body, in association with motor proteins such as kinesin.

Objectives

Previous and current work in the Fujita laboratory aims at harnessing the molecular tools required to obtain specific binding, directed kinesin-mediated transport of selected cargo. The practical aim of the project was thus to find new ways to orientate and immobilize MTs on a substrate in a controlled fashion, so that they could subsequently support directed transport.

Methods

Two approaches were chosen: self-assembly and orientation through viscous drag imposed by an AC electro-osmotic flow. The first approach was explored through a droplet drying method, while the second one used substrate-integrated electrode arrays that were fabricated by standard microfabrication techniques. Evaporation-driven self-assembly was found to produce interesting monolayers, especially on Highly Oriented Pyrolitic Graphite. As for orientation mediated by electro-osmotic flows, practical experiments could not be carried out, insofar as much time was spent on understanding of the physics enabling efficient pumping in buffers with high ionic strength (such buffers are necessary for MT stability). These investigations ultimately resulted in both efficient fabrication processes and physical models for producing suitable microelectrode arrays.