Biochemistry in Nano-Channels

Professors: Jonathan V. Sweedler, Mark A. Shannon
Staff: Chang Young Lee, Bruce R. Flachsbart
Doctoral Student: Ming Zhong

Goals

- To manipulate electrokinetic transport of molecules through nanocapillary arrays (NCA) in hybrid PMMA nano/microfluidic devices for chemical and biochemical applications.
- To construct multiple membrane stacks for better understanding of fundamental nanofluidics and molecular transportation properties.
- To enhance separation and characterization capabilities.
- To design all-silicon nano/microfluidic devices for reliable collection and separation of cell-to-cell signaling molecules.

Research Results (cont’d)

- Validation of mass-spectrometry-based quantitation in the device.

Fundamental Questions/Challenges

- Fabricate the inner nanopores in an NCA or a silicon with molecular recognition elements, thus creating the ability to transform molecules as they traverse the nanopores.
- Control the electrokinetic flow precisely for delivering sample plugs for separation and ultrafiltration.
- Enable fluidic manipulations and selective reactions within a multilayer device, including the deposition of analytes into nanopores and electrokinetic delivery of analytes to required locations.
- Characterize these efforts via mass spectrometry to validate the analyte transport.

Research Plan

- Investigate the electrokinetic transport properties of the packed nano/microfluidic devices.
- Fabricate complex ultrafiltration devices with multiple membranes and multiple microfluidic channel layers.
- Develop multi-layer silicon microfluidic devices with nanoporous silicon membranes between layers.
- Test reliability of the silicon devices for long term applications.
- Create unique methods based on analyte adsorption to quantify compounds with mass spectrometry.

Research Results

- Confocal images show ability to selectively pack a channel.

Micro-Nanofluidics