A microfluidics approach to probing filopodial development in neurons

Anika Jain, Cell and Developmental Biology
Co-Advisers: Martha U. Gillette, Cell and Developmental Biology
Rashid Bashir, Micro & Nano-technology Lab.

Key Research Aims and Goals
To investigate the effects of substrate-bound and diffusive guidance cues on the development of dendritic filopodia and spines.

Research Highlights and Results
- We are exploiting the unique properties of polydimethylsiloxane (PDMS) microfluidic devices towards studying early neuronal development. Recently, our group demonstrated the efficacy of solvent-extraction as a PDMS-treatment protocol that enables low-density cultures of primary hippocampal neurons. [[1], Fig. 1a].
- We have used flow manipulations in closed-channel microdevices to generate stable and instructive gradients of substrate-bound cues, such as laminin and poly-L-lysine (PLL), to allow precise control over neuron development and network formation. [[2], Fig. 1b].

Future Research Plans
- These neuron culture and gradient generation techniques will be used to compartmentalize neuronal dendrites into fluidically isolated channels, in order to selectively stimulate only certain regions of the cell, with a high degree of spatio-temporal control.
- This will enable us to study filopodial dynamics during early neuronal development. We will specifically investigate the effects of substrate-bound cues (e.g., laminin and PLL), diffusive cues (semaphorin3A), chemical stimulation (glutamate) and cell-cell contact and signaling.