Nanofluidics for precise chemical release: towards artificial chemical synapses and neurotransmitter-based neuroprosthetics

Peter D. Jones

Natural and Medical Sciences Institute at the University of Tübingen

The clinical validation of neuroprosthetic devices has demonstrated the potential for intricate communication between artificial devices and the nervous system[1]. Chemical release from micropipettes has supported the possibility of functional neurostimulation by neurotransmitter-based prosthetics[2]. However, technology to fabricate chemical neuroprosthetics does not exist. Challenges include precise control of chemical release and integration of a dense array of individually-controlled release sites.

I will present our recent technological developments towards nanopore-based artificial synapses[3] and the establishment of a platform to investigate the practicality of chemical neuroprosthetics by nanofluidic chemical release *in vitro*[4]. Practical considerations and future prospects for chemical neuroprosthetics will also be discussed.

This work relies on photolithographic microfabrication of high resolution microfluidics and focused ion beam milling of nanopores as small as 30 nm. Integration of arrays of nanopores with individual microfluidic and electrical addressing is enabled by a novel microfabrication process, with a foundation on the standard microelectrode array to facilitate experiments with neuronal tissues or cultures.

References

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