Multifunctional Flexible Parylene-Based Intracortical Microelectrodes

David S. Pellinen, Taegyun Moon, Rachel Miriani, Rio J. Vetter, and Daryl R. Kipke

A new polymer-based flexible microelectrode with drug delivery capability has been developed by the NEL (Neural Engineering Lab) at the University of Michigan. The probe was fabricated and tested for electrical and fluidic functionality in early stage design. It is a micro-fabricated, multi-channel polymer probe capable of selectively delivering chemicals at the cellular level, as well as electrically recording and stimulating neurons *in vivo*. The width and height of the fluidic channel are 9*µ*m and 50*µ*m, respectively. The electrical recording sites are located on the top side of the probe—designed to function for both electrical recording and stimulation (Fig. 1). The fluid enters the inlet port of the microprobe and flows through the micro-channel inside of the probe until it comes out of the outlet ports of the microprobe as shown in Fig. 1. Fig. 2 shows a sequential process of a water bubble growing at the fluidic outlet port of the polymer microprobe. *In vivo* chronic recording experiments succeeded in demonstrating the *in vivo* reliability of the probe. Successful *in vivo* experiments confirm the suitability of the probes as implantable chronic recording devices with robust fluid delivery function.

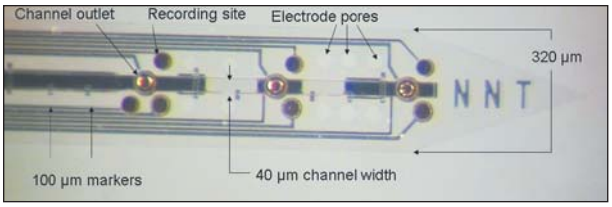

Fig. 1 – Photograph view of the flexible parylene-based microfluidic electrode. The total thickness of the device is nominally 20µm, with a channel height of 5µm.

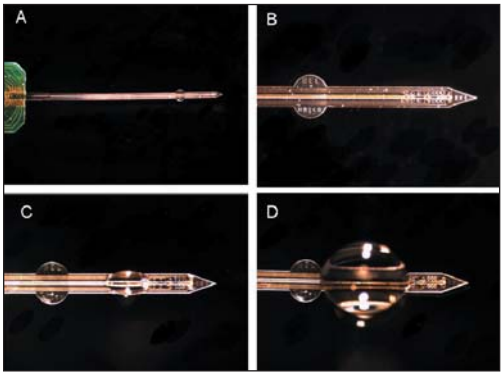

Fig. 2 – Pumping through a microfluidic electrode. Fig. A shows the whole electrode, up to the bonding pads. The fluid connection (not shown) is to the far left of the probe. Fig. B shows the implant portion of the electrode prior to fluid delivery. Fig. C shows the initiation of flow, which quickly develops into a large bubble of fluid in Fig. D.