Microfluidic Integration into Neural Implants

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Neural implants for recording and stimulation are still primarily microelectronic devices despite decades of development. The limitations of operating in this single electrical mode for interfacing with biological tissue are well known. One major drawback is its non-specific field recording and/or non-selective excitation of groups of cells in the general vicinity of the probe. These current technological deficiencies can be addressed by integrating microfluidics with electrodes and electrochemical sensors. Multimodality neural interfaces that combine electronics and microfluidics open new possibilities for probing and detecting neural patterns as well as a method by which to achieve local chemical delivery. Spatial and temporal control of delivery of drugs, neurotrophic factors, neurotransmitters, and other species is of great interest to the neuroengineering community. However, few groups are actively pursuing the integration of microfluidics with neural implants or in vitro neural investigation platforms. Unlike microelectronics, packaging and interfaces to microfluidics are not yet standardized. Thus, the integration of both electrical and fluidic modalities into a tiny implant presents many technological challenges. Biocompatible microfluidic systems for neural engineering platforms, along with interface technologies, will be presented.