Self- Aligned Microchip Device for Automated Measurement of Quantal Exocytosis

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Neurons and endocrine cells secrete neurotransmitters and hormones as a method for cell-to-cell communication through the process of exocytosis. Disruption of exocytosis underlie neurological disorders such as Parkinson's disease and the accounts for the toxicity of clostridial neurotoxins. In order to study the regulation of exocytosis it is important to carry out studies at the level of single-cells and resolve single-vesicle release events. Carbon-fiber microelectrodes are commonly used to perform single-cell measurements but are slow and labor-intensive to use. Therefore we are developing microchip devices with arrays of electrochemical electrodes for high-throughput measurement of single-vesicle release events.

One challenge in the development of these devices is automatically targeting individual cells to each recording electrode. Here we describe a microchip device that uses a self-aligning surface chemistry approach to target individual cells to each electrochemical microelectrode in an array. The microelectrodes are small and "cytophilic" in order to promote adhesion of a single cell whereas all other areas of the chip are covered with a thin "cytophobic" film to block cell attachement and facilitate movement of cells to electrodes. This cytophobic film also insulates unused areas of the conductive film. Amperometric spikes resulting from single-granule fusion events were recorded on the device and had amplitudes and kinetics similar to those measured using carbon-fiber microelectrodes.

Use of this device will increase the pace of basic neuroscience research and may also find applications in assaying neurotoxins and development of pharmaceuticals.

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