Public Abstract

First Name:Jia

Middle Name:

Last Name:Yao

Adviser's First Name:Kevin

Adviser's Last Name:Gillis

Co-Adviser's First Name:

Co-Adviser's Last Name:

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Title:STUDY OF LOW NOISE HIGH THROUGHPUT MICROCHIP DEVICES FOR ELECTROCHEMICAL MEASUREMENT FROM SINGLE CELLS

Understanding the mechanisms of vesicle fusion and transmitter release is of broad medical significance. It will not only aid in the development of therapies for diseases where release of neurotransmitters is compromised, but it will also advance our understanding of treatments that modulate transmitter release. In order to achieve this goal, we are developing transparent multi-electrochemical electrode arrays on microchips in order to automate measurement of quantal exocytosis. In order to achieve low noise recording to resolve miniature current signals, I measured the current noise power spectral density (SI) to understand the physical basis of dominant noise sources. My results demonstrate that the current standard deviation varies somewhat with electrode material with Au $\hat{=}$ carbon fiber > nitrogen-doped diamond-like carbon > indium-tin-oxide. Microchip electrodes have a noise performance that is comparable, and in some cases superior, to that of traditional gold standard carbon-fiber microelectrodes.

Whereas patterning hundreds of electrodes in a small area is straightforward using photolithography, easily making connections between hundreds of electrodes and external amplifiers remains a bottleneck. Here I report a simple multiplexing approach using multiple fluid compartments that can potentially reduce the number of external connections by $\sim$ 100-fold. In this approach the set of electrodes in every fluid compartment are wired in parallel and connected to external amplifiers. Cell recordings are made from the set of electrodes in one fluid compartment at a time. Measurements demonstrate that this approach attains current noise levels as low as that obtained with individual electrodes. The new device will enable high-throughput studies of quantal exocytosis that can be combined with fluorescence microscopy.