Chapter 15

Methodologies for Detecting Quantal Exocytosis in Adrenal Chromaffin Cells Through Diamond-Based MEAs

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Abstract

Diamond-based multiarray sensors are suitable to detect in real-time exocytosis and action potentials from cultured, spontaneously firing chromaffin cells, primary hippocampal neurons, and midbrain dopaminergic neurons. Here, we focus on how amperometric measurements of catecholamine release are performed on micrographitic diamond multiarrays (μG-D-MEAs) with high temporal and spatial resolution by 16 electrodes simultaneously.

Key words Diamond microelectrode devices, Chromaffin cells, Exocytosis, Ion beam lithography

1 Introduction

Chromaffin cells of the adrenal gland have been extensively used as a model for investigating exocytosis as the process of catecholamine release shares with neurosecretion many molecular players [1–3]. The gold standard technique for monitoring the release of oxidizable molecules from single cells is the carbon fiber (CFE) amperometry, which allows to resolve single exocytotic events with sub-millisecond time resolution [4–7]. This approach, however, has a main drawback. It allows to carry out only one measurement at the time, whereas this limitation can be overcome by using multielectrode arrays [8–11]. Integrated multielectrode CMOS devices for amperometric measurements have been proposed as well [12, 13]. They appear suitable for recording exocytotic events with sufficient time resolution and amplitude sensitivity. However, the long-term reliability of these complex silicon-based complex devices is still an open question, especially regarding the stability of the silicon oxide passivation, which is known [14] to slowly hydrolyze when in contact with a water-based environment.

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