Semiconductor-based 2D chemical imaging sensors for Neuron cell monitoring

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Abstract

Conventional methods for studying neuron cells typically involve cell culture followed by analysis through electrophysiology [1], immunology [2], molecular biology [3], and optical imaging techniques [4]. However, these methods often suffer from poor spatial and temporal resolution, invasiveness or destructiveness, high costs and complexity. For instance, electrophysiology commonly requires the use of expensive microelectrode arrays (MEAs) and relies on the random distribution of neuronal cell growth and differentiation, limiting precise studies [5]. In this study, a semiconductor-based chip with 2D chemical imaging ability from light-addressable potentiometric sensors was applied for neuron cell monitoring with directly culture and flexible measurements. Illumination spot enables the designed measurement of surface potential changes akin to electrophysiological responses, offering flexibility, rapid scanning, digital imaging, and cost advantages. Both thin-Si and a-Si:H on ITO/glass substrate with different high dielectric constant layer including Al_2O_3, HfO_2 and NbOx were used to study the feasibility for neuron cell culture. By means of Mirror LAPS measurement setup, the 2D bio imaging could be real-time collected to obtain the drug effects on cells. This proposed chip and system has a high potential toward detecting rapid simulation of signal transmission among neurons for future applications in drug screening cellular analysis by reducing the need for animal experiments.

Reference

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