Special Issue on Neural Engineering

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Neural engineering is an interdisciplinary field that brings nano and microtechnology, material science, microelectronics and medicine together.

For past decades, electrode array technology has become an essential tool in neural recoding and stimulation. Electrical stimulation is used in deep brain stimulation to treat Parkinson's disease, and it is also used to transduce sounds into neural signals in cochlear implant. Electrical recording technology has been used in the brain-machine interface systems to decode neural signals from neural populations.

Accordingly, there are growing interests in developing next-generation microelectrode arrays that are highly dense, flexible, stretchable, minimally invasive, and biocompatible. Due to its potential impact on human health and well-being, we select neural engineering as a theme of this Special Issue of *Biomedical Engineering Letters*.

In this issue, we have invited five review papers that cover microelectrode array technologies for *in vivo* and *in vitro* neural interfaces and related biological studies in the brain.

The first paper entitled “Next generation flexible neural and cardiac electrode arrays” is described by Kim and colleagues [1]. Authors introduce the most recent development of flexible and stretchable microelectrode array technology that is aimed to make conformal contacts with dynamic surfaces of the brain and heart. Engineering approaches to integrate electronic circuitry while achieving high electrode counts are discussed.

The second paper entitled “MEMS-based micro electrode technologies capable of penetrating neural tissues” is described by Kim and colleagues [2]. They reviewed microelectrode arrays aimed to be used as penetrating electrodes for brain tissues. The fabrication of 2D and 3D microelectrode array using silicon, polyimide, parylene, and liquid crystal polymer is reviewed. In addition, multi-functional devices that integrates fluidic channels or light wave-guides are discussed.

The third paper entitled “Strategies for minimizing glial response to chronically-implanted microelectrode arrays for neural interface” is described by Jun and colleagues [3]. When electrode arrays are implanted in the brain, tissue-electrode interfaces change dynamically and influence the performance of the electrodes. This paper introduces biological studies on the tissue-electrode interactions in terms of electrical recordings. Various approaches to rescue the electrical functionality of the implanted electrodes are discussed.

The fourth paper entitled “Recent trends in micro electrode array technology for *in vitro* neural interface platform” is described by Nam and colleagues [4]. In this paper, various

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types of microelectrode array platform specifically developed for *in vitro* experiments are introduced. Planar-type microelectrode arrays are used for studying neural circuits in brain slices or primary neuronal networks. Recent trends in integrating nanomaterials for advanced nanoelectrodes, and integrated circuit design for ultra-high density microelectrode arrays are highlighted.

The fifth paper entitled “Capacitive monitoring of bio- and neuro-signals” is described by Lee and colleagues [5]. This paper introduces a new non-invasive technology to monitor brain signals using capacitive sensors. As non-invasive recording of brain signals are of interest in many areas including personal health care and well-being, the core sensor technology is a good theme to be included in this special issue with other invasive microelectrode technology.

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