**Multielectrode Arrays for cell potential measurements: testing novel insulating layer between electrodes and culture**

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**Introduction:**

This paper reports the fabrication of planar sixty channels Mutielectrode Arrays (MEAs) in order to investigate the use of TiO2 as insulating layer between electrodes and cell culture. Among its advantages, we can highlight the high mechanical and chemical stability, high dielectric constant, low cost, optical transmittance (about 90% in the visible range), good adhesion to the glass substrates, and biocompatibility [1–4]. The goal is to measure cell potentials and obtain images from neural cell cultures, specifically from dorsal root ganglion (DRG) neurons. We have successfully developed all fabrication steps in order to generate MEAs with 100% national technology. Testing results point out that the device yields very good performance, close to standard commercial MEAs, and is biocompatible.

**Materials and Methods:**

MEAs’ fabrication was made through conventional silicon microfabrication processing using glass as substrate. The device consists of sixty round, flat electrodes, connected to square contact pads by the tracks. Fabrication steps can be subdivided into 4 basic parts, after the cleaning of the substrates: (1) deposition of an insulator interlayer between glass and conductor, which will form the (2) electrodes/ tracks/ contact pads through lift – off technique, (3) formation of the insulation layer, also using lift – off, and (4) placement of a glass ring that surrounds the active region of MEA.

**Results:**

The electrical characterization of the noise level from the TiN electrodes showed good sensitivity to noise, compatible with commercial systems. Most of the working TiN electrodes have showed low noise, with amplitudes ranging from -8 to 10 μV, i.e. 20 μVp-p (peak-to-peak potential). In addition, we have performed electrode tests: Cyclic Voltammetry (CV) and Impedance Spectroscopy (IS), which showed good responses. Finally, we have performed the biocompatibility test to evaluate the TiO2 insulator interlayer.

**Discussion:**

Regarding the CV test, resulting curves of our MEA presented similar shapes to commercial device, but with higher current density, as well as IS test. Moreover, due to the qualities of the conductor used (such as high charge injection safe limit and low impedance), TiN may be considered an interesting option for extracellular stimulation and neural activity recording. The biocompatibility test to evaluate the TiO2 insulator interlayer with cell culture using DRG neurons showed that the neurons developed themselves and there was proliferation of non-neuronal cells.

**Conclusion:**

The present work confirmed that, based on all tests and considerations, we have successfully developed process steps, as in the implementation of MEAs with functional microelectrodes. Results arising from testing the device reported in this work are within the expected range and compatible to standard commercial MEAs, so they are suitable for MEA applications.

**References:** [1] K. Hashimoto, H. Irie, and A. Fujishima, Jpn. J. Appl. Phys. 44(12): 8269-8285, 2005; [2] A. Dhar, and T. L. Alford, APL Mater. 1(1): 012102, 2013; [3] M. Carballo-Villa et al., J. Biomed. Mater. Res. A 90(1): 94-105, 2009; [4] F. López-Huerta et al., Materials (Basel) 7(6): 4105-4117, 2014.