Polymeric recording of neural network in vitro

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I. Introduction

Polymeric structures including microchannels and microwells were used in order to constrain neuronal geometry and ensure proximity of electroactive compartments to recording sites [1-4], for the recording and stimulation of neuronal activity in vitro.

This thesis project consists to improve the polymeric structure and adapt it for culture cells to record the neural network electrical activity in vitro.

II. Description

The neurons are very similar to the electronic circuits: they can be represented as resistance and capacitors and they use electricity (and chemicals components) to communicate between each other.

II.A. The system

The polymeric structure consists in a polymer block with 2 wells and one microchannel as connection between them. The cells are constrained across the microchannel as shown in Fig. 1. The cells need medium for survive and this medium (inside of the wells) is electrically conductive, so this allow to us to introduce 2 electrodes in the medium to measure the electrical activity in the microchannel without touching the cells.
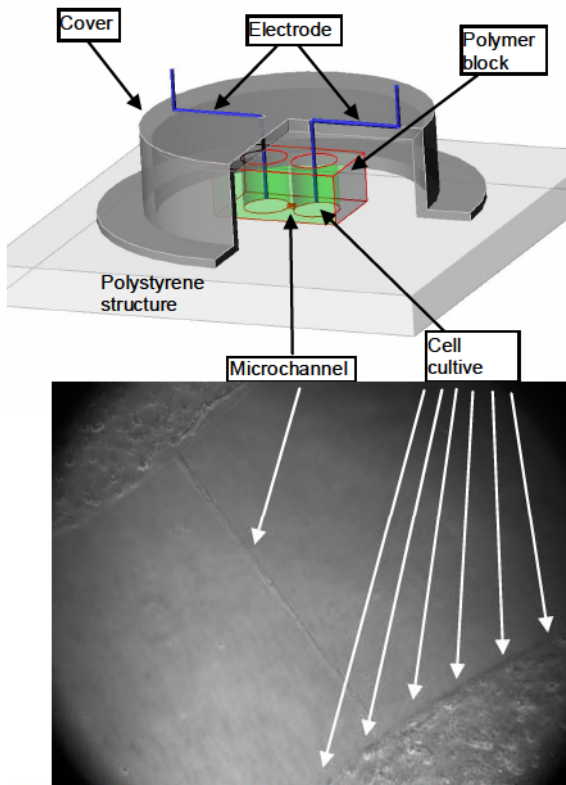

Figure 1. Up-section (3D model of the system with the microchannel and electrodes). Down-section (a 10X microscope photo of the cell cultivate with the microchannel)

Right now it is possible to record from 40 differents channels in simultaneous way (we use Multichannel Systems Amplifier for this task) that means 40 differents cultures cells as shown in Fig. 2
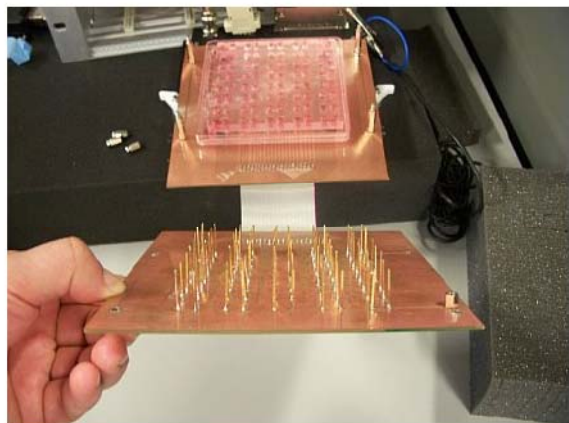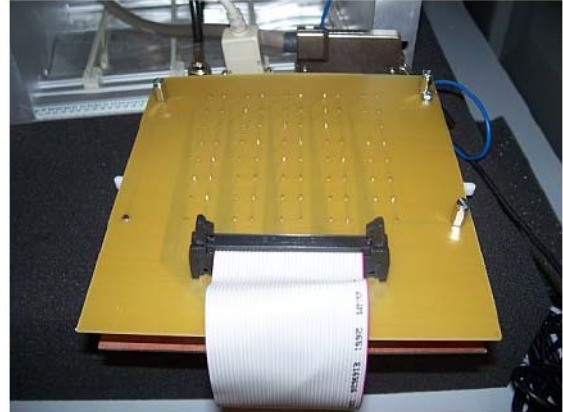

Figure 2. Electronic circuits (both images) and 80 wells PDMS block (down-section)

III. Results

We can record signals of the neurons that are constrained inside of the microchannel of the polymer block structure (Fig. 3).

The activity of all the cells that inside of one well are very similar between them and almost constant, but any external or internal change (temperature, ph, osmolarity, etc) can affect their activity as you can see in Fig. 4

The electrical activity of each well is almost unique. Right now we are analyzing the data and making tests to set up the correct parameters to make drug screening.
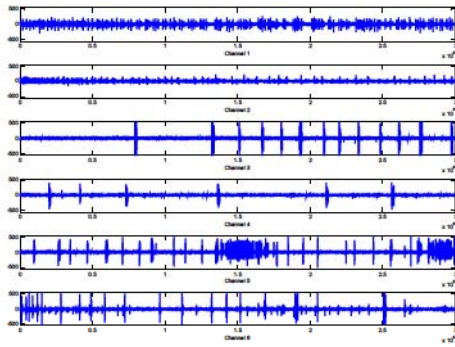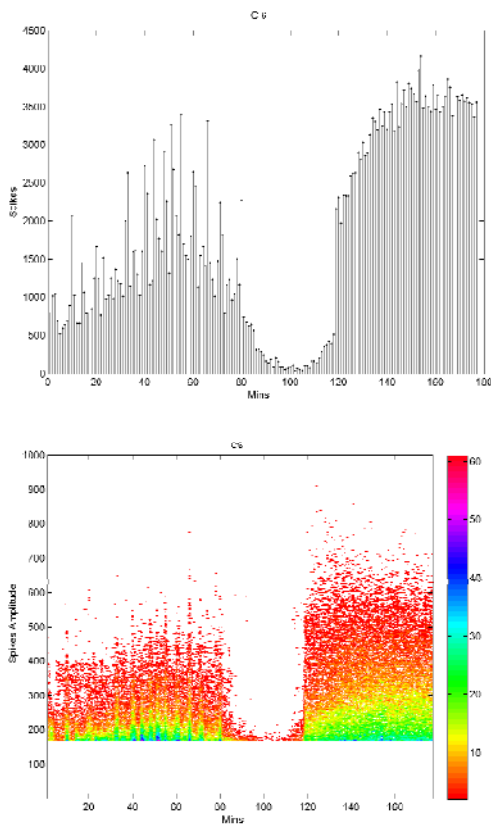
Figure 3. Recording signals from 6 channels

Figure 4. Spike Activity. Up (Total spikes per minute).
Down (Spikes quantity and amplitude. The left bar
indicates the number of spikes per color)

IV. Acknowledgments

V. References

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