Evaluation of printed microsensors for microphysiometry

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Introduction

Printed interdigitated electrode structures (IDES) for use in biomedical application will allow simple, accurate and inexpensive bioelectronic sensor chip measurements, with applications in diagnostics, medical research, and environmental monitoring. In this work it could be shown that the electrical readout of printed BioChips essentially corresponds to obtained results with conventional thin film fabricated BioChip-D sensors from cellasys GmbH. Special attention was devoted to the most sensitive measurement frequency, which could be determined at 10 kHz for the investigated L929 cell line.

Materials & Methods

A standard cell line can be a biological sample for BioChip validation and therefore can serve as a reproducible in vitro model of human tissue for illustration of the working principle [1]. L929 cells were cultured in chemically defined serum-free DME/F12 + ITS medium for the cell based experiments.
The electrical impedance of the BioChips was measured using a potentiostat VERSASTAT3 (Princeton Applied Research, USA) in the electrochemical impedance spectroscopy (EIS) mode. The basal impedance values are recorded before the impedance – altered by the attached cells – is measured after 24 h cell culture.

Results & Summary

Electrical readout

In figure 1, the functionality of the printed BioChips for cell based assays could be confirmed. In the range of 10 kHz all obtained values seem to be the most comparable with the measurements obtained from the conventional BioChip-D. The rise of impedance caused by cells is known to be more important around this frequency [2].

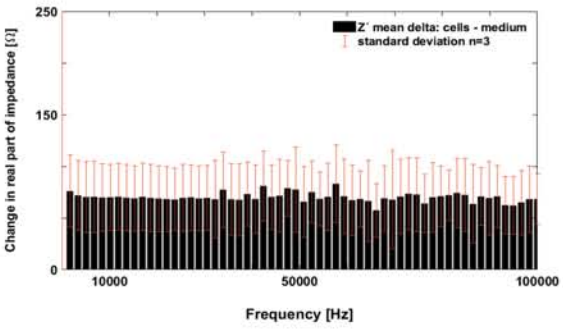

Figure 1. A change in impedance due to attached cells can be seen for the whole investigated spectrum.

Cell adherence and cell growth

The micrographs shown in figure 2, reveal the adherence of L929 cells to the printed graphene electrode surface. The DNA observation shows a clear indication of cell adhesion taking place. Thus, the printed ink surface characteristics are supporting cell attachment and provide a natural environment for cells.

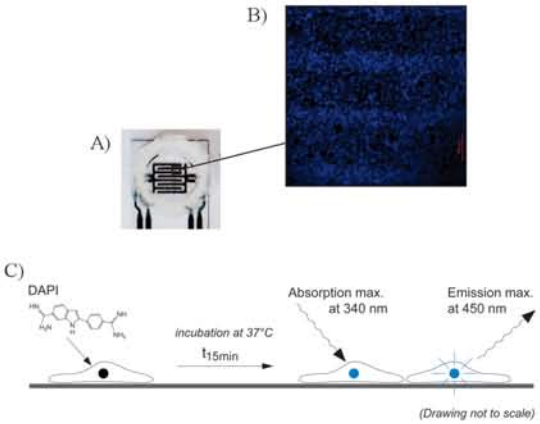

Figure 2. A) BioChip IDES with line width 100 µm, B) Fluorescence micrographs of confluent L929 cells, C) Priciple of uclei staining.

References

[1] Schwarzenberger, T., Wolf, P., Brischwein, M., Kleinhans, R. et al., Impedance sensor technology for cell-based assays in the framework of a high-content screening system. Physiological measurement 2011, 32, 977–993, DOI: 10.1088/0967-3334/32/7/S18.

[2] Wegener, J., Keese, C. R., Giaever, I., Electric cell-substrate impedance sensing (ECIS) as a noninvasive means to monitor the kinetics of cell spreading to artificial surfaces. Experimental cell research 2000, 259, 158–166, DOI: 10.1006/excr.2000.4919.

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BIOGRAPHY
www.graphene-biosensors.eu

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