Cell-based biochip for single-cell measurement

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The merging of microelectronics and biology has brought forward the challenge to grow living cells on microelectronic surfaces [1]. Biodevices couple the processing power of microelectronic devices with the selectivity of biological systems. Bioelectronic devices have a potential for toxicological testing, pharmacological studies and medical diagnostics. As many biological tests rely on living cells these cell-based biosensors are of increased interest.

Interdigitated microelectrodes, multielectrode arrays (MEA) with multiple microelectrodes and with nanosized electrodes were fabricated by e-beam lithography. These electrode structures were used as carrier for growth of an adherent cell layer of Caco-2 cells.

Caco-2cells were seeded on top of the microstructured surfaces as suspension in a nurturing medium. The electrical properties of living cells were investigated ex-vivo via impedance measurements. 3 types of microelectronic interfaces were tested and compared. The cell monolayer on the microchip was subject of electrical measurements. Cell-free electrolytes were used as reference media.

A measurement of the bioimpedance of living cells in electrolyte was performed. The impedance between electrodes was measured at frequencies ranging from 100 Hz up to 1 MHz applying a voltage below 10 mV. With microelectrodes in the µm-range several electrodes could simultaneously contact one individual cell. The cell coverage could successfully be determined by electrical bioimpedance spectroscopy utilizing an array of microelectrodes.

The fabricated array of biocompatible microelectrodes provides the technical bias for a future cell-based biosensor for continuous monitoring of cell growth, cell condition and the influence of pharmacological active substances.

[1] M. Brischwein, E.R. Motrescu, E. Cabala, A.M. Otto, H. Grothe, B. Wolf, Lab-on-a-Chip, 3(4), 234-40 (2003)

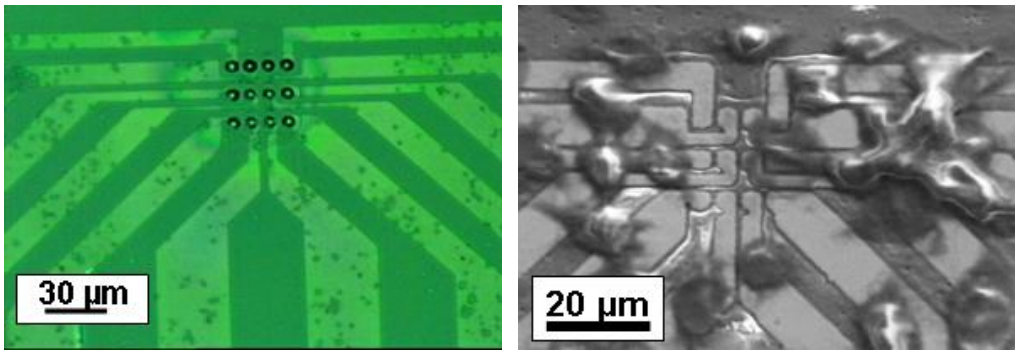

Fig. 1.

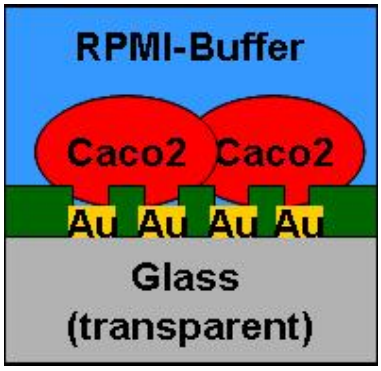

Fig. 2

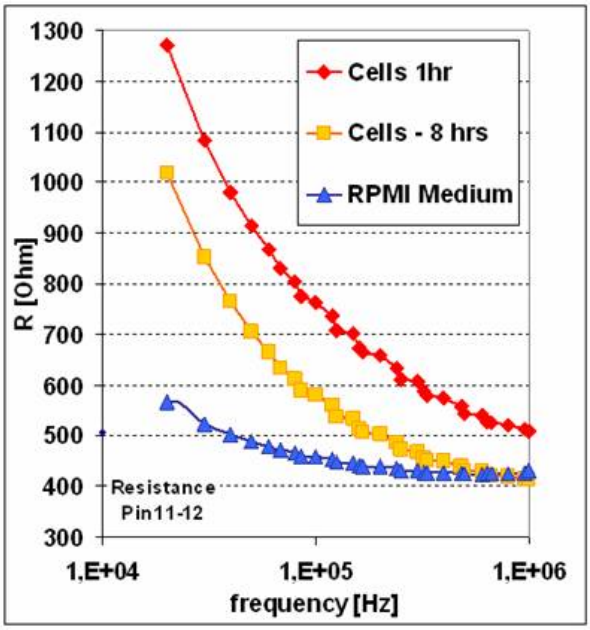

Fig. 3.