Frontiers in nano- and microstructures on microarrays for cell and tissue real time monitoring by bioimpedance spectroscopy

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The demand on innovative nano-biotechnology is the miniaturisation of devices and the optimization of material surface topologies. This report represents an overview and introduction of novel cell based micro-sensors used as (i) cardiomyocyte biosensors, (ii) mamma carcinoma chips, and (iii) embryonic cell microarrays coupled to a microlaser manipulation platform. The goal of the biosensor technology is the development of high-sensitive screening systems that allows the electronic detection of drugs and tissue-secreted factors involved in receptor-directed diseases by impedance spectroscopy and/or electrophysiological recording. For this purpose, spontaneously beating neonatal rat cardiomyocytes were cultured on substrate integrated microelectrodes for counting contractions by extracellular recording of field potential. Angiotensin II, the ligand of the AT_1 receptor with a positive chronotropic activity, was detected at very low concentrations of 10^{-11}M. Furthermore, a multiwell-multimicroelectrode array (MMEA) has been designed and developed for the screening of cardiomyocyte ischemia, effects of phorbol-12-myristate-13-acetate (PMA), and of selective agonists of the neuropeptide hormone receptor Y in 2D/3D mamma carcinoma models. The cell/tissue based chips consist of biological targets for the detection of ligand/receptor interactions via impedance spectroscopy (reflecting the molecular and physiological alterations dependent on the frequency range up to 10^6 Hz). For a parallel real time monitoring the sensor platform was adapted to a 96 well plate-MMEA for a high content screening.

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