Proceedings

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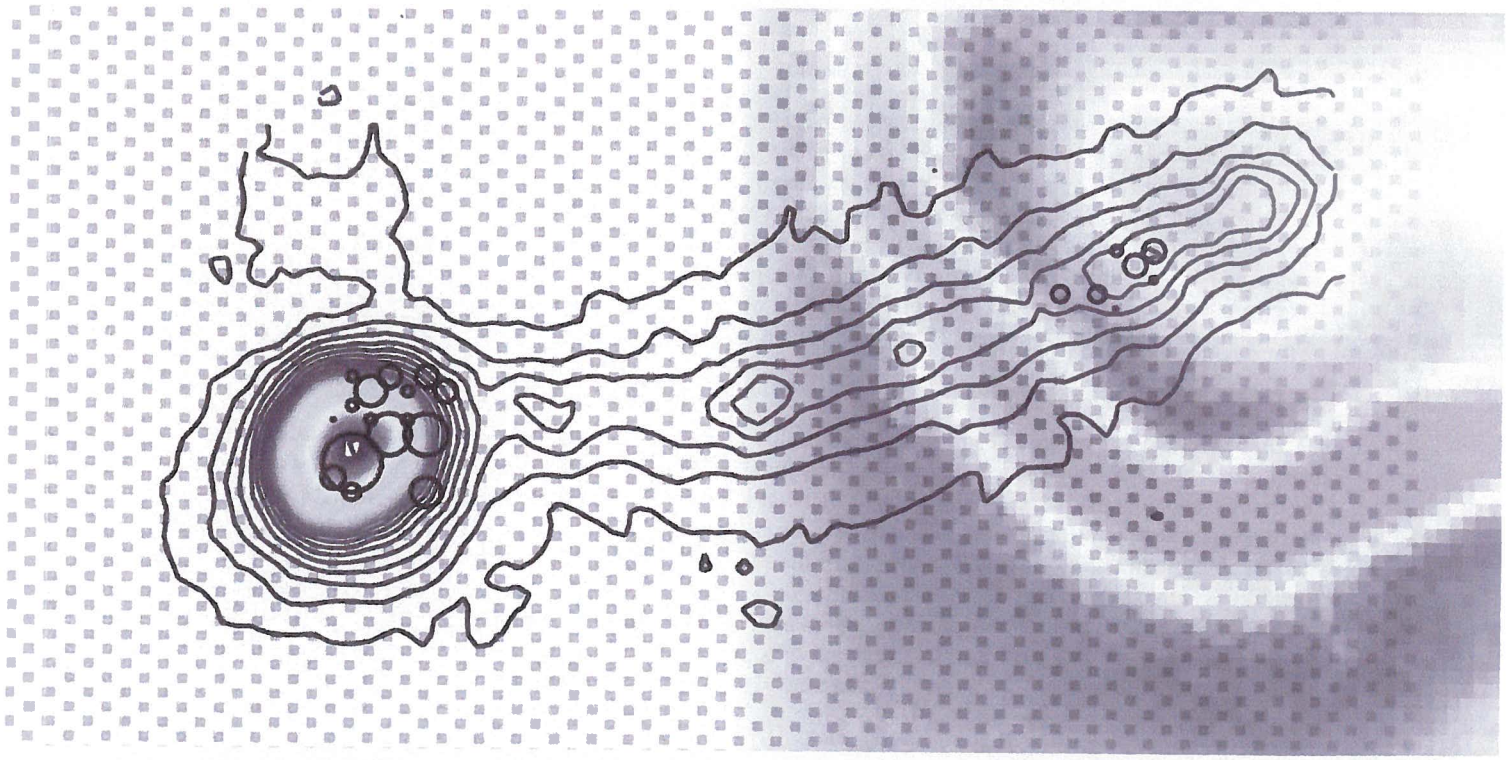

Tübingen Neurotech 2014

1st Tübingen Symposium on Current Topics in Neurotechnology

Bernstein Center Freiburg

NMI achieving results

Band 9

Real-time Monitoring of Lesion Healing by Impedance Spectrometry on Chip

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Abstract
An impedance-analyzer-system was developed and used for long-time impedance measurements of living epithelial tissue. For the measurement of impedance spectra the CaCo2-cellline was used. As measurement platform a microelectrode array of planar interdigitated electrodes (IDES) was developed. This setup provides low signal-to-noise ratio and allows long-time measurement using a specific software for long-time measurement. Successful permeability measurements with Bromelain as permeation enhancer as well as measurements of the regenerative properties of the CaCo2-cellmonolayer could be demonstrated. With this impedance spectroscopy system non-invasive in-vitro investigations could be performed and will in future allow addressing a wide range of pharmaceutical and medical cytological issues such as drug uptake and regeneration properties.

1 Background

Impaired wound healing leads to infection and tissue necrosis. This has been a strong motivation for the search and identification of new wound healing agents. For a screening of potential candidates a fast and reliable methodology to test the wound healing capabilities of substances has been frequently demanded. While in-vivo tests and clinical studies are essential for approval of new drugs, a fast ex vivo screening method is required for the plethora of newly designed therapeutic substances.

In this work we present a microelectronic system for automatic impedance monitoring of wound healing of an epithelial layer. Impedance spectroscopy has already been successfully employed for monitoring of fibroblast behaviour, for toxicological screening and to monitor the mortality of living cells [1,2]. Using a reproducible cell culture of epithelial cells, the healing process of an mechanically inflicted wound may be monitored in real-time and fully automatically. Such a cell culture based model systems will provide a deeper understanding of how these compounds exert their activities in biological systems and contributes to the future discovery of wound healing agents.

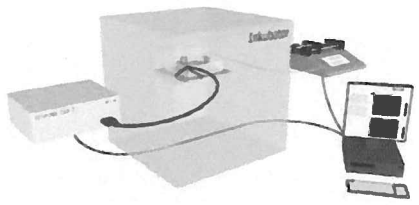

Fig.1 Schematic setup of impedance-analyzer-system

2 Methods

In this work we present an impedance-analyzer-system (Fig.1) for long-time impedance measurements of living epithelial tissue. The cells used for this study are the CaCo2-cellline which has metabolic properties comparable to the human small intestine epithelial cell walls. Combining the CaCo2-cells with the measurement system mentioned above allows to investigating important biological problems such as drug intake and regeneration properties.

The use of microstructural and planar interdigitated electrodes (IDES) provides low signal-to-noise ratio and allows long-time measurement. The contact pad is adapted to the Multichannel System MEA60 biochip standard. Each sensor chip (Fig 2) holds 4 separated culture wells with noble metal IDES on glass. The impedance-analyzer-system contains a specific software solution for continuous online-monitoring in real-time. By implementing a microfluidic media supply made of biocompatible materials the system can be extended.

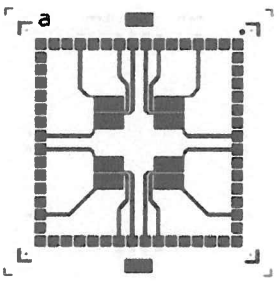

Fig.2 Schematic image of IDES Sensor with 8-electrode pairs