TEEROC

In vitro Bio-Impedance Measurement Device applied on a dynamic Lung-On-Chip model

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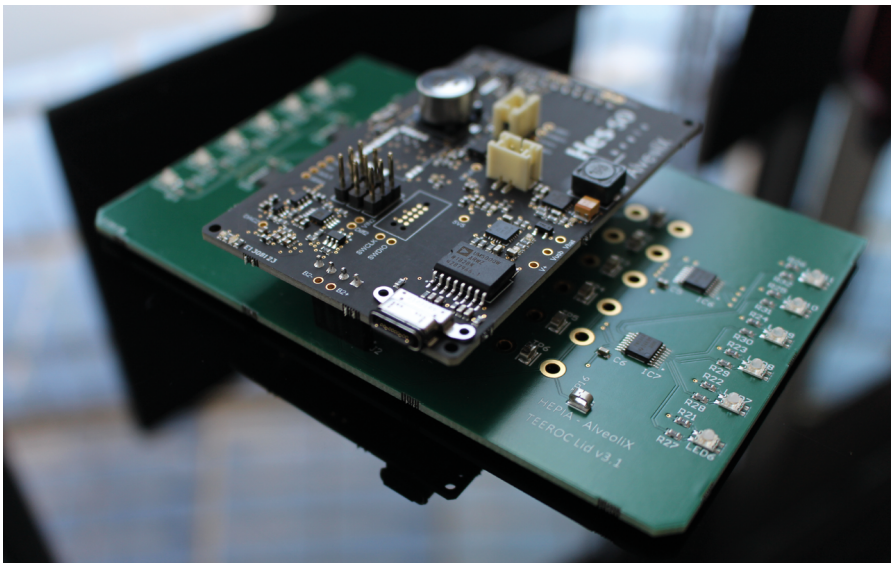
Brief description

TEEROC (for TEER-On-Chip) is a full spectrum impedance device composed of two printed circuit boards (PCB). The first one contains the intelligence and measurement electronics, based respectively on a STM32 microcontroller and the Analog Devices' spectrum analyzer AD5933. The second one called "Lid" is the interface between the electronics and the biologist well plate. Using multiplexers, we can perform a sequential acquisition of TEER on 12 wells mimicking the dynamics of the *in vitro* lung.

Key points

The choice of designing the device in separate blocks allows the measuring PCB to be used for other geometries such as well plates. This provides the user with a flexible measuring system that can be adapted to standard biological equipment. In addition, the choice of integrating the AD5933 chip from Analog Devices allows a considerable reduction in the price of this technology, making TEEROC a cost-effective in-house device. For communication, we used USB-C or Bluetooth. The energy is provided by a battery.



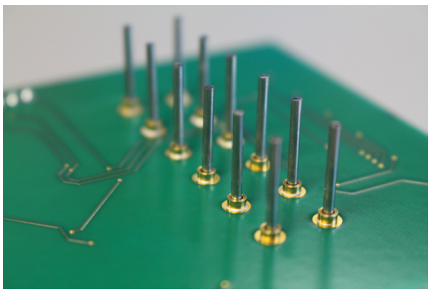
Printed circuit boards used to measure in vitro bio-impedance. ©HEPIA

Bio-impedance measurement is a technique used to evaluate the integrity of a single layer of epithelial cells. As the cells are immerged in a conductive growing medium, the measurement can be done by applying an alternative voltage through the barrier, thus observing the induced current and deducing the electrical impedance of the cell monolayer.
Such non-invasive method is used to study the impact of drugs on the single-layer characteristics by evaluating its integrity.

This study is the result of a collaboration between HEPIA's Tissue Engineering Lab and the Bern-based start-up AlveoliX. Both laboratories share the same interest in TEER device development and the design of a robust, reliable home-made instrumentation.

The developed system is a full spectrum impedance measurement device based on the system-on-chip AD5933 by Analog Devices. The ability of the AD5933 to generate peak-to-peak excitation voltage to a maximum of 100 kHz, thus measuring an impedance range from 1 Ω to 10 MΩ makes it a perfect fit for our application. Two boards have been redesigned during the project: the first one contains the electronics for the measurement, control, communication and powering, as opposed to the second one, which only acts as the interface between the electronics and the wells containing the cells. The measurement is achieved with a press-fit two-point electrode system designed in a previous project.

Project partner: Janick Stucki, AlveoliX AG, Bern



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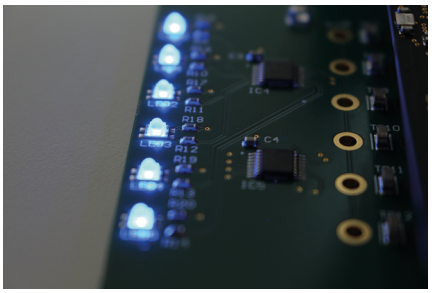

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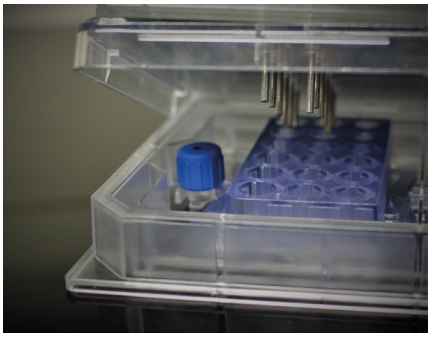

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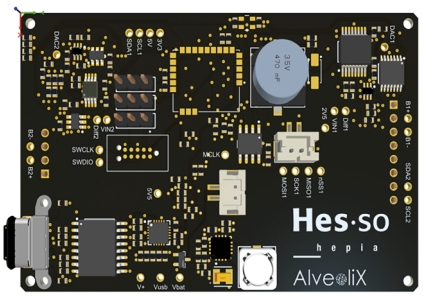

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Output

This jointly developed *in vitro* bio-impedance measurement device will be valorised by HEPIA and AlveoliX.

Alveolix will use this technology for its specific *in vitro* lung model and HEPIA will continue to work on the technology for other cellular barrier models.

Special equipment

In this project, HEPIA used interdisciplinary expertise such as electronics and biology (*in vitro* cellular models).

Legend

1 - Stainless steel electrodes submerged in the cell-culture medium. ©HEPIA
2 - Visual indicators of the cell-culture wells under measurement. ©HEPIA
3 - Application of the system on Lung-On-Chip well plate (AlveoliX AG). ©HEPIA
4 - Printed circuit board rendering of the TEEROC system. ©HEPIA

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