Heart-on-chip monitoring of cardiomyocyte electrical activity

Commonly used acronym: *Microelectrode arrays*

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Organisation

Name of the organisation Interuniversitair Micro-Electronica Centrum (IMEC)
Department Life Science Technologies
Country Belgium
Geographical Area Flemish Region

SCOPE OF THE METHOD

The Method relates to	Animal health, Human health
The Method is situated in	Basic Research, Translational - Applied Research
Type of method	In vitro - Ex vivo
Specify the type of cells/tissues/organs	Human induced pluripotent stem cells derived cardiomyocytes

DESCRIPTION

Method keywords

action potentials
local field potentials
heart-on-chip
induced pluripotent stem cells
cardiac toxicity
drug testing
in vitro

Scientific area keywords

cardiac toxicity
organ-on-chip
drug screening
in vitro cell culture

Method description

This method is used to monitor cardiac cell cultures *in vitro*. It can be used for monitoring both cell activity and drug-induced cardiac side-effects for primary cardiomyocytes or hIPSC-derived cardiomyocytes. Unlike conventional microelectrode array systems that only measure the local field potentials around cardiac cells, the imec-developed microelectrode array monitors the extracellular electrical activity, intracellular (open-cell) action potentials, and impedance of cells cultured directly on the chip. Furthermore, this method offers high throughput recordings of cells: the CMOS-based chip contains 16384 recording electrodes, wherein 1024 channels can simultaneously record multimodal cell electrophysiology on single-cell level. This multimodal MEA may open up new opportunities in high-throughput cell-based pharmacological screening as well as fundamental studies of cells.

Lab equipment

Imec-developed microelectrode array chips and read-out setup.

Method status

Published in peer reviewed journal

PROS, CONS & FUTURE POTENTIAL

Advantages

High quality electrical recordings (intracellular action potential recordings) High spatio-temporal resolution Single-cell recordings 16,384 recording electrodes Pacing Multimodal Structured chip surfaces.

Challenges

Custom-made tools ;
Large volume of data ;
Complex chip fabrication.

Modifications

Software upgrades for user-friendliness ongoing ;
Hardware improvements.

Future & Other applications

Brain-on-chip ;
Cancer-on-chip ;
Gut-on-chip ...

REFERENCES, ASSOCIATED DOCUMENTS AND OTHER INFORMATION

Links

A 16384-electrode 1024-channel multimodal CMOS MEA for high-throughput intracel…
Single-cell recording and stimulation with a 16k micro-nail electrode array int…
Open-cell recording of action potentials using active electrode arrays
Action potential-based MEA platform for in vitro screening of drug-induced card…
Put your heart on this chip and your cancer treatment becomes ‘healthier’

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