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cellasys GmbH

BioChip-based electrochemical platform for the label-free monitoring of living cells
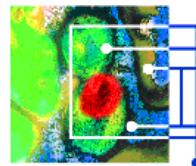
2012/09/08

LINZ 2012
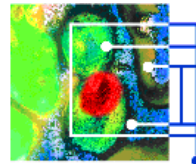
EUSAAT 2012

Dr.-Ing. Joachim Wiest

www.cellasys.com

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Prof. Dr. rer. nat. Bernhard Wolf
Technische Universität München

Motivation

Continuous monitoring of vitality and morphology of living cells

- Chemosensitivity (Individualized therapy against cancer)

- Toxicology (Alternative for animal experiments)

- Pharmacology

- Environmental monitoring

- Cell culture media optimization

- Basic research in cell biology

- Quality control for tissue engineering / transplantation

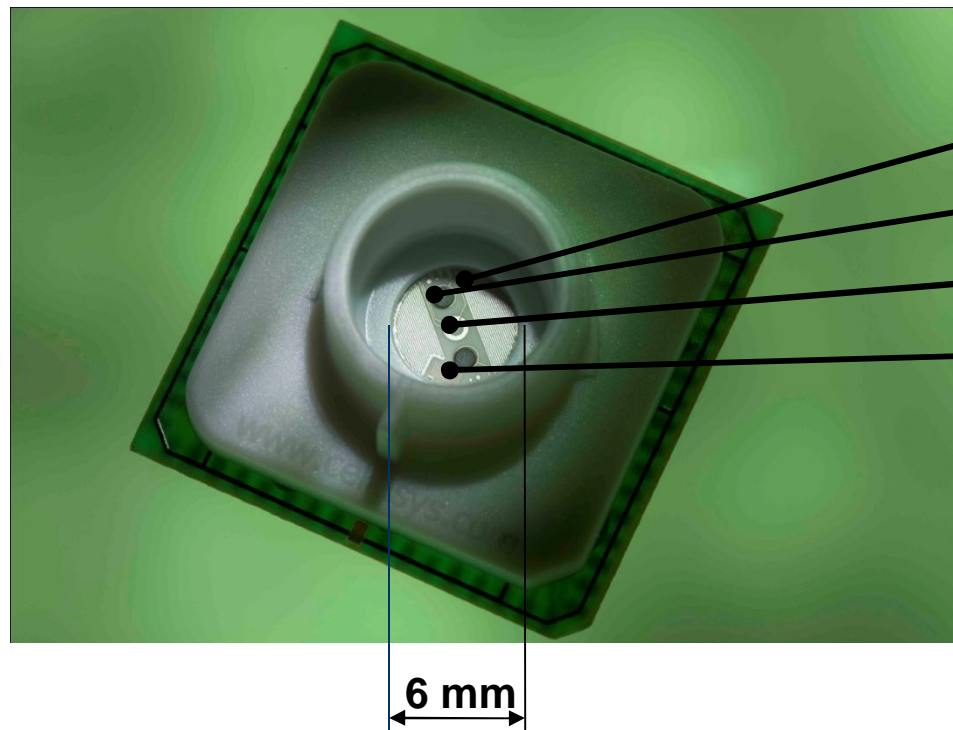J. Wiest et al.: Cellular assays with multiparametric bioelectronic sensor chips, Chimia 59, 2005

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Physiological & physical Parameters

Extracellular acidification

H⁺

Adhesion

Cellular respiration

Respiration → pO₂

Acidification → pH

Adhesion → Impedance

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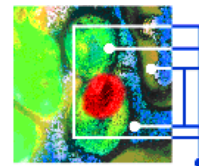Technische Universität München
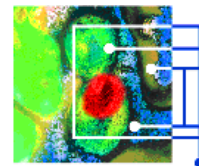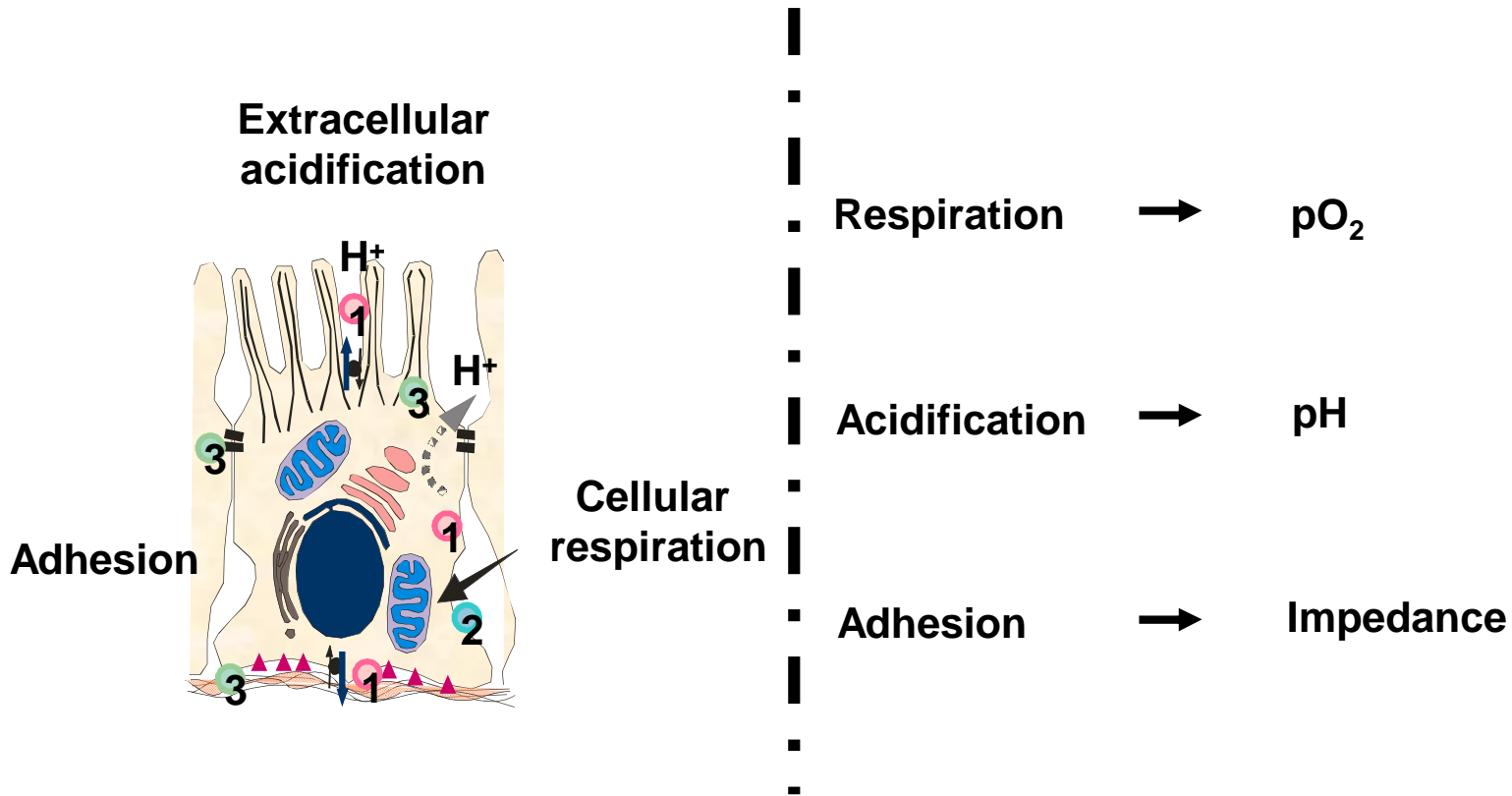
BioChip-C (electrochemical)

IDES (2x), impedance
Metaloxide (2x), pH
Amp. sensor, pO_2
Pt 1000, temp.

6 mm

Microsensorchip for monitoring of cellular respiration (pO_2), extracellular acidification (pH), morphological changes (impedance) and temperature.
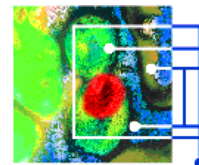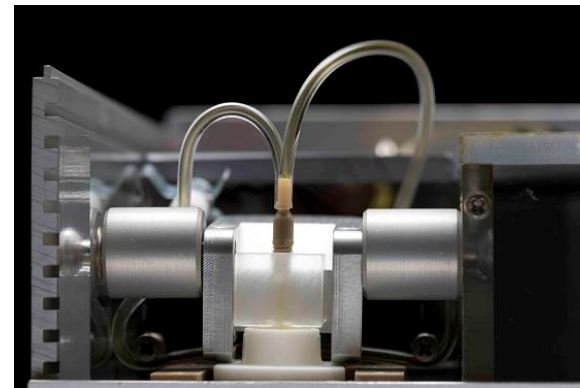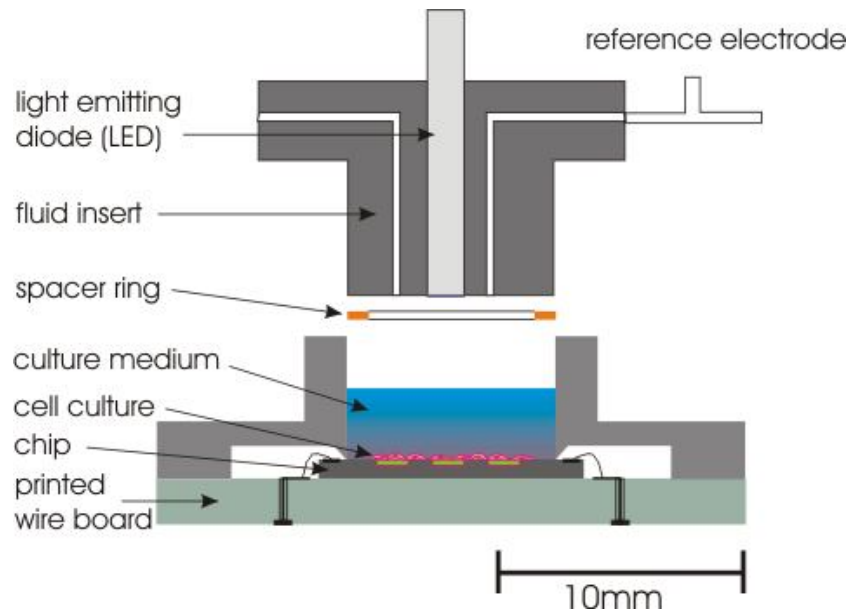
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IMOLA system

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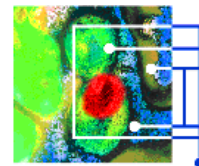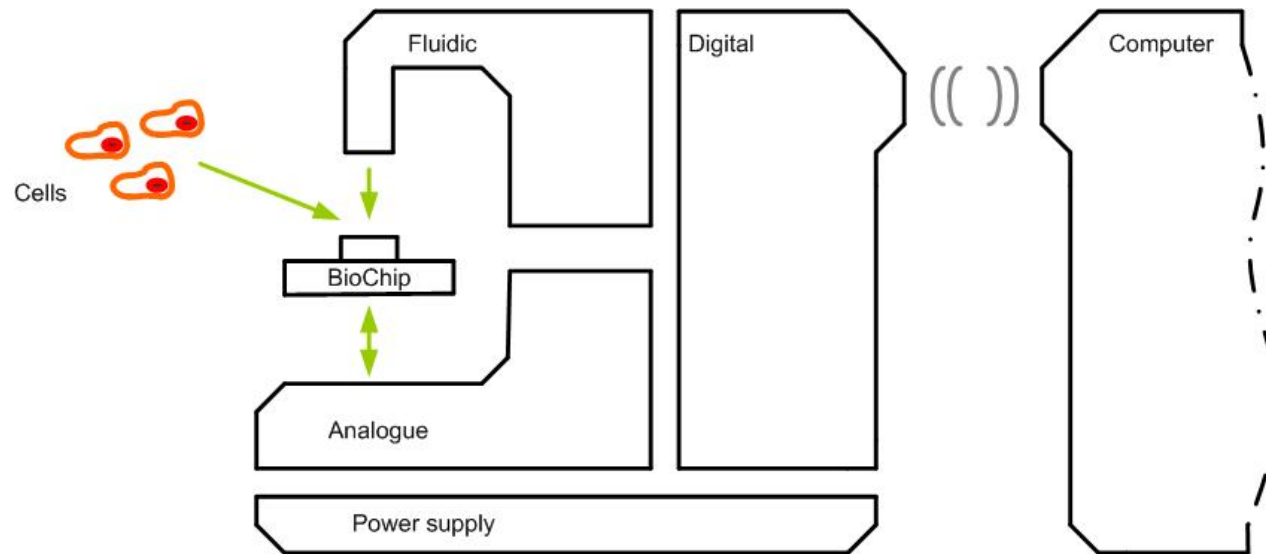
IMOLA fluidic
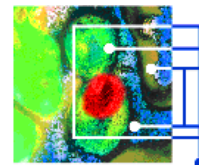
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6xIMOLA system

6-channel-version:

- Six IMOLAs
- One peristaltic pump
- Six closed and sterile systems
- Incubator (37 °C)
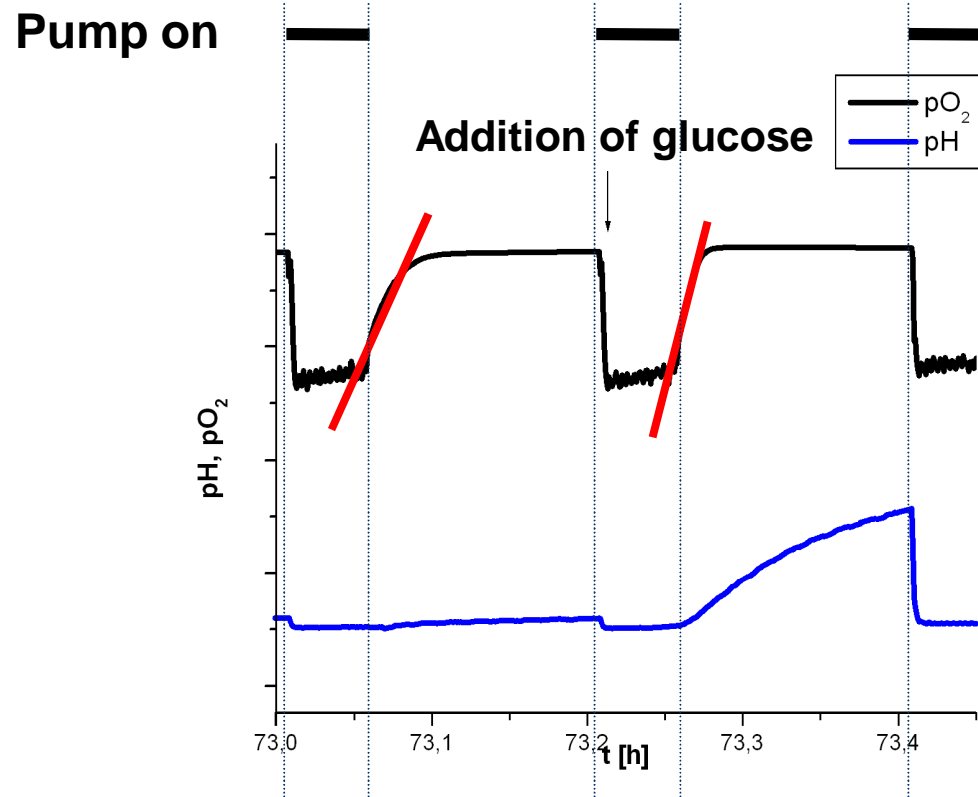- Flexible CAN-bus extension possible

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Determination of yeast-vitality

Pump on

Addition of glucose
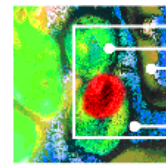
pO₂
pH

Measurement of relative changes

Red: linear regression

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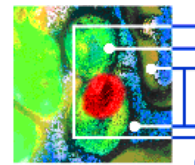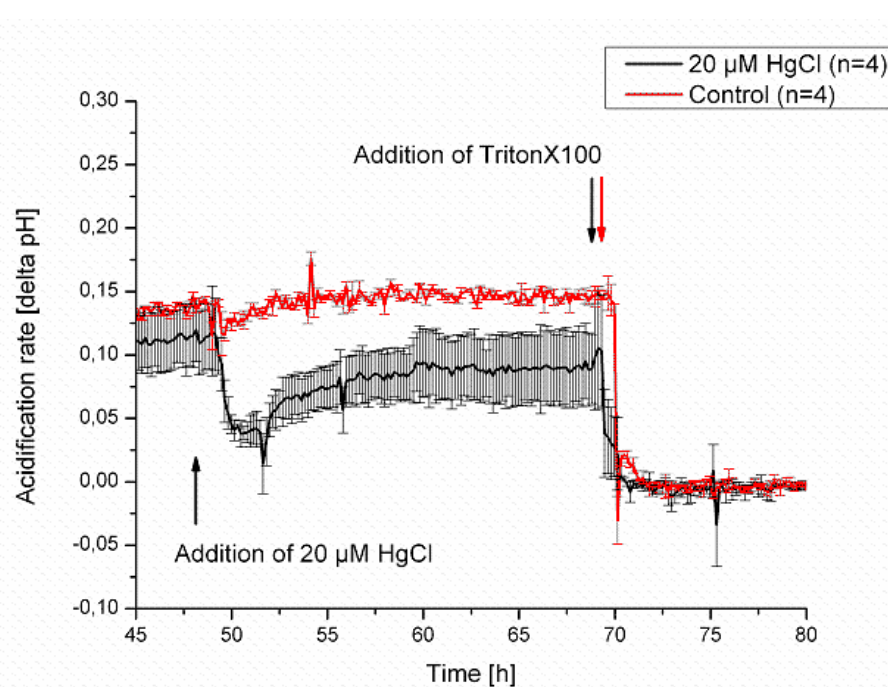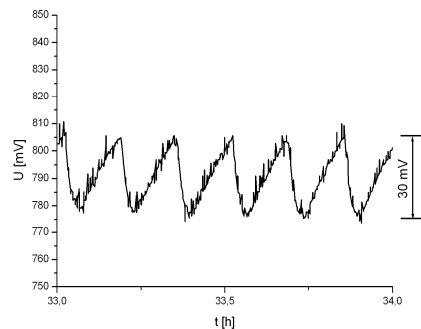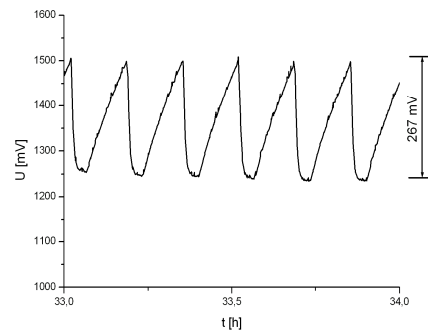
Toxicology

- 3T3 fibroblasts
- Investigation of toxicokinetic behaviour using mercury
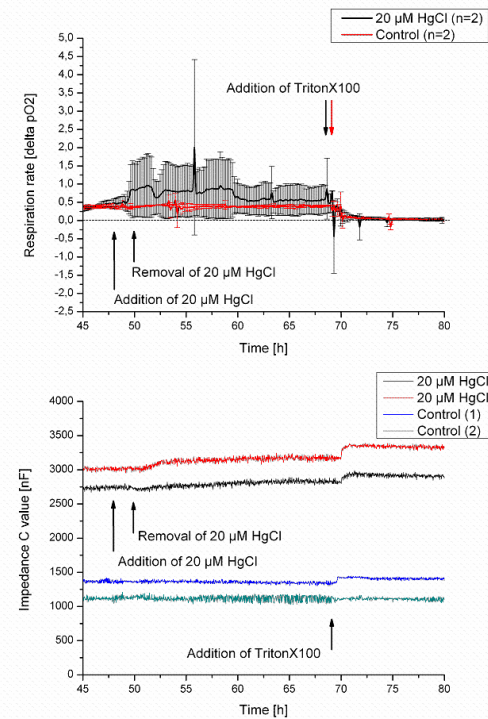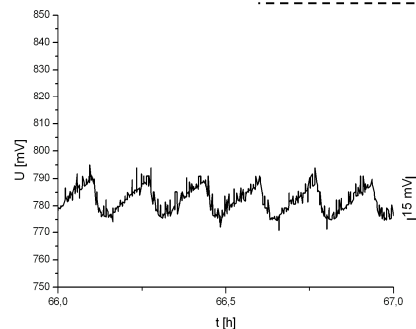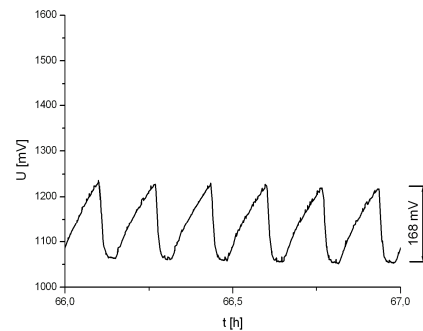
Vitality of tumor cells (MCF-7)

Control
(vital cells)

+ Doxorubicin (1µM)
(reduced vitality)

Cellular respiration (pO_2)

Extracellular acidification (pH)

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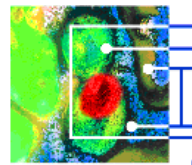
Chemosensitivity pO$_2$ & pH
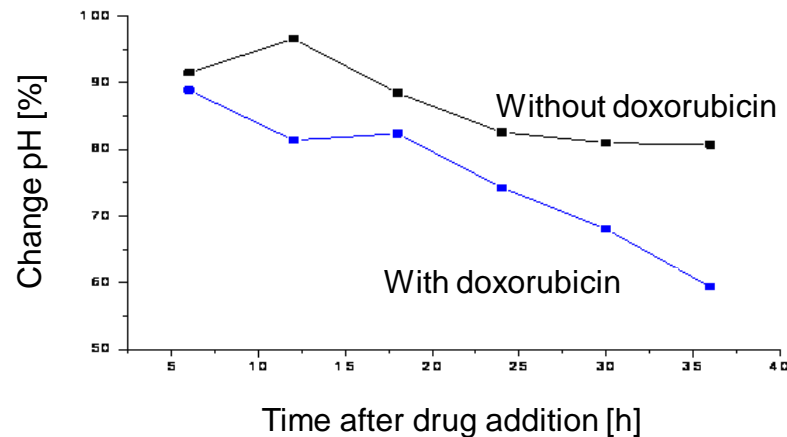
Interpretation of vitality data
(Determination of gradients)

Comparison of toxicodynamic
effects on tumour cells with and
without addition doxorubicin .

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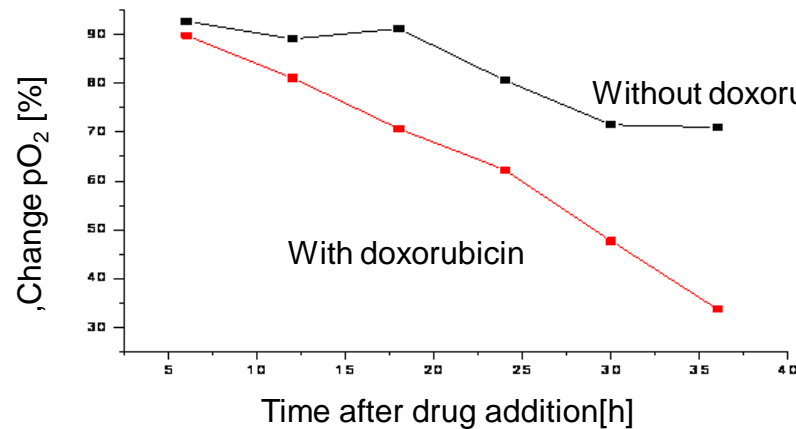
IMOLA software for data analysis
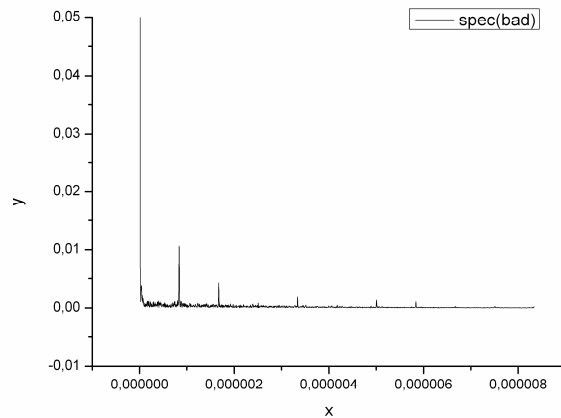
a) Fourier transformation of data

b) Filter on 1. Maxima

c) Retransformation to time domain

d) Linear regression

e) Standardization

f) Arrangement in groups

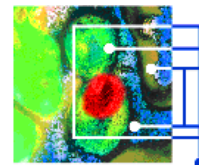g) Arithmetic mean and standard deviation

h) t-test

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Linear regression vs. FFT

Effect of CAA toward MCF-7

Legend:
- 17-FFT
- 17-LR
- 19-FFT
- 19-LR
- 21-FFT
- 21-LR

Y-axis: FFT / LR
X-axis: Time

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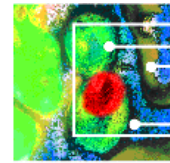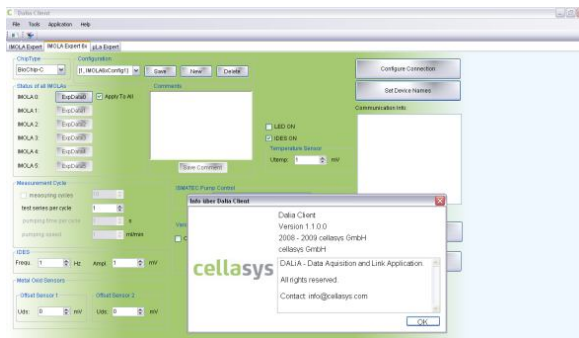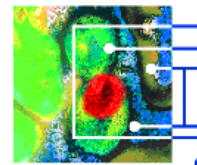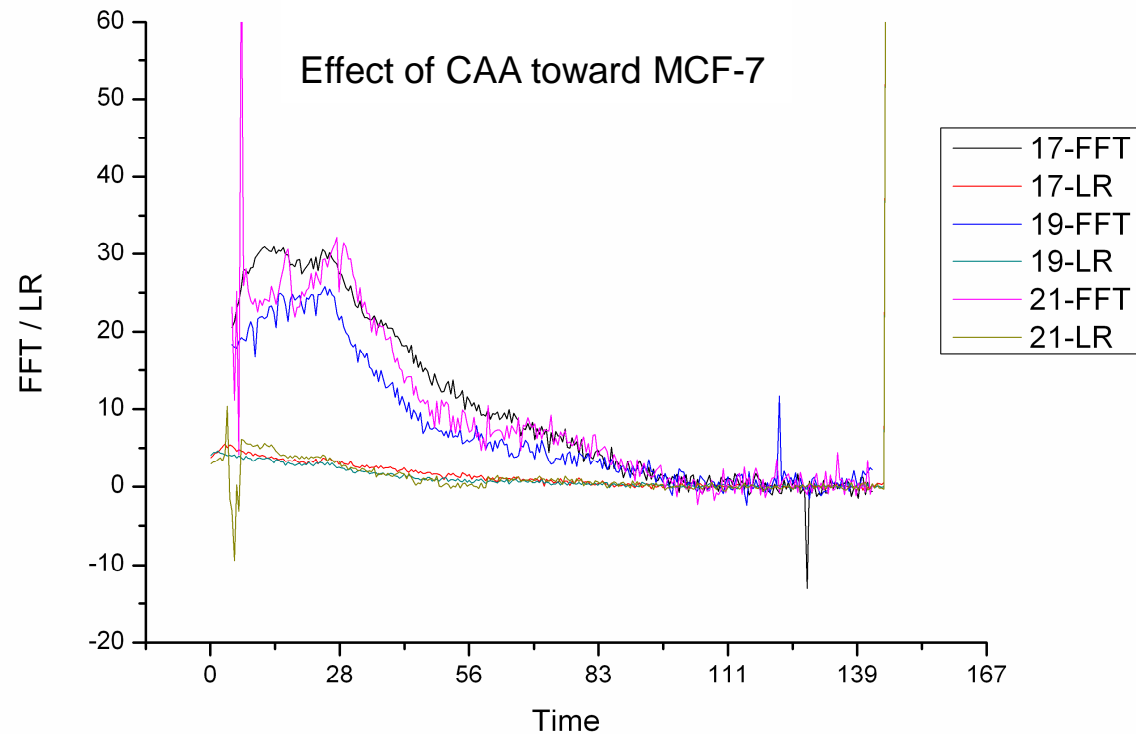
Summary I – Investigated cells

Type	Name	Description
Cell suspension	Yeast	Baker's yeast
Cell suspension	Escherrichia coli	Bacteria
Cell suspension	Chromera velia	Micro-algae
Cell suspension	Chlorella kessleri	Algae
Monolayer	MCF-7, MDA, HeLa, Caco-2, HepG2, PANC-1, K562, BxPC3	Human cancer cell lines
Monolayer	L929, 3T3	Mouse fibroblasts
Monolayer	CHO	Hamster ovary
Monolayer	Primary cells	Mouse neuron cells

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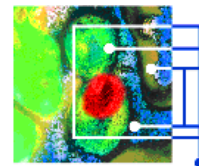
Summary II – Investigated cells

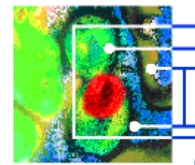| Type	Name	Description
Tissue / 3D	Primary cells	Mouse liver
Tissue / 3D	Primary cells	Sheep pancreas
Tissue / 3D	Primary cells	Human breast cancer
Tissue / 3D	Primary cells	Human laryngeal cancer
Tissue / 3D	Spheroids	Rat liver
Special – Serial culture	HepG2 → MCF7	Serial connection of HepG2 (sender) and MCF7 (receiver) cells
Special - Coating	Primary human hepatocytes	Coating of BioChip with collagen

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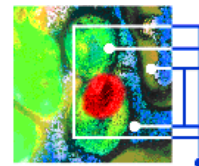
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Team

Thanks to the team of the Heinz Nixdorf-Lehrstuhl für Medizinische Elektronik

Further information:

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