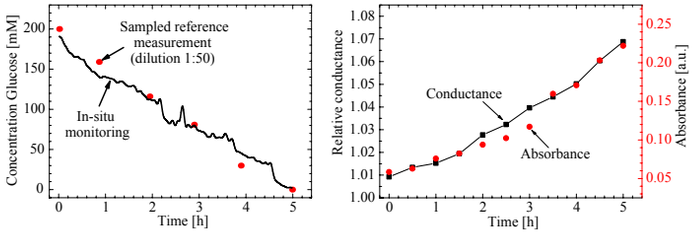

BIOHYBRID SYSTEMS

The Fraunhofer IMS is at the cutting edge of MEMS, nano, and biosensor technology, which combines traditional CMOS technology with innovative post-processed bio and nanostructures.

In the last decade, the semiconductor technology has been seeing a new trend, called »More than Moore«, where added values to silicon-based devices are provided by incorporating new functionalities.

The ability to interface biological elements and silicon-based devices offers the opportunity to propose fully integrated solutions for biosensors. Biohybrid systems – i.e. BioMEMS and BioCMOS, microfabrication and microelectronic technologies suitable for biological applications – have great potential for miniaturized biosensors, microchip arrays or portable Point-of-Care Testing (POCT) applications.

- Customized biosensor systems (e.g. glucose, lactate)
- Markerless and quantitative sensor technology
- Real-time monitoring in body fluid
- Customized electrochemical sensor technology
- Immuno sensor technology
- Application specific packages and tests

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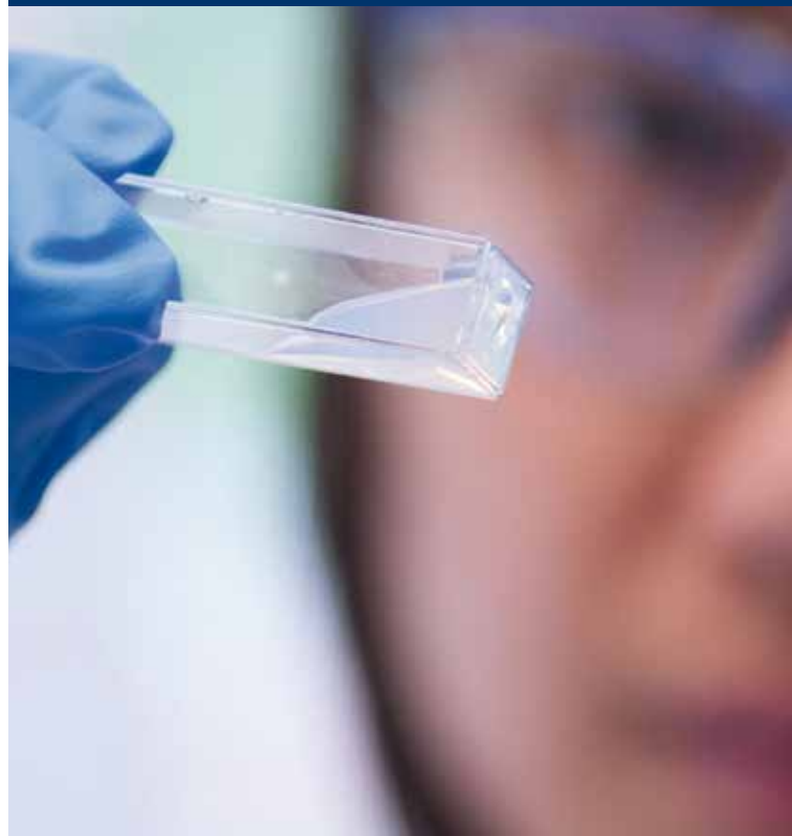
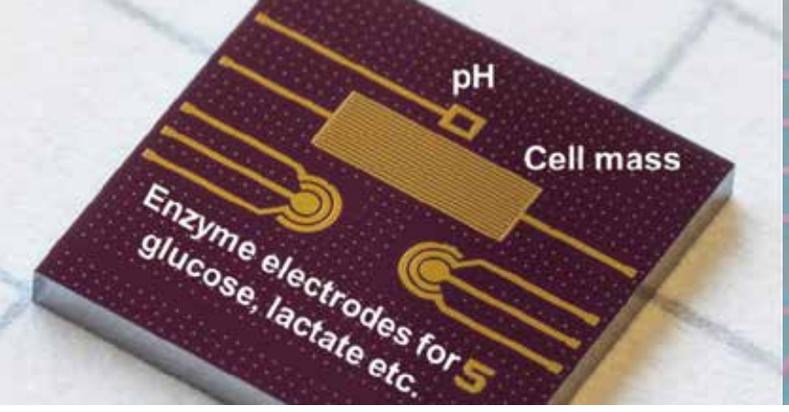
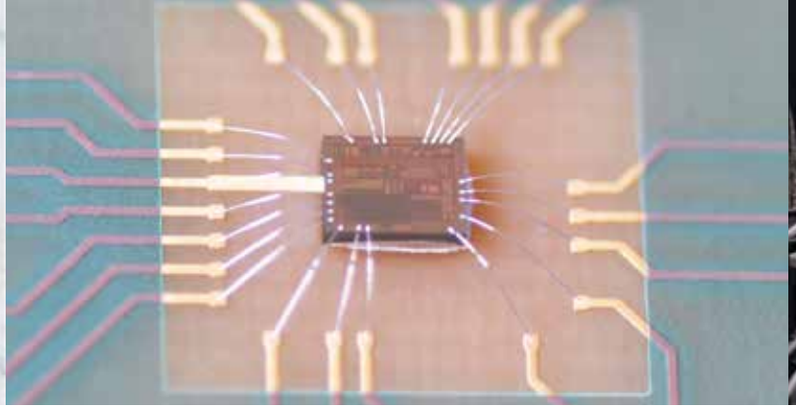
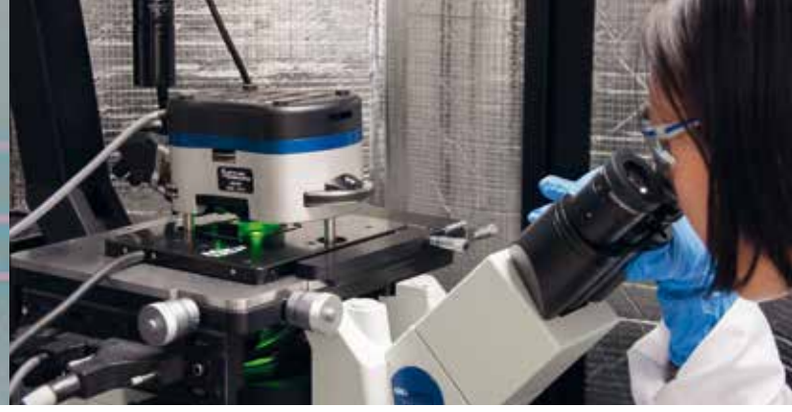
BIOPROCESS MONITORING









MULTI SENSOR SYSTEMS

In biotechnological production, the precise and continuous measurement of process parameters can significantly enhance production control and efficiency. Parameters of interest include glucose, lactate, cell density, pressure and pH but also therapeutic proteins such as cytokines and interferons. The monitoring of multiple parameters directly inside the bioreactor allows immediate control of the bioprocess with a cost-effective setup.

The Biohybrid Systems group at the Fraunhofer IMS develops multi sensor systems for the monitoring and automation of bioprocesses. Multiple sensors are integrated on one chip, bringing economic, small-sized and easy to handle systems on the market. The multi sensor chips are sterilized and introduced into the bioreactor, enabling the in-situ monitoring of bioprocesses.

Highlights of the developed sensors include enzymatic glucose sensors with a wide linear measurement range up to 200 mM and single use cell density sensors. All sensors are designed for single use applications and perfectly fit the growing market of single use bioreactors.

We are looking forward to meeting your needs for the in-situ monitoring of bioprocesses.

NANO POTENTIOSTAT

High performance biosensors need reliable and precise electronics for control and read out. For amperometric sensors, the Fraunhofer IMS has developed a nano potentiostat circuit. It is designed to be used with a three electrode configuration in which it keeps the working electrode at a defined potential relative to a reference electrode. Through a third counter electrode a current is delivered which maintains the potential between reference and working electrode.
The nano potentiostat has a wide redox current range from 100 nA to 100 µA, allowing operation of different kinds of sensors, electrodes and analyte solutions. With its small chip size of 2.5 mm x 3.4 mm, it fits into a large variety of sensor housings and setups. Thanks to an integrated SPI interface, connectivity via USB can be easily realized using a converter circuit.
Together with the nano potentiostat, a transponder chip is offered for wireless transmission of the sensor signal, making user-friendly sensor solutions possible.

Parameter	**Value**
Power Supply	2.6 V
Operating Temperature	10 °C - 50 °C
Pol. Voltage	0 - 2.4 V
Redox Current Analog Mode	100 nA - 100 µA
Power Consumption	300 µW @ 2.6 V
Resolution ADC	13 Bit
Chip Size	2.5 mm x 3.4 mm
Pins	22

LAB CAPABILITIES

The equipment available in the Biohybrid Systems laboratory enables the integration of biological elements on compatible surfaces, e.g. metals, oxides, silicon, glass, carbon nanotubes (CNTs), graphene. It includes:

- UV-Vis and fluorescence spectroscopy (absorption, excitation, emission spectra)
- Dynamic Light Scattering
- Zeta-potential measurement
- Contact angle measurement
- AFM, optimized for operation in water and biological samples
- Optical microscopy (bright field, fluorescence)
- Surface Plasmon Resonance
- Electrochemistry and Impedance Spectroscopy
- Nano-Dispenser