

# Oxygen Microsensors

# O<sub>2</sub>



Sensor tip thinner than a hair ( $< 50 \mu\text{m}$ )  
Integrate & measure on-the-spot

- Profiling of biofilms and sediments
- Insertion in plant and animal tissue
- Micro-respiration systems
- Micro-invasive measurement in packages

# Oxygen Microsensors



Needle-type oxygen microsensors are miniaturized chemical optical oxygen sensors designed for all research and packaging applications where a small tip size ( $< 50 \mu\text{m}$ ) and fast response time ( $t_{90} < 3 \text{ s}$ ) are necessary. The optical oxygen microsensors are based on  $140 \mu\text{m}$  and  $230 \mu\text{m}$  silica fiber and are available with sensor tip diameters from  $< 50 \mu\text{m}$  to  $230 \mu\text{m}$ . The oxygen microsensors are mounted in different housings (needle-type housing, implantable) and offer a unique research tool for investigating systems where micro-invasive and small sensors are needed.

## Features

- High spatial resolution ( $< 50 \mu\text{m}$ )
- High temporal resolution ( $t_{90} < 3 \text{ s}$ )
- Measurement range from 3 ppb up to 15 ppb dissolved oxygen
- No consumption of oxygen
- Signal independent of flow velocity
- Measures oxygen in liquids as well as in gas phase

## Needle-Type Oxygen Microsensors

Needle-type oxygen microsensors are perfectly suited for measuring oxygen distribution profiles in sediment and biofilms with a high spatial resolution of less than  $50 \mu\text{m}$ . The oxygen-sensitive tip of an optical fiber is protected inside a stainless steel needle. This design is optimal for easy penetration of tissue, septum rubber or packaging materials. After penetration the sensor tip is extended for measurement.



## Implantable Oxygen Microsensor

Implantable probes are the miniaturized fiber optic oxygen sensors designed for various customized applications. The tiny probe has a tip size of  $< 50 \mu\text{m}$  to  $230 \mu\text{m}$  while the outer diameter ranges from  $140 \mu\text{m}$  to  $900 \mu\text{m}$ .

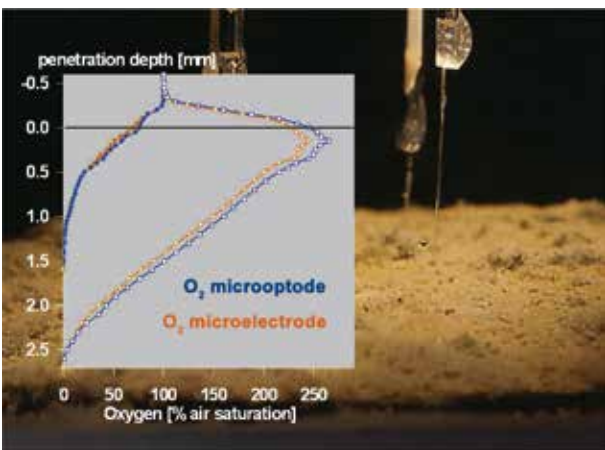
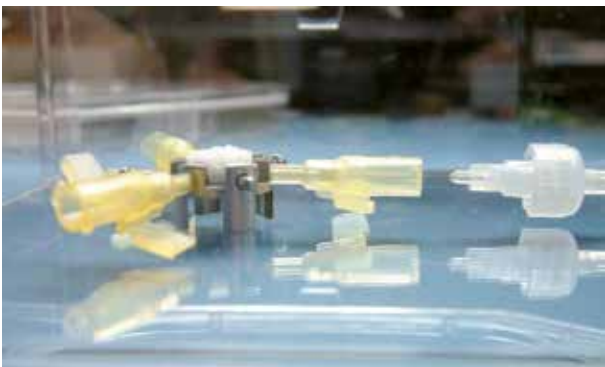
The microsensor tip is not mounted in any additional housing. The bare glass fiber tip can be mounted to your own housings, steel tubes and micro respirometer chambers etc. The small outer diameter even allows insertion into implantable Venlon-tubes. Moreover the microsensor can be deployed in sealed containers to measure the oxygen content directly.

## Sensor Designs and Customization

Further microsensor designs are available, like e. g. microsensors integrated in a metal flow-through cell (FTCM) for oxygen monitoring in perfusion systems inside smallest volumes, or needle-type housings with fixed oxygen microsensor (NFS). These oxygen microsensors are solutions for special applications. If your application requires a customized oxygen microsensor design contact our service team!



# Oxygen Microsensors



## Examples for Applications

### Packaging & Quality Control

Oxygen inside packaging can lead to oxidative deterioration of certain products. Therefore, determination of the oxygen content within packages or pharmaceutical vials is of essential importance to ensure both the filling quality and the long-term storage stability. With our micro-invasive needle-type oxygen microsensors we offer a simple tool to determine residual oxygen both in the headspace and in liquids. The septum of the vial or package is pierced with the needle and the sensor is extended for measurement. As the measurement is made inside the package no error-prone and time consuming sampling is necessary. These oxygen microsensors are ideal tools for quality control in the food & beverage, packaging, and pharmaceutical industries.

### Tissue Engineering

Oxygen microsensors measure the oxygen content in various volume compartments of the tissue engineering constructs. To do so, hair-thin sensors are inserted into the constructs and the oxygen content is measured online. In this way, the oxygen partial pressure is measured with a high local resolution and correlated with the constructs tissue quality (composition of the extracellular matrix).

### Profiling: Profile Measurements in Sediment and Tissue

Due to the extraordinary high local resolution ( $< 50 \mu\text{m}$ ) our oxygen microsensors are ideally suited for recording microprofiles e.g. in sea-floor sediments, biofilms, plant physiology and human physiology. On the left you see oxygen profiles of a marine sediment populated with photosynthetically active microorganisms, measured in dark (closed symbols) and under strong illumination (open symbols). The measurement was performed simultaneously with an optical oxygen microsensor (blue) and a Clark-type micro-electrode (yellow). Both sensing tips have a distance of approx.  $50 \mu\text{m}$ .

Is your application missing?  
Contact us and we will find your  
customized solution!

# Oxygen Microsensors

Specifications	Normal Oxygen Range		Trace Oxygen Range	
	Gaseous & Dissolved Oxygen	Dissolved Oxygen	Gaseous & Dissolved Oxygen	Dissolved Oxygen
Measurement range	0 – 100 % O <sub>2</sub> 0 – 1000 hPa	0 – 45 mg/L 0 – 1400 µmol/L	0 – 10 % O <sub>2</sub> 0 – 100 hPa	0 – 4.5 mg/L 0 – 140 µmol/L
Limit of detection	0.03 % oxygen	15 ppb	0.007 % oxygen	3 ppb
Resolution	± 0.01 % O <sub>2</sub> at 1 % O <sub>2</sub> ± 0.05 % O <sub>2</sub> at 20.9 % O <sub>2</sub>	± 0.005 mg/L at 0.4 mg/L ± 0.025 mg/L at 9.0 mg/L	± 0.002 % O <sub>2</sub> at 0.008 % O <sub>2</sub> ± 0.006 % O <sub>2</sub> at 2.5 % O <sub>2</sub>	± 0.7 ppb at 3 ppb ± 2.5 ppb at 1000 ppb
Accuracy	± 0.05 % O <sub>2</sub> or < 3 % rel.		± 3 ppb or < 3 % rel.	
Measurement temperature range	0 – 50 °C			
Response time (t <sub>90</sub> )	< 3 sec. (gas)	< 10 sec. (liquid)	< 3 sec. (gas)	< 10 sec. (liquid)
<b>Properties</b>				
Compatibility	Aqueous solutions, ethanol, methanol			
No cross-sensitivity with	pH 1 – 14 CO <sub>2</sub> , H <sub>2</sub> S, SO <sub>2</sub> Ionic species			
Cross-sensitivity to	Organic solvents, such as acetone, toluene, chloroform or methylene chloride Chlorine gas			
Sterilization procedures	Steam sterilization Ethylene oxide (EtO)			
Cleaning procedures	3 % H <sub>2</sub> O <sub>2</sub> , ethanol, soap solution			
Calibration	Two-point calibration in oxygen-free environment (nitrogen, sodium sulphite) and air-saturated environment		Two-point calibration in oxygen-free environment (nitrogen) and a second calibration value optimally between 1 and 2 % oxygen	
Storage stability	5 years provided the sensor material is stored in the dark at room temperature (20 °C +/- 5 °C)			

## Transmitters & Accessories



**Microx 4 / Microx 4 trace**  
Stand-alone fiber optic oxygen transmitter



**OXY-10 micro**  
10-channel micro fiber optic oxygen transmitter for use with oxygen microsensors.



**OXY-4 micro**  
4-channel micro fiber optic oxygen transmitter for use with oxygen microsensors.