Oxygen Microsensors

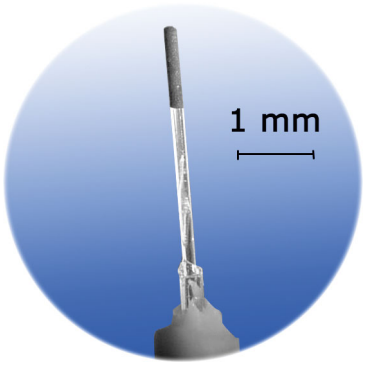
Sensor tip thinner than a hair (< 50 µm)

Integrate & measure on-the-spot

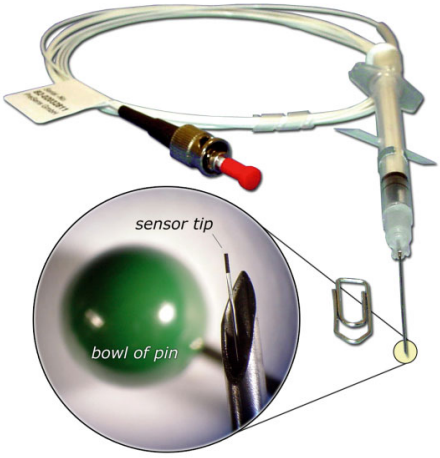
- Profiling of biofilms and sediments
- Insertion in plant and animal tissue
- Micro-respiration systems
- Micro-invasive measurement in packages

PreSens
PRECISION SENSING

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 µm) and fast response time (t_{90} < 1s) are necessary. The optical oxygen microsensors are based on a 140 µm silica fiber and are available with two different sensor tip diameters, a < 50 µm tapered tip and a 140 µm flat-broken tip. The oxygen micro-sensors are mounted in different housings (needle-type housing, implantable) and offer a unique research tool for investigating systems where micro-invasive, small and robust sensors are needed.

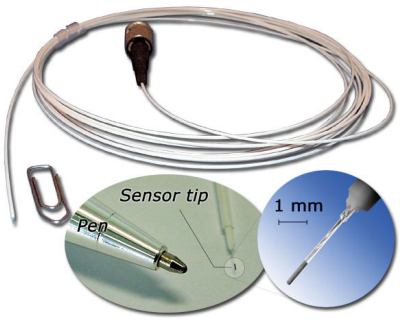


Features

- High spatial resolution (< 50 µm)
- High temporal resolution (t_{90} < 1s)
- Measurement range from 1 ppb up to 22.5 ppm dissolved oxygen
- No consumption of oxygen
- Signal independent on flow velocity
- Measures oxygen in liquids as well as in gas phase

Needle-type Oxygen Microsensors

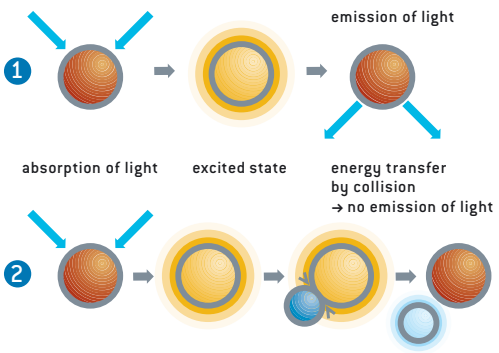
Needle-type oxygen microsensors are perfectly suited for measuring oxygen distribution profiles in sediment and biofilms with a high spatial resolution of less than 50 µm. The oxygen-sensitive tip of an optical fiber is protected inside a stainless steel needle. This design is optimal for easy penetration 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 from < 50 µm (TS) to 140 µm (TF) while the outer diameter ranges from 140 µm to 900 µm.

The micro-sensor 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. It can be deployed in sealed containers to measure the oxygen content directly.



The Smart Measurement Method

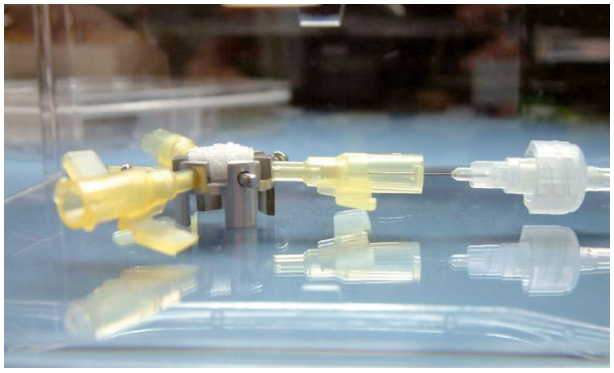
The light from the blue LED excites the sensor spot to emit fluorescence. If the sensor tip encounters an oxygen molecule, the excess energy is transferred to the oxygen molecule in a non-radiative transfer, decreasing or quenching the fluorescence signal. The degree of quenching correlates to the partial pressure of oxygen in the matrix, which is in dynamic equilibrium with oxygen in the sample. The decay time measurement is internally referenced.

Oxygen Microsensors

Examples for Applications

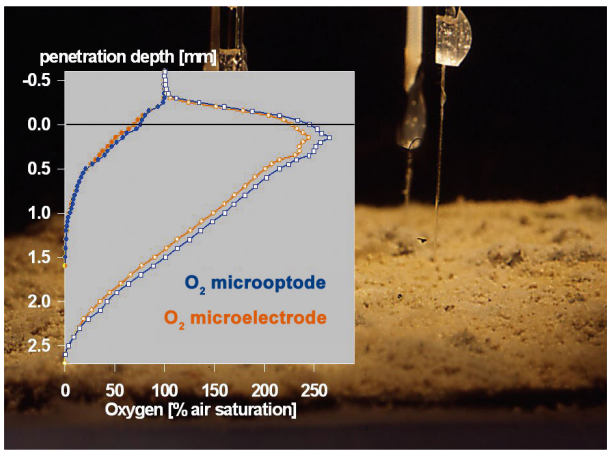
Oxygen Concentration of Small Headspace Packages

The 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 both the headspace and dissolved oxygen. 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 sampling is necessary.



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 µm) our oxygen microsensors are ideal 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 µm.

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

Oxygen Microsensors

	Sensor type PSt1		Sensor type TOS7	
Specifications	**Gaseous & Dissolved Oxygen**	**Dissolved Oxygen**	**Gaseous & Dissolved Oxygen**	**Dissolved Oxygen**
Measurement range	0 – 50 % O_2 0 – 500 hPa	0 – 22.5 mg/L 0 – 700 µmol	0 – 3 % O_2 0 – 28.8 hPa	0 – 1.1 mg/L 0 – 34.5 µmol
Limit of detection	0.05 % oxygen	20 ppb	0.002 % oxygen	1 ppb
Resolution	± 0.01 % O_2 at 0.21 % O_2 ± 0.09 % O_2 at 20.9 % O_2 ± 0.1 hPa at 2 hPa ± 0.87 hPa at 207 hPa	± 0.005 mg/L at 0.09 mg/L ± 0.04 mg/L at 9.06 mg/L ± 0.14 µmol at 2.83 µmol ± 1.3 µmol at 283 µmol	± 0.0009 % O_2 at 0.002 % O_2 ± 0.001 % O_2 at 0.02 % O_2 ± 0.010 hPa at 0.23 hPa ± 0.015 hPa at 2.0 hPa	± 0.4 ppb at 10 ppb ± 0.63 ppb at 200 ppb ± 0.013 µmol at 0.31 µmol ± 0.020 µmol at 6.20 µmol
Accuracy	± 0.4 % O_2 at 20.9 % O_2 ± 0.05% O_2 at 0.2 % O_2		± 1 ppb or ± 5 % of the respective concentration whichever is higher	
Drift at 0 % oxygen	< 0.1 % O_2 within 30 days (sampling interval of 1 min)		< 10 ppb within 30 days (sampling interval of 1 min)	
Measurement temperature range	0 – 50 °C		0 – 50 °C	
Response time TS* (t_{90})	< 1 s (gas)	< 2 s (liquid)	not available	
Response time TF** (t_{90})	< 15 s (gas)	< 30 s (liquid)	< 15 s (gas)	< 30 s (liquid)
Properties				
Compatibility	Aqueous solutions, ethanol, methanol			
No cross-sensitivity with	pH 1 – 14 CO_2, H_2S, SO_2 Ionic species			
Cross-sensitivity to	Organic solvents, such as acetone, toluene, chloroform or methylene chloride Chlorine gas			
Sterilization procedures	Steam sterilization (only implantable & TF** sensor) Ethylene oxide (EtO)			
Cleaning procedures	3 % H_2O_2, ethanol, soap solution			
Calibration	Two-point calibration with 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)			

*TS: tapered sensor tip with a diameter < 50 µm and no optical isolation

**TF: flat-broken sensor tip with a diameter of 140 µm

Transmitters & Accessories

Microx TX3
Single channel, temperature compensated oxygen meter for use with oxygen microsensors

OXY-10 micro
10-channel oxygen meter for use with oxygen microsensors

OXY-4 micro
4-channel oxygen meter for use with oxygen microsensors

LP-1 - LCD Control Panel
The LP-1 control panel is the device for controlling PreSens single-channel oxygen transmitters without the need to connect them to a PC