Oxytherm+

Liquid-phase oxygen electrode system for photosynthesis & respiration studies

Hansatech Instruments

Oxytherm+

Liquid-phase oxygen electrode system for photosynthesis & respiration studies

- > PC operated electrode control unit with USB connectivity
- > Advanced electronic electrode chamber with solid-state Peltier temperature control between 3 - 40°C
- > Oxytherm+ Photosynthesis version fitted with automated white LED light source up to 4,000µmols m^{-2} s^{-1}
- > Suitable for liquid-phase samples between 0.2 - 2.5ml with 0 – 100% oxygen concentration
- > 24 bit high resolution measurement of oxygen signals
- > Integral systems for measurement of pH & other ion-selective electrode (ISE) signals with 16 bit resolution
- > Onboard LCD readings of oxygen signal, auxiliary & ISE signals & chember temperature
- > 8 channel capability via purchase of additional systems
- > OxyTrace+ Windows® software for data acquisition, hardware control & data analysis
- > Real time 0 – 4.5v analogue output of oxygen signal

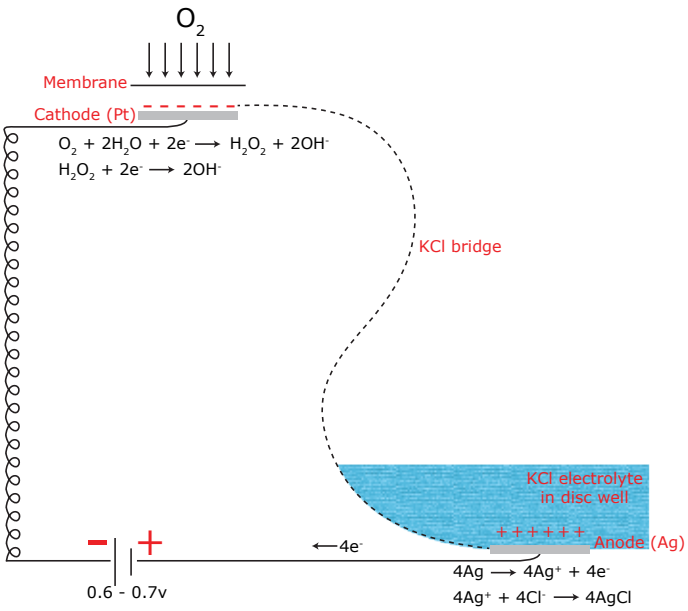
Oxytherm+ electrode control unit

The next generation Oxytherm+ oxygen electrode control unit combines striking aesthetics with enhanced features and functionality offering significant advances in flexibility and performance over previous generations of electrode control unit. As a complete system, Oxytherm+ provides a convenient yet powerful tool for measurements of oxygen evolution or uptake across a broad range of liquid-phase samples from chloroplast extractions to mitochondrial suspensions with oxygen concentrations up to 100%.

Oxytherm+ offers unrivalled price vs. performance combining simplicity of operation with an enviable feature set. The outstanding flexibility ensures Oxytherm+ is equally useful in both a teaching and research capacity. 24 bit resolution allows detection of minute changes in oxygen tension without needing to apply instrument gain. This results in beautiful, noise free traces even when zoomed close in on areas of interest. Integral electronics provide precision sample and sensor temperature control via an advanced electronic electrode chamber between 3 - 40°C.

The system allows realtime graphing of signals from auxiliary inputs and ion-selective electrodes providing scope for comprehensive analysis of oxygen activity simultaneously with signals such as pH, TPP+, calcium, potassium and hydrogen ions. Signals from all inputs are additionally displayed on an LCD screen mounted within the front panel of the Oxytherm+ control unit.

Up to 8 individual Oxytherm+ control units may be linked to a single PC and operated simultaneously from OxyTrace+ software providing a powerful, multi-channel system.



Oxygen electrode disc

Since its original design in the early 1970's by Tom Delieu and David Walker, the S1 Clark Type Oxygen Electrode disc remains largely unchanged – a true testament to the quality and reliability of the sensor. The S1 consists of a platinum cathode and silver anode set into an epoxy resin disc and is prepared for use by trapping a layer of 50% saturated KCl solution beneath an oxygen permeable PTFE membrane. A paper spacer placed beneath the membrane acts as a wick to provide a uniform layer of electrolyte between anode and cathode.

When a small voltage is applied across these electrodes (with the platinum negative with respect to the silver), the current which flows is at first negligible and the platinum becomes polarised (i.e. it adopts the externally applied potential). As this potential is increased to 700 mV, oxygen is reduced at the platinum surface, initially to hydrogen peroxide H_2O_2 so that the polarity tends to discharge as electrons are donated to oxygen (which acts as an electron acceptor). The current which then flows is stoichiometrically related to the oxygen consumed at the cathode providing a fast, effective method of detecting small changes in oxygen tension in a liquid-phase sample.

Oxytherm+ electrode chamber

Oxytherm+ is supplied in 2 versions; Oxytherm+R (Respiration) and Oxytherm+P (Photosynthesis). Each version is fitted with an advanced electronic oxygen electrode chamber with a specific feature sets to suit the intended purpose.

Both versions offer precision sample and sensor temperature control between 3 - 40°C via an integral Peltier element. Chamber temperature is configured from within the OxyTrace+ Windows software with actual chamber temperature indicated on an LCD display mounted on the front panel of the Oxytherm+ electrode chamber. A tricolour LED indicates if the chamber is cooling (blue), heating (red) or at set temperature (green).

The reaction vessel of the Oxytherm+ electrode chamber is constructed from precision bore borosilicate glass tube with a prepared S1 electrode disc forming the floor of the reaction vessel. The vessel is contained within an insulated block which is fitted with a Peltier element and a large heat sink. This combination allows Oxytherm+ to deliver precise, effective temperature control of sample and sensor without the requirement for a thermoregulated circulating water bath. Temperatures may be configured via OxyTrace+ software in 0.1°C increments anywhere between 3 - 40°C.

The Oxytherm+ electrode chamber is fitted with a plunger with a central bore. The height of the plunger may be adjusted easily to suit liquid-phase sample volumes of between 0.2 - 2.5ml whilst the central bore easily accommodates Hamilton type syringes allowing additions/subtractions to/from the reaction vessel during an experiment. An optical port in the front of the chamber provides maximum visibility of the entire height of the reaction vessel allowing the plunger height to be easily adjusted to the correct height.

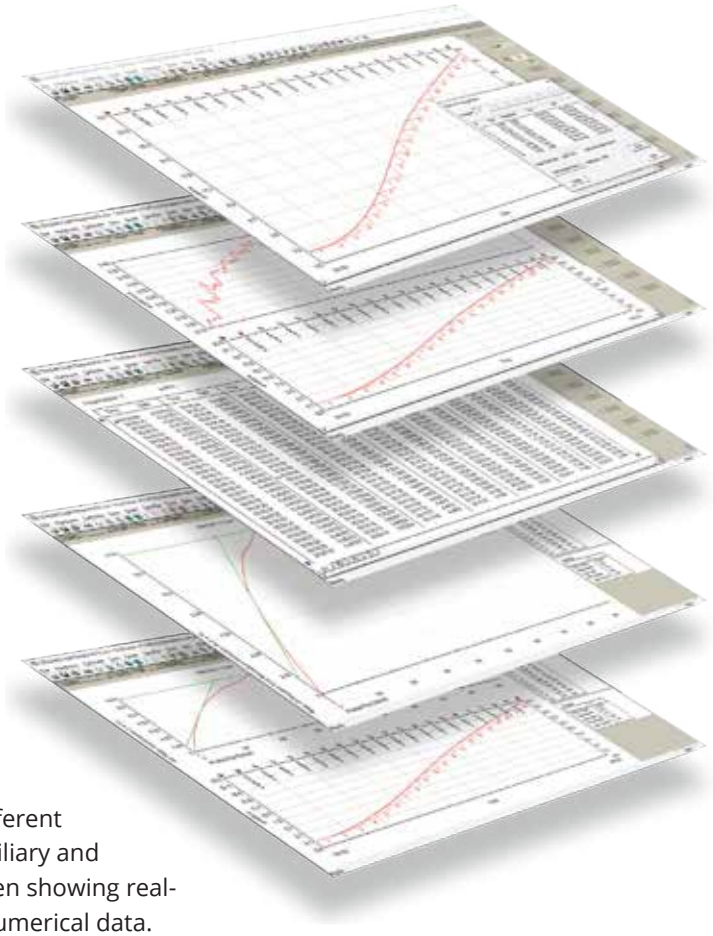
Oxytherm+R is perfectly suited to measurements of cellular respiration with it's predecessor used widely all over the world in measurements of mitochondrial respiration. Oxytherm+R is fitted with a gas-tight version of the plunger.

The Oxytherm+P has additional functionality to provide optimum suitability for photosynthesis studies. 2 high intensity white LED light sources are mounted against the outer wall of the reaction vessel. This provides uniform illumination of samples between 1 and 2ml in volume up to 4,000µmols m^{-2} s^{-1}.

PFD light tables consisting of up to 20 individual light steps may be configured within the OxyTrace+ software for automatic execution during an experiment. Additional analysis tools are available within the software to automatically calculate quantum yield based on the measured rates of change during each light step.

A sliding shutter plate allows the sample to be placed in full dark conditions for dark respiration measurement phases.

OxyTrace+ software



OxyTrace+ is a multi-function Windows® program supplied with Oxytherm+ for system configuration, calibration, data acquisition and analysis.

An automated 2 step calibration routine guides the user quickly and effectively through the system calibration process using electrode values measured from air-saturated and deoxygenated water.

For Oxyther+P systems, OxyTrace+ allows simple configuration of comprehensive PFD tables consisting of up to 20 individual light steps. Light intensity adjustments are performed automatically during the measurement. OxyTrace+ also allows calibration of the Oxytherm+P light source from a simple software routine. This requires the QTP1 PAR/temperature sensor to be connected to the rear of the Oxytherm+ control unit and placed into the reaction vessel prior to the addition of any liquids.

A tabbed interface allows a simple transition between the different data views including oxygen electrode (and if configured, auxiliary and external ion-selective electrode) real-time output, a split screen showing real-time rate of change above the oxygen signal and tabulated numerical data.

Post acquisition analysis tools allow automatic calculation of oxygen rates from user-defined rate intervals. For Oxytherm+P systems, additional analysis tools automatically calculate rates of change for defined PFD light steps with a calculation of quantum yield presented at the end of a measurement. All files are saved as Comma Separated Values (CSV) data files opening effortlessly in external data processing packages such as MS Excel®.

OxyTrace+ will run on all supported Microsoft operating systems.

System components

Oxytherm+ systems are supplied with the following components:

Oxytherm+R

- OXYT1+R: Oxytherm+ electrode control unit with Respiration Peltier electrode chamber
- S1: Oxygen electrode disc and SMB-SMB connection cable
- A2: Membrane applicator to assist with smooth application of electrode membrane
- S2/P: Pack of 5 magnetic followers
- S3: Pack of 2 replacement borosilicate glass reaction vessels
- S4: PTFE membrane (0.0125mm x 25mm x 33m)
- S7C: Set of replacement o-rings for electrode chamber
- S16: Cleaning kit for the S1 electrode disc.

Oxytherm+P

- OXYT1+R: Oxytherm+ electrode control unit with Photosynthesis Peltier electrode chamber
- S1: Oxygen electrode disc and SMB-SMB connection cable
- QTP1: Light/temperature probe sensor for calibration of LED light source with mounting collar
- A2: Membrane applicator to assist with smooth application of electrode membrane
- S2/P: Pack of 5 magnetic followers
- S3: Pack of 2 replacement borosilicate glass reaction vessels
- S4: PTFE membrane (0.0125mm x 25mm x 33m)
- S7C: Set of replacement o-rings for electrode chamber
- S16: Cleaning kit for the S1 electrode disc.

Technical specifications

Oxytherm+ electrode control unit

Measuring range:	Oxygen: 0 - 100%, pH: 0 - 14pH, Aux: 0 - 4.096V
Signal inputs:	S1 O_2 electrode (SMB), pH/ISE (BNC), Aux (8 pin Mini Din), QTP1 PAR/Temp probe (6 pin Mini Din)
Resolution:	Oxygen: 0.0003% (24 bit), pH: 0.0006pH (16 bit), Aux: 62.5µV/bit (16 bit)
Polarising voltage:	700mV
Input sensitivity:	0 - 9000nA
Magnetic stirrer:	Software controlled 150 - 900rpm in % steps
Sampling rate:	0.1 - 10 readings/s
Electronics:	Microcontroller: 16 bit high performance CPU running at 32 MHz ADC: Dual, Low power, 16/24 Bit Sigma Delta
Display:	61 x 2 character blue LCD
Communications:	USB2.0
Analogue output:	0 - 4.5V O_2 signal
Dimensions (HWD):	250 x 125 x 65mm
Weight:	0.63 Kg
Power:	95 - 260V universal input mains supply. Output 12V DC 2.5A

S1 oxygen electrode disc

Electrode type:	Clark type polarographic oxygen sensor
Electrode output:	Typically 1.6µA at 21% O_2
Residual current:	Typically 0.04µA in 0% O_2
Response time:	10 - 90% typically < 5 seconds
Oxygen consumption:	Typically <0.015µmol/hr^{-1}

Oxytherm+R electrode chamber

Suitability:	Liquid-phase respiration
Temp range:	3 - 40°C (25°C ambient)
Response time:	<10 min, accuracy: +/- 0.5°C
Sample chamber:	Precision bore, borosilicate glass tube
Sample volume:	0.2-2.5ml
Plunger:	Variable height gas-tight plunger with central bore
Optical ports:	Front viewing window
Dimensions:	132 x 100 x 90mm
Weight:	0.65Kg

Oxytherm+P electrode chamber

Suitability:	Liquid-phase photosynthesis
Temp range:	3 - 40°C (25°C ambient)
Response time:	<10 min, accuracy: +/- 0.5°C
Sample chamber:	Precision bore, borosilicate glass tube
Light source:	2 x white LED
Max. intensity:	4,000 µmols m^{-2} s^{-1}
Light control:	Automated adjustment via PFD table configuration in OxyTrace+ software
Sample volume:	0.2-2.5ml (1 - 2ml if sample illumination is required)
Plunger:	Variable height plunger with central bore
Optical ports:	Front viewing window with sliding shutter plate
Dimensions:	132 x 100 x 90mm
Weight:	0.66Kg

Hansatech Instruments is a British company that has been developing high quality scientific instrumentation for over 40 years. Our systems are used widely for teaching & research in cellular respiration & photosynthesis programs in more than 100 countries throughout the world. We have gained an enviable reputation for quality, reliability & excellent price/performance.

Our product range consists of a range of modular solutions for the measurement of oxygen using Clark type polarographic sensors. We also develop chlorophyll fluorescence measurement systems using both continuous excitation & pulse-modulated measurement techniques with further optical instrumentation for the measurement of sample chlorophyll content.

Purchasers of Hansatech Instruments products can be assured of ongoing support & prompt & efficient attention to enquiries at all times. Support is available both directly & from our global distributor network. Customers are encouraged to register their instruments on our website which allows access to our Support Ticketing System in addition to instruments manuals & software upgrades.

Hansatech Instruments Ltd
Narborough Road, Pentney, King's Lynn, Norfolk PE32 1JL, UK
Tel: +44 (0)1760 338877 Fax: +44 (0)1760 337303
info@hansatech-instruments.com
www.hansatech-instruments.com

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