Low vibration variable temperature cryostat, sample in exchange gas

The OptistatSXM provides a controlled low temperature sample environment, in which the sample is cooled by a dynamic exchange gas fed from an integral liquid helium reservoir. The OptistatSXM is designed to operate as part of a wide range of measurement systems. This cryostat is ideal for experiments requiring low levels of vibration, electrical and/or optical access, fast sample change and a low base temperature (1.6K).

Components

A typical OptistatSXM system consists of:

- OptistatSXM
- Sample rod
- Sample holder
- Windows
- ITC temperature controller
- Gas flow pump
- High vacuum pumping system
- Cryogen transfer tube

Optional items:

- Wiring and electrical connections to the sample

Features and benefits:

- 1.6 – 300 K temperature range
- Low vibration design for applications requiring high levels of mechanical stability including Scanning probe Microscopy (SPM), Near-field Scanning Optical Microscopy (NSOM), Scanning Tunneling Microscopy (STM) and Atomic Force Microscopy(AFM)
- The exchange gas sample environment allows fast change times for high sample throughput
- Generous optical access for sensitive light collection measurements (f/2.2 for the radial windows)
- Large sample space enables the integration of user-built or commercially available probe heads for a wide range of atomic scale microscopy applications
- Compact design for use on optical tables
- Efficient cryogenic design provides the convenience of consistent low temperature operation over a working day
- Excellent control and stability of the sample temperature enabled using the dynamic exchange gas principle
- An extensive range of demountable windows for spectroscopy from near ultraviolet to extreme infrared provides flexibility for current and future applications

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An example of application for the OptistatSXM

An Optistat SXM in the 'Spectrométrie Physique' laboratory (Grenoble University/ CNRS/CEA) is used to produce single photons from individual semiconductor quantum dots. Single photons are used in quantum information processing such as quantum cryptography.

Mode of operation

The cryostat contains an integral liquid helium reservoir, a variable temperature insert (VTI) and radiation shields cooled by the evaporating helium. In the OptistatSXM, the sample is in a dynamic exchange gas environment, this means the cryogen flows into the sample space, thereby cooling the sample directly.

Liquid helium is supplied from the reservoir to the VTI through a needle valve, allowing the flow to be optimised to suit the operating requirements. A heat exchanger at the bottom of the sample space is fitted with a heater and thermometer, so that the temperature of the helium flowing through the sample space can be controlled by a temperature controller. This helium then flows over the sample and out of the cryostat to a small vacuum pump, which is used to promote the flow and obtain temperatures below 4.2K. The sample is mounted on a sample rod and loaded into the cryostat through a NW50 flange.

Changing the sample simply involves removing the sample rod, maintaining overpressure of the exchange gas, replacing the sample and inserting the rod back into the cryostat. There is no need to break the insulating vacuum and warm the cryostat up. The resulting sample change times are very short, typically a few minutes.

1.6 K base temperature achievable

This can be achieved either in continuous flow or in single shot mode, using a large displacement pump (typically 25 m3/hr). In single shot mode, the sample space is filled with liquid helium and pumped enabling a base temperature of 1.6K. Base temperature will be maintained until all the liquid helium in the sample space has evaporated.

Low vibration design

The cryostat is designed to use the exhausting helium gas from the helium reservoir to cool the radiation shielding, thereby minimising the helium consumption. This eliminates the need for a nitrogen reservoir to cool the radiation shielding, which would be a source of vibration due to the boil off of liquid nitrogen. The low vibration design enables sensitive measurements such as SPM, NSOM, STM and AFM to be performed with the Optistat SXM.

Optical access

Up to five sets of windows can be provided (four radial; one axial). As standard, two of the radial windows are fitted with Spectrosil B windows and the remaining windows fitted with blanks. Each set includes three windows (indium sealed inner window, radiation shield and outer vacuum case window). All windows are demountable and may be exchanged at a later date for measurements over different regions of the optical spectrum. Oxford Instruments offers an extensive range of window materials permitting spectroscopic measurements from ultra violet to extreme infrared. We can also provide 'wedge' (non-parallel faces) windows and anti-reflection coatings, to limit the reflection of windows.

Electrical access

For electrical measurements, wires may be terminated at pins above the sample holder and/or on wired coax connectors. This provides maximum flexibility for different experimental configurations. Please contact us to discuss particular requirements.

Automated operation

If the cryostat is fitted with an auto needle valve, the ITC503 temperature controller can be used to optimise the helium flow rate automatically and allow automation over most of the operating temperature range.

Oxford Instruments Object Bench software included with the ITC temperature controller provides the opportunity to automate data acquisition. The PC software takes measurements from any independent instrument (with computer interface) at different user-defined temperatures.

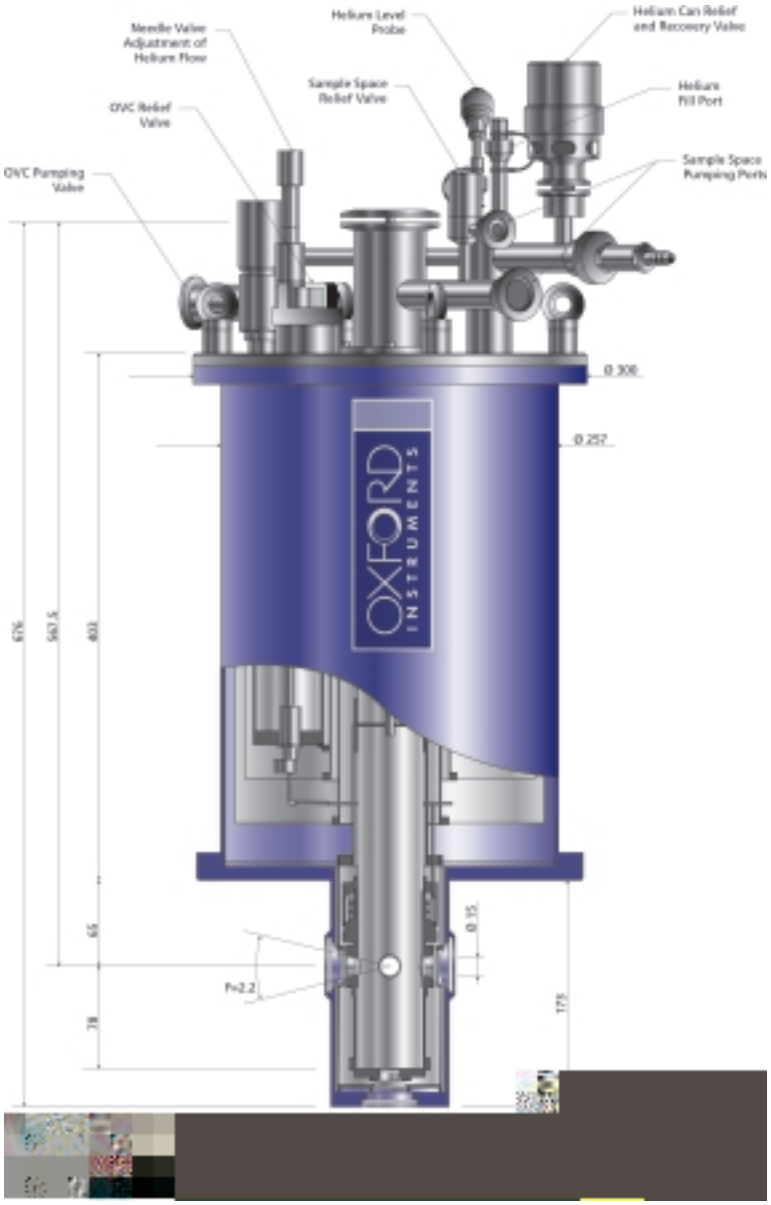
This is an ideal configuration for routine measurement programmes.

Helium level control

The helium level in the integral bath can be monitored via a helium level probe connected to a helium level meter (ILM 210). This option can be supplied on request.

Other configurations

Please contact us to discuss options to meet specific experimental configurations that may not be satisfied by our standard options.



The OptistatSXM cryostat

System components

Cryostat basic components:

OPTISXM	Optistat SXM bath cryostat, dynamic 49 mm sample space
SRSXM	Sample rod
SHSXM	Optical sample holder for Optistat SXM

Transfer tubes

OPTITTN2F	Short cryostat leg flexible helium transfer tube

Window options:

O(QI QM QO)	Spec B window set
O(WI WM WO)	Spec WF window set
O(ZQI ZQM ZQO)	Z-cut Quartz window set.
O(SI SM SO)	Sapphire window set
O(MI MM MO)	Mylar window set
O(AI AM AO)	Aluminised Mylar window set
O(PI PM PO)	Polythene window set
O(KI KM KO)	KRS5 window set
O(ZI ZM ZO)	Zinc selenide window set
O(PPI PPM PPO)	Polypropylene window set

Notes: Windows are quoted per set'. A set comprises one inner window, one radiation shield window and one outer window. As standard, two of the radial windows are fitted with Spectrosil B windows, and the remaining windows fitted with blanks. Alternative window materials can be fitted on request. Orientation of window sets should be specified at time of order.

Electrical connections:

LX10	Wired 10 pin seal
CX1	Wired miniature coax connector
TSR	Wired RhFe sensor

Temperature controller options:

ITC 503	Temperature controller (Upgradable to 3 channels, RS232 and GPIB computer interface)
CC1	3m cryostat cable- 10 pin connector.
SCI	Three channel upgrade interface for ITC503
HCB	Heater control board

Pumps:

GF4	Gas flow pump
EPS40	40m³/hr helium pumping system (for lower base temperature)
HVP	High vacuum pumping station (to pump the Outer vacuum can)

Other options:

ILM210	Single liquid helium level meter and probe
EXSKSXM	Extended spares kit (Orings, clamps …)
SV10	Storage vessel adaptor

Specifications

Sample space diameter (mm)	49 mm
Temperature range(K)	4.2-300K(with GF4 pump) 1.6-300K (with EPS40 pump)
Temperature stability(K)	+- 0.1K using an ITC controller (measured over 10 min period)
Liquid helium reservoir capacity (L)	4L
Hold time at 4.2K (hours)	>= 10
Sample change time (mins)	5
Optical access	f/2.2 for radial windows

Oxford Instruments Superconductivity

UK
Tubney Woods, Abingdon
Oxfordshire OX13 5QX
Tel: +44 (0)1865 393 200
Fax: +44 (0)1865 393 333

China
Rm. 14-F, No.1 Plaza
No.800 Nanjing East Road
Shanghai 200001
Tel: +86 21 63608530/1/2/3
Fax: +86 21 63608535

Germany
Otto-von Guericke Ring 10
D-65205 Wiesbaden
Tel: +49 6122 937 171
Fax: +49 6122 937 175

Italy
Via Leone Tolstoi 86
20098 San Giuliano
Milanese
Milan
Tel: +39 02 98 2215
Fax: +39 02 98 2414

Japan
Haseman Building
2-11-6 Tomioka, Koto-ku
Tokyo 135-0047
Tel: +81 03 5245 3261
Fax: +81 03 5245 4472

Spain
Avda Mata Piñonera, 2
28700 San Sebastian de los Reyes
Madrid
Tel: +34 91 659 0740
Fax: +34 91 654 6794

U.S.A.
130A Baker Ave. Ext.
Concord, MA 01742-2121
Tel: +1 978 369 9933
Fax: +1 978 369 6616

E-mail:
superconductivity@oxinst.co.uk

Visit our web site at
www.oxford-instruments.com

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