



Continuous helium flow cryostat, sample in exchange gas

The OptistatCF is a continuous helium flow cryostat, providing a controlled low temperature exchange gas environment for samples. It is designed to operate as an integral part of an optical measurement system. This cryostat is ideal for experiments requiring high sample throughput and for samples which are difficult to cool by conduction.

Components

A typical OptistatCF system consists of:

- OptistatCF helium cryostat
- Sample holder and rod
- Windows
- Cryogen transfer tube
- ITC temperature controller
- High vacuum pumping system
- Helium dewar

Optional items:

- Gas flow pump
- Gas flow controller
- Automated transfer tube
- Wiring and electrical connections to the sample
- Simple height adjust/ rotate sample rod
- Precision height adjust / rotate sample rod
- Liquid cuvette

Features and Benefits

- 2.3K to 300K temperature range. 500 K option available
- Sample in exchange gas allows quick sample change for high sample throughput
- Superb optical access (f/1) for measurements requiring light collection
- Optimised clear beam throughput (15mm diameter aperture) allows a large illumination area for measurements involving the detection of low intensity light
- Can be operated in different cryogen transfer modes
- Very low helium consumption (less than 0.55L/Hr at 4.2K using a LLT transfer tube!)
- Optimised thermal design provides excellent control and stability of the sample temperature
- A wide range of sample holders and rods is available increasing the cryostat flexibility
- An extensive range of demountable windows for spectroscopy from near ultraviolet to extreme infrared provides flexibility for current and future applications
- The compact design of the OptistatCF makes it straightforward to integrate with a wide range of spectrometers
- The cryostat can also be run with liquid nitrogen achieving a base temperature of 77K
- The cryostat can be operated in any orientation



Example of application for the OptistatCF

Dr Handong Sun from the Institute of Photonics (Glasgow) is using the OptistatCF to perform experiments of photoluminescence (PL) and PL excitation (PLE) spectra from 5K to 300K on dilute nitrides of III-V semiconductors and related nanostructures. The aim is to elucidate the electronic states and PL mechanisms in this novel material system.

Mode of operation

The OptistatCF works on the continuous flow principle. Liquid cryogen is transferred from a separate helium or nitrogen dewar and circulated through a transfer tube to the heat exchanger of the cryostat. The cryogen flow is regulated by a needle valve on the transfer tube.

Precise temperature control is obtained using an ITC temperature controller to drive a heater located near the sample holder, sample temperature being measured using a rhodium iron temperature sensor.

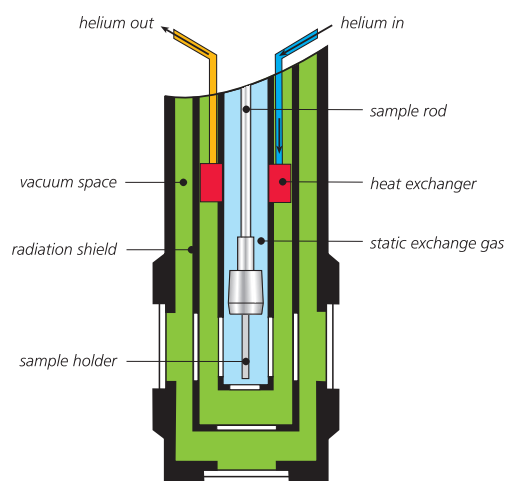
Two OptistatCF models are available. In static exchange gas versions, the circulating cryogen does not come into contact with the sample. The heat exchanger is in good thermal contact with the sample space which contains an independent exchange gas (usually helium). The sample is cooled by conduction through the exchange gas. This is usually the preferred option because in this version there is no liquid in the optical beam path.

In dynamic versions, temperature stabilised cryogen flows into the exchange gas space cooling the sample directly. This version is recommended for large low conductivity samples or when large heat loads are applied to the sample. Also the cryostat can be used in single shot mode. The sample space is then filled with helium and pumped enabling a base temperature of 1.6K for approximately 20 minutes. (using an EPS 40 pump).

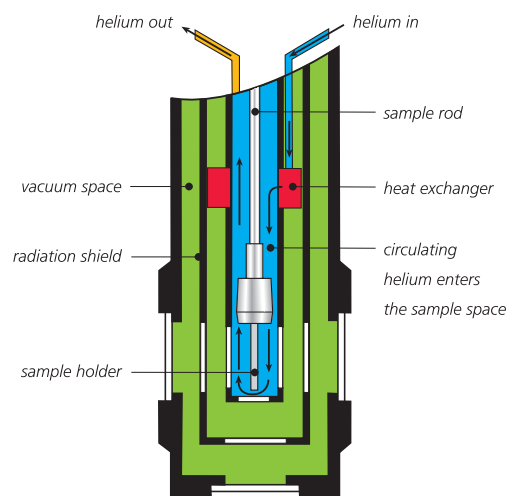
Changing the sample simply involves removing the sample rod, maintaining overpressure of the exchange gas, replacing the sample and inserting the rod back into the cryostat. There is no need to break the insulating vacuum and warm the cryostat up. The resulting sample change times are very short, typically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

High temperature option

Both static and dynamic versions offer an option to go up to 500K. However in that case the inner window must be sapphire sealed with a copper gasket. This must be specified at time of order.



Static exchange gas sample space

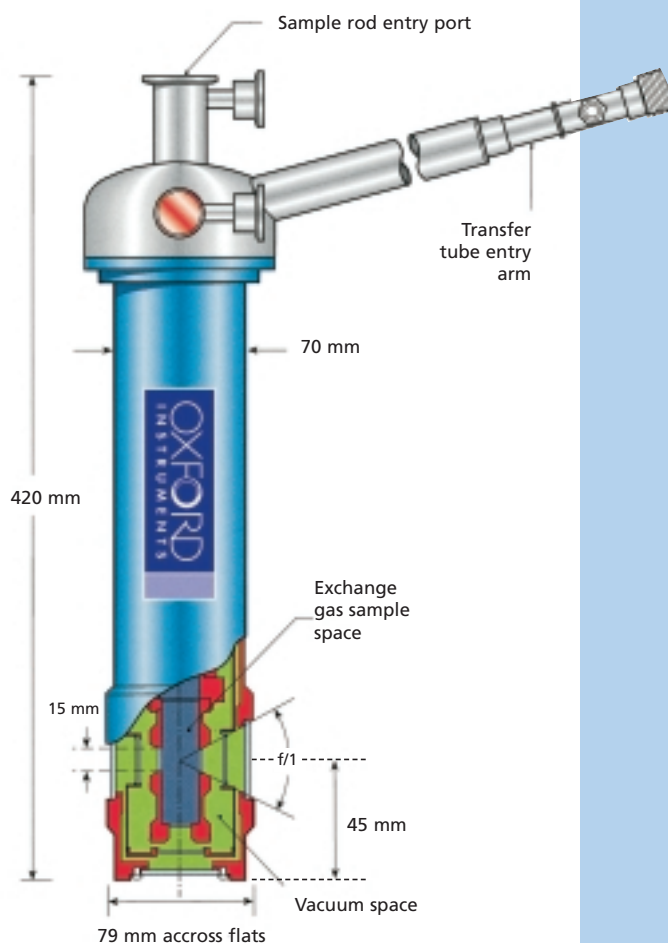


Dynamic exchange gas sample space

Optical access:

The OptistatCF has excellent optical access ($f/1$). The large acceptance angle makes it ideal for light collection measurements (for example in luminescence and Raman studies). The large clear access (15mm diameter in transmission) is important for small signal measurements that benefit from a large illumination area (for example in FTIR and UV/Visible absorption spectroscopy).

Up to five sets of windows can be provided (four radial; one axial). Each set includes three windows (inner, radiation shield and outer case windows). 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 ultraviolet to extreme infrared. We can also provide 'wedge' (non-parallel faces) windows and anti-reflection coatings, to limit the reflection of windows.



OptistatCF cryostat

'Push' or 'Pull' mode operation

The OptistatCF can be operated either in 'push' or 'pull' operating mode. In the 'pull' mode operation, a gas flow pump is used to pull the helium from the storage dewar to the sample compartment. The advantage is that the storage dewar pressure does not need to be monitored (since it remains at 1 atmosphere), the cryostat can reach a lower base temperature and the helium flow stability is improved.

In the 'push' mode operation, the flow of liquid helium is generated by pressurising the storage dewar. The advantage is that the need for a gas flow pump is removed thus saving cost and eliminating the noise and vibration generated by the pump.

Automated operation

Automated operation of the OptistatCF is possible with the LLT 650/13 automatic transfer tube. This, coupled with the advanced features of the ITC temperature controllers, allows fully automated control across the entire 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.

Transfer tube options

Low loss transfer tube(LLT) for minimum helium consumption

In continuous flow cryostats, the transfer tube is in constant use and its performance contributes to the overall helium consumption of the cryostat system and the base temperature capability. Oxford Instruments Low loss transfer tubes (LLT) use the cold gas exiting the cryostat to cool the shields surrounding the incoming liquid within the transfer tube, and therefore minimise the consumption of helium to less than 0.55 L/hour at 4.2K.

-Low cost helium and nitrogen transfer tube:

A lower cost helium transfer tube (TTL200) that does not operate using the gas-cooled mechanism is available on request. This transfer tube provides an alternative in situations where budget is limited. However the cryostat helium consumption, in that case, is higher depending on the sample temperature required.

For applications requiring only nitrogen temperatures in the range of 77K base temperature, a low cost nitrogen transfer tube can be provided on request.

- Special transfer tube:

If our standard range of transfer tubes doesn't meet your requirements, please contact us to discuss. We can offer transfer tube options which suit typical optical bench mounting arrangements.

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. Contact your local sales representative for special requirements.



Wiring to the sample holder

Wide range of options for sample holders and rods:

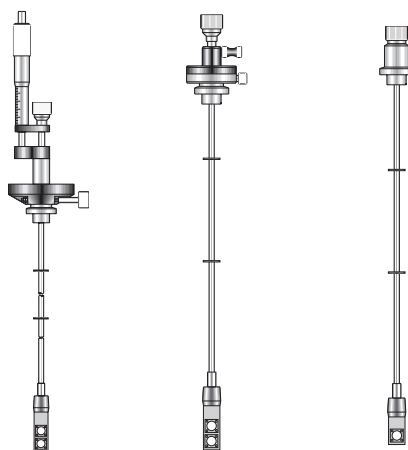
If your experiment requires a precise position of your sample, there are two sample rod options.

The *simple height adjust and rotate sample rod* provides sliding adjustment with locking screws to hold a fixed position. The range of vertical motion is 32 mm. Positioning accuracy is 0.5 mm (height) and 1 °(rotation).

The *precision height and adjust rotate sample rod* provides height adjust with a resolution of 10 µm and a goniometer for setting the rotation angle with a resolution of 12 minutes.

Both sample rods are supplied fitted with a double sample holder making them ideal for reference measurements.

The OptistatCF also enables experiments on liquid samples. In that case the sample is placed in a quartz cuvette which is in turn placed inside a cell holder, directly screwed onto the bottom of the sample rod.



Precision height adjust and rotate sample rod

Simple height adjust and rotate sample rod

Standard sample rod

Other configurations

Please contact us to discuss options to meet specific experimental configurations that may not be satisfied by our standard options. For instance, a special 49 mm diameter sample space OptistatCF can be supplied on request.

System components

Cryostat basic components:

OPTI	OptistatCF, static, 20 mm sample space
or OPTID	OptistatCF, dynamic, 20 mm sample space.
SR	Sample rod
SH3	Optical sample holder
or SH1	Plain sample holder

High temperature option:

OPTICFHT	OptistatCF, static, 20 mm sample space, 500 K
OPTICFDHT	OptistatCF, dynamic, 20 mm sample space, 500 K

Sample holder and rod options:

SH7	Cuvette holder
CV	Quartz cuvette
OPTIHTR	Simple height adjust/rotate
OPTIHTRPS	Precision height adjust/rotate

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(HI QM QO)	500K sapphire / Spec B 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: A set comprises one inner window, one radiation shield window and one outer window.

Windows are quoted 'per set'. Blanks will be fitted to ports which are not fitted with windows. Orientation of window sets should be specified at time of order.

Electrical connections:

LX10	Wired 10 pin seal
CX1	Wired miniature coax connector

Cryogen Transfer tube options:

For minimum helium consumption:

LLT600/13	Low loss flexible gas shielded transfer tube
LLT650/13	Automated low loss flexible gas shielded transfer tube

Low cost option:

TTL200	Flexible transfer tube
NSA	Nitrogen side arm

Temperature controller options:

ITC 601RHFE	Temperature controller (One channel, RS232 Computer interface)
ITC 503	Temperature controller (Upgradable to 3 channels, RS232 and GPIB computer interface)
CC1	3m cryostat cable- 10 pin connector.

Pumps:

GF4	Gas flow pump
EPS40	40 m ³ /hr helium pumping system (for lower base temperature)
HVP	High vacuum pumping station (to pump the outer vacuum can)

Other options:

HD 30	30 litre helium dewar
SV12	Storage vessel adaptor
SKCF	Spares kit (Orings, clamps, ...)
VC31	Gas flow controller with helium flowmeter
VC41	Gas flow controller with helium and nitrogen flowmeters

Specifications

	Optistat CF static version used in 'pull' mode	Optistat CF static version used in 'push' mode	Optistat CF dynamic version used in 'pull' mode	Optistat CF dynamic version used in 'push' mode
Temperature range	3.4-300 K with GF4 pump 2.3-300 K with EPS40 pump 500 K as an option	4.2-300 K 500 K as an option	3.4-300 K with GF4 pump 2.3-300 K with EPS40 pump 1.6-300 K in single shot 500 K as an option	4.2-300 K 500 K as an option
Temperature stability (K)	+/- 0.1K (measured over 10 min period)			
Maximum sample space available	20mm diameter			
Sample holder dimensions (mm)	19mm wide x 30mm long (Optical sample holder version has a 15mm aperture)			
Cool down from ambient to 4.2 K (mins)	25 (35 mins for the 500 K option)			
Cool down helium consumption from ambient to 4.2 K (l)	1.5			
Helium consumption at 4.2 K (L/hr) (see note 1)	<0.55 (using LLT600/13)			
Sample change time (mins)	5			
Cryostat weight (kg)	3.7			

Notes:

1. All specifications refer to the base model cryostat with 2 sets of Spectrosil B windows used with an LLT transfer tube and an ITC controller.

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