Continuous helium flow cryostat, sample in vacuum

The OptistatCF-V is a continuous helium flow cryostat providing a controlled low temperature vacuum environment for samples, designed to operate as an integral part of an optical measurement system. This cryostat is ideal for experiments requiring a large sample space and a minimum number of windows in the optical beam path thus reducing reflective losses.

Components

A typical OptistatCF-V system consists of

- OptistatCF-V helium cryostat
- Sample holder
- 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

Features and benefits:

- Wide temperature range from 3.2 K to 500 K
- Superb optical access (f/0.9) for measurements requiring light collection
- Optimised clear beam throughput (23 mm diameter aperture) allows a large illumination area for measurements involving the detection of low intensity light
- Large sample space enabling studies of samples with a wide range of size and geometry
- Can be operated in different cryogen transfer modes and in any orientation
- Very low helium consumption (less than 0.45 L/Hr at 4.2 K using a LLT transfer tube!)
- Optimised thermal design provides excellent control and stability of the sample temperature
- An extensive range of demountable windows for spectroscopy from near ultraviolet to extreme infrared provides flexibility for current and future applications
- No cold windows enabling the use of any window material above 300 K
- Demountable radiation shield windows to maximise transmission intensity
- The compact design of the OptistatCF-V makes it straightforward to integrate with a wide range of spectrometers
- The heat exchanger sub assembly is compatible with the MicrostatHe and the MicrostatHe Rectangular tail. This provides further upgrade options to adapt the unit for additional applications
- The cryostat can also be run with liquid nitrogen achieving a base temperature of 77 K

Mode of operation

The OptistatCF-V 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. The sample is positioned on the sample holder in good thermal contact with the heat exchanger and surrounded by a vacuum. To change the sample, the cryostat is warmed to room temperature, the vacuum released and the outer case and radiation shield removed.

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Example of application for the OpistatCF-V

Dr Martin Kemerink and Mr Hans Gommans at the university of Eindhoven (Netherlands) are using the OptistatCF-V to conduct I-V characterisation and admittance spectroscopy on plastic solar cells. More specifically, their aim is to determine the electron and hole mobilities in these condensed organic blends at various temperatures in order to pinpoint the physical origin of conduction.

Optical access:

The OptistatCF-V has excellent optical access (f/0.9). The large acceptance angle makes it ideal for light collection measurements (for example in luminescence and Raman studies). The large clear access (23 mm diameter) is important for small signal measurements that benefit from a large illumination area (for example in FTIR and UV/Visible absorption spectroscopy).

The windows in the radiation shield are demountable. Removal of these windows minimises reflective losses. This is an important consideration for applications involving low intensity optical signals.

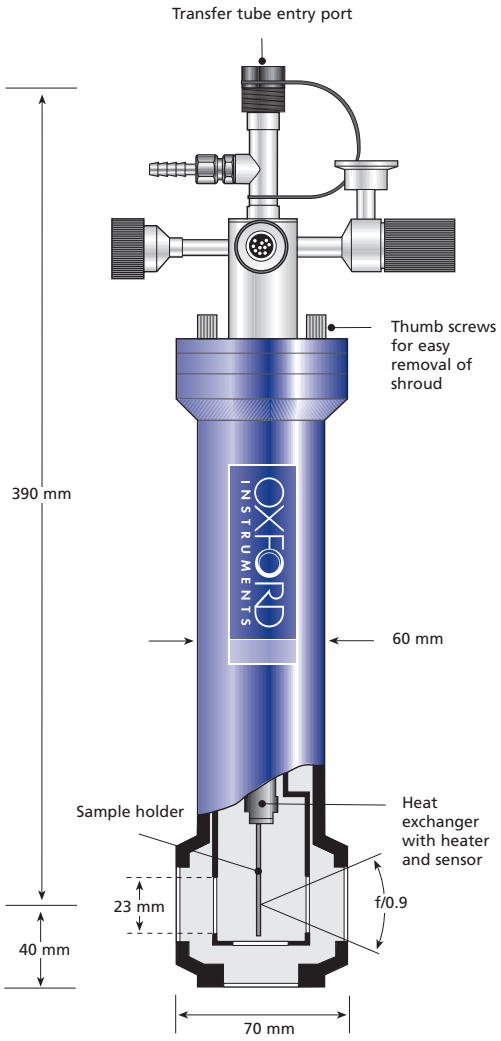
Up to five sets of windows can be provided (four radial; one radial). Each set includes two windows (one on the radiation shield and one on the outer vacuum can).

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 intensive wide range of window materials permitting spectroscopic measurements from ultra violet to extreme infrared (including THz applications). We can also provide 'wedge' (non-parallel faces) windows and anti-reflection coatings, to limit the reflection of windows.

'Push' or 'Pull' mode operation

The OptistatCF-V can be operated both 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 one 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.



The OptistatCF-V

Automated operation

Automated operation of the OptistatCF-V is possible with the LLT750/13 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 0.45 L/hour at 4.2 K.

- Low cost nitrogen transfer tube:

For applications requiring mainly nitrogen temperatures in the range of 77 K 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.

Experimental flexibility

The heat exchanger sub-assembly of the OptistatCF-V is compatible with the tail of the MicrostatHe and MicrostatHe rectangular tail. These tails can be purchased at a later date thus expanding the versatility of the system for other applications such as Microscopy (requiring small working distance between microscope objective lens and sample) and Magneto-optical Kerr effect (requiring a small outer dimension cryostat which can fit between the poles of an electromagnet.)

Other configurations

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

From left to right: Interchangeable MicrostatHe tail, cold unit fitted with the MicrostatHe radiation shield, MicrostatHe Rectangular tail, OptistatCF-V radiation shield and OptistatCF-V tail.

System components

Cryostat basic components:

COLDUNIT	Cooling unit
CFVTAIL	Tail set for OptistatCF-V
VH2	Optical sample holder or
VH1	Plain sample holder

Windows options:

O(QM QO)	Spec B window set
O(WM WO)	Spec WF window set
O(ZQM ZQO)	Z-cut Quartz window set.
O(SM SO)	Sapphire window set
O(MM MO)	Mylar window set
O(AM AO)	Aluminised mylar window set
O(PM PO)	Polythene window set
O(KM KO)	KRS5 window set
O(ZM ZO)	Zinc selenide window set
O(PPM PPO)	Polypropylene window set

Note: A set comprises 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:

LLT700/13	Low loss flexible gas shielded transfer tube (for vertical cryostat operation)
LLT600/13	Low loss flexible gas shielded transfer tube (for horizontal cryostat operation)
LLT750/13	Automated low loss flexible gas shielded transfer tube (for vertical cryostat operation)
NSA	Nitrogen side arm

Temperature controllers options:

ITC601RHFE	Temperature controller (One channel, RS232 Computer interface)
ITC503	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 m3/hr helium pumping system(for lower base temperature)
HVP	High vacuum pumping station (to pump the outer vacuum can)

Other options:

HD30	30 litre helium dewar
SV12	Storage vessel adaptor
SKCFV	Spares kit (Orings, clamps …)
VC31	Gas flow controller with helium flowmeter
VC41	Gas flow controller with helium and nitrogen flowmeter

Cryostat Tail options:

MICROTAIL	Tail set for MicrostatHe
MICRORTAIL	MicrostatHe Rectangular Tail

Specifications

	OptistatCFV used in 'pull' mode	Optistat CFV used in 'push' mode
Temperature range	3.2-500 K with GF4 pump 2.3-500 K with EPS40 pump	4.2- 500 K
Sample holder dimensions	20 mm wide x 50 mm long (optical sample holder version has a 12.5 mm aperture)	
Maximum sample space (space within radiation shield)	30mm wide x 58mm long	
Temperature stability (K)	+/- 0.1K (measured over 10 min period)	
Cool down from ambient to 4.2 K(mins)	10	
Cool down helium consumption from ambient to 4.2 K (l)	<1.3	
Helium consumption at 4.2 K (l/hr) (see note 1)	<0.45	
Sample change time (mins)	60	
Cryostat weight (kg)	2	

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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