Sample in liquid ^{3}He refrigerator

The HelioxTL top-loading system employs the latest enhancement to our ^{3}He technology. One of the crucial parameters of a top-loading system is the room height required to remove or insert an experimental probe. The HelioxTL top-loading ^{3}He insert is exceptionally compact and fits within both our standard or extended length dewars. Minimum room height requirements are 3.7 m and 4.1 m, although with a specially designed dewar and insert, the top loading room height may be reduced to approximately 3 m.

Features and Benefits

- Top loading into the mixture – ensuring good sample thermalisation and high stability of the thermal environment.
- Multi-service access – provides a unique platform that can be used with a range of sample probes, such as Swedish rotators and high frequency coaxial lines.
- Multi-technique access – highly suitable for multi-user facilities
- Quick and simple sample change – no need to remove the ^{3}He during sample change, giving quicker turnaround times and reducing the risk of leaks.
- Seamless integration – with Oxford Instruments Superconductivity magnet technology

Components

The HelioxTL consists of:

- An insert - including the sorb, the 1 K pot and the ^{3}He pot (Figure 1)
- A probe or combination of probes (experimental access and wiring)
- External ^{3}He dump

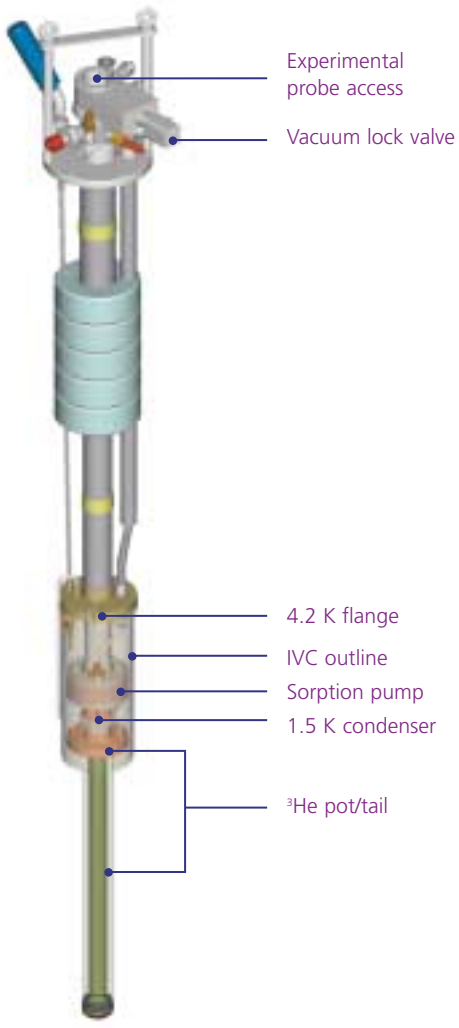

Figure 1: The HelioxTL system

OXFORD INSTRUMENTS

Operation

The sample is mounted onto the top-loading probe and inserted directly into the ^{3}He liquid through the central access of the insert (Figure 2). A vacuum lock allows the sample to be inserted and withdrawn without loss of ^{3}He or entry of air into the sample space.

When the probe has been inserted, the sorb is warmed to over 30 K. This re-condenses the ^{3}He gas on the 1 K pot assembly which runs down to cool the sample. At this stage the sample is surrounded by ^{3}He liquid at approximately 1.2 K. The sorb is then cooled, and it begins to reduce the vapour pressure above the liquid ^{3}He to decrease the sample temperature. The minimum temperature possible in this type of refrigerator is approximately 250 mK with no experimental heat load.

Performance

The top-loading insert offers an outstanding base temperature of below 260 mK for typically more than 50 hours whilst still sustaining high cooling power performance. Over 400 µW of heat load may be applied to the mixing chamber yet still maintain a base temperature of less than 300 mK. Typical regeneration time is approximately 50 minutes.

Several temperature sensors are fitted. These include a carbon resistor on the sorption pump and RuO_2 sensors at the 1 K stage and on the ^{3}He pot. A Cernox™ sensor is also fitted on the ^{3}He pot for high temperature options, where the temperature range is extended up to 80 K.

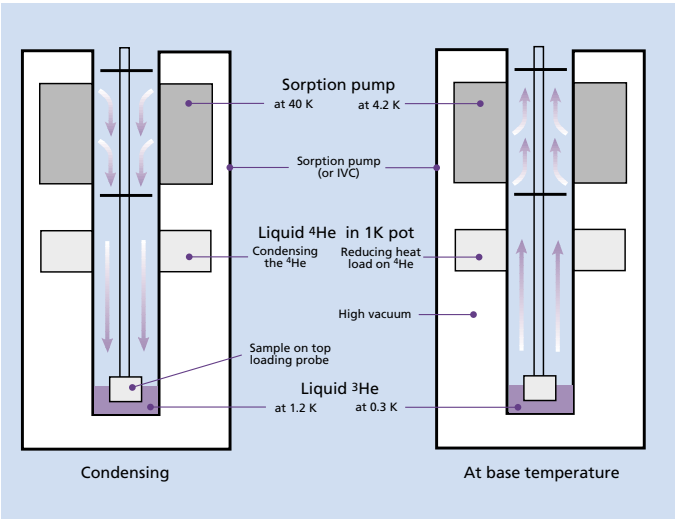

Figure 2: Operating principle of the HelioxTL

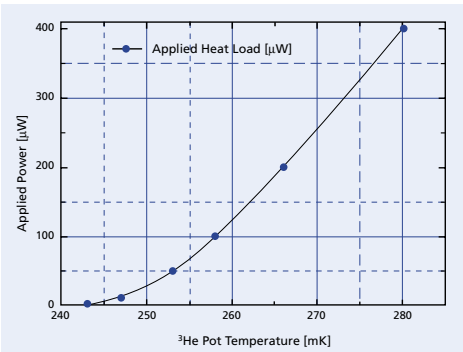

Figure 3: Cooling Power Performance of the HelioxTL with high heat load from the top loading probe (100 µW).

Experimental access

The standard probe supplied with the system is a top-loading probe with a vacuum lock fitted with experimental wiring consisting of a 24-way loom of twisted pair constantan wire attached to the 1 K region. Spare probes for the HelioxTL can be purpose built to enable a wide range of experimental services.

Magnetic field

The HelioxTL is fully compatible with Oxford Instruments Superconductivity range of standard superconducting magnets, which use both standard or extended length dewars.

HelioxTL

Standard Specification		Description
HEL3TL38S	Base temperature	<260 mK for >50 hrs (no applied heat load)
	Cooling power	<300 mK for > 6 hours with 400 μW applied heat load
	Temperature range	Base temperature to 1.5 K
	Temperature stability	Below 1.2 K: <+/-3 mK
	Thermometers	Uncalibrated RuO_2 sensors on 1 K stage and ^{3}He pot.
		Carbon resistor on sorption pump.
		Uncalibrated RuO_2 sensor on top-loading probe.
	^{3}He regeneration time	50 mins
	Liquid Helium consumption	2 litres to cool probe to 4 K
		0.05 litres/hr additional consumption to run
	Hold time at base temperature	>50 hours
	Sample access	Via top loading probe(s) of 38 mm diameter liquid environment
	Experimental wiring	Via top-loading probe
		24-way loom wired in twisted constantan pairs to tag strip on probe in the 1 K region.

High Temperature Upgrade		Heliox TL extended operating temperature range
HELHT	Thermometers	RhFe or Cernox™ sensor to ^{3}He pot or probe for operation above 6 K.
	Temperature range	Up to 80 K
	Temperature stability	+/-100 mK at T>1.5 K

Standard Options		
HE3TLP38	Spare top-loading probe 38 mm insert	Insert, ^{3}He gas storage, auto-needle, safety valves, ITC^{503} temperature controller.
HE3TLPUMP	Pumping manifold for 1K pot	Rotary pump, pumping lines, vacuum valves and gauge.
HESG20	^{3}He Gas	^{3}He gas for HelioxTL wide bore system.
ROTH1	Fully calibrated ruthenium oxide sensor	RuO_2 sensors mounted in a sealed copper can and fully calibrated.
ROTH2	Generically calibrated ruthenium oxide sensor	Thermally cycled RuO_2 sensors selected for their 4 K resistance value.
SMD10/15VSEX	Vapour shielded Dewar	Vapour shielded Dewar: 250 mm neck diameter.
		Useable liquid volume 60-65 litres (with magnet and insert fitted)
		Liquid helium consumption, approx. 575 cc/hr (static, with zero flow through insert).

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