Applications

- High temperature studies of solids in a controlled environment
- Phase transitions in polymers
- Catalytic studies of pressed powders
- Semiconductor materials studies

The Standard

- Up to 700° C operation
- Precise temp control to ±1° C
- Water-cooled Al cell body
- Evacuable or pressurizable
- Swagelok™ gas flow ports
- OFHC copper sample holder mounted in stainless steel shell
- Baseplate mounted

The Options

- Single channel temp controller
- Window materials
- Slide mount
- Stainless steel sample holder

CIC Photonics

THE Hot-One™

Transmission Cell for High Temperature Sample Analysis

The Technical Problem

In today's pursuit of high temperature materials development for aerospace, military and industrial applications, researchers in science, engineering, and metallurgy must be able to study the physical and chemical properties of both existing and new materials.

Infrared absorption and transmission using FT-IR spectrometry is one of the most important tools being applied to these studies. To utilize FT-IR the investigator requires a special sampling cell that is capable of taking the sample materials to high temperatures while maintaining the cell body at a low enough temperature suitable for the spectrometer compartment. Precise temperature control of the sample can also be a critical issue.

The Theoretical Solution

Studies of materials at ambient temperature by infrared spectroscopy are well established and published. Even studies at elevated temperature are well documented. Spectroscopic analysis over a range of temperatures permits the researcher or analyst to probe chemical kinetics, catalysis, structural transformations, phase changes, and many other physicochemical properties. To perform high temperature analysis, however, requires a sampling accessory which can take a sample through specified temperature ranges in a controlled environment. The actual application determines the type of high temperature transmission cell that should be chosen. The cell comprises a sample holder and some means of heating that enclosure. Most heated cells are designed to be placed in the beam without additional transfer optics. Heated cells match the normal beam size of the spectrometer, which ranges from 3-mm to 12-mm diameter. Heating is accomplished with resistance heater-wire. Most commercially available cells can only be heated to 300° to 400° C.

For catalytic studies, the cell must have an inlet and outlet for flow of gas or pulling a vacuum. Certain cell designs that sandwich the sample between infrared windows are not suitable for this application; the sample must remain free standing.

Some designs meant for moderate temperature operation, up to 250°C, do not insulate the cell's heat from the surrounding environment. Other cells meant for higher temperature operations employ insulation jacketing. For highest temperature operation, water cooling is required in addition to insulation. Cell materials that will perform well at a given temperature limit, without reactivity, must be used. There is a trade-off between a sample's size range and energy throughput.

The Product Solution

The Hot-One™ provides a controlled high temperature tool for studies of accelerated degradation of materials as a function of temperature for studies of phase transitions in polymers, reactions on catalytic substrates, for studies of semiconductor materials, and for other applications at the fore front of materials research.

The Hot-One™ high temperature transmission cell is designed to operate at higher temperatures than most commercially available cells. The standard version is capable of operating at up to 700°C and can control temperature precisely to ±1°C. Higher temperature versions are available.

Parts in contact with the sample can be either OFHC copper (standard) or stainless steel. The sample holder stands free in an oven-type heater. The heater can accept a 22-mm diameter sample holder; the OFHC copper sample holder will accept a 12-mm diameter sample.

Design: The sample holder of the Hot-One™ has a built-in annular stainless steel heater. The heater is held in place by a fitting at the top of the device. An airspace acts as further insulation. The aluminum cell body surrounds the heater. Two Swagelok™ ports provide for inlet and outlet of coolant. Two additional Swagelok™ ports have been included for evacuation, pressurization, or flow of gas. The sample temperature is monitored by a type K thermocouple. The standard configuration has the cell body mounted to the baseplate.

Operation: The sample is loaded into the center of the transmission cell and is surrounded by heating elements, producing uniform heating of its circumference. Power for resistive heating is provided and controlled by an auxilliary microprocessor-based self-timing digital temperature controller.

The transmission cell is either flushed with an inert gas or evacuated during operation.

A water cooling coil wound inside the cell body keeps the cell, O-ring seals, and KBr windows cool to the touch.

The Purchase Solution

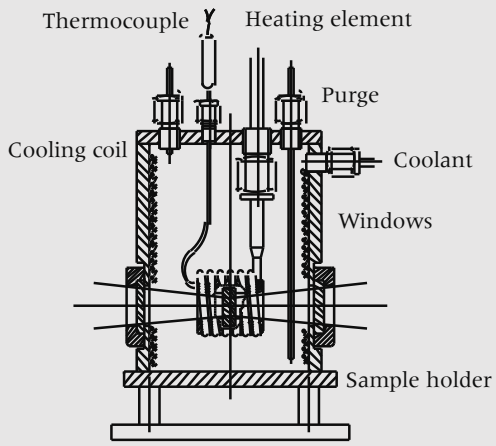
The Hot-One™ comes equipped with a OHFC sample holder, 275 watt heater, type K temperature probe, coolant flow tubing, and KBr windows. A temperature controller such as the Pacesetter™ is also required (see the Pacesetter data sheet).

Product Numbers:

The Hot-One™	41B100
The Pacesetter™	25B600
OHFC Copper sample holder	41B750
Type K Thermocouple	TKC-6
KBr windows	41B500
CAF_2 windows	41B506
Silica windows	41B512

CIC Photonics

The Hot-One™ Cross-section



Specifications

Temperature Range
Room temperature to 700°

Temperature Stability
± 0.5% of span (1°C)

Heater Power
Up to 275 watts

Window Material
Potassium Bromide (KBr)

Heater
Cable heater

Cell Housing
Clear anodized aluminum

Sample mount
OFHC copper

Cooling
Water flow

Outside Cell Temperature
50°C above ambient at 700°C

Vacuum Capability
10^{-3} Torr or better

Leak Rate
<1% of vacuum per hour

Sample Size
22-mm diameter maximum; 12-mm within OFHC copper mount

2715-D Broadbent Parkway, NE
Albuquerque, NM 87107

CIC Photonics