

AMI CHEMISORPTION SERIES

PRODUCT



Introduction

Altamira Instruments (AMI) was founded in Pittsburgh, Pennsylvania, in 1984 and was founded by three professors in catalysis at the University of Pittsburgh.

Since its inception, AMI has been committed to providing high-quality characterization equipment in the field of catalysts and powder science and technology.

In 1985, AMI developed the world's first fully automatic temperature programmed chemisorption analyzer AMI-1. After several generations of iterated product updates over the past 40 years, a variety of technical modules have been developed. On the basis of the chemisorbent analyzer, different modules, such as Fourier in situ infrared, SSITKA, high pressure analysis, programmed temperature vulcanization, can be freely selected to form solutions for different application scenarios.

The AMI-300 series of fully automatic programmed chemisorption analyzer, BenchCAT micro-reactor system and high-throughput catalyst screening system can be customized according to user requirements. Customized products are suitable for a wider range of analysis and research. From the pressure range of the analysis station to the number of analysis stations to the special functions of the instrument control software, AMIs can meet the more stringent requirements of users in the use of the instrument.

In 2018, AMI advances into physical adsorption instruments market and introduced a high-precision physical adsorption instruments that can accurately measure the micropore size distribution of samples. Subsequently, a physical adsorption instruments for rapid detection was introduced, and the specific surface area of four samples could be detected in up to 40 minutes. The AMI physical adsorption instruments has a very high testing speed, and the error of sample data reproducibility has reached an advanced level of less than or equal to 1%.

As a result, AMI has become a leading professional manufacturer in the field of adsorption characterization of solid materials and catalysts.

Typical customers of AMI services are Stanford University, Carnegie Mellon University, University of Michigan, National Res Energy Lab (NREL), Oakridge Nat Labs and other top global universities, as well as international industry giants such as GE, HP, Dow Chemistry, British Petroleum, Exxon Mobil. It covers many different fields such as energy and chemical industry, environmental protection, batteries, catalysts, medicine, advanced materials and so on.

For the global market, AMI works closely with professional adsorption characterization industry distributors in various countries to provide them with perfect service and after-sales support capabilities through professional training. AMIs currently have service centers in these countries: Germany, Canada, the United Kingdom, Italy, China, Mexico, Brazil, India, Thailand, South Korea, Singapore, and so on.

AMI will customize these instruments to meet your exact research needs today.

AMI will customize these instruments in the future to meet your changing research needs.

Dynamic Chemisorption and the AMI-300

Perform dynamic temperature-programmed catalyst characterization experiments unattended with the latest generation fully automated instrument from Altamira Instruments.

Determine metals dispersion, relative activity, adsorption strength, in one third the time of traditional volumetric methods. Analyze the off gas with the standard TCD or integrate our economic mass spectrometer or other detector if you wish. Let us customize the instrument so you can, for example:

- 1 also use it as an atmospheric reactor
- 2 carry out lengthy pre-treatments in a separate station
- 3 provide fast-switched feed compositions to mimic lean-rich burn scenarios
- 4 provide SSITKA capability, and many more

The leader in automated TPD/TPR/O/TPRx, and pulse chemisorption instruments since 1985, Altamira Instruments is the catalyst researcher's primary resource for automated catalyst test instruments and bench-scale reactor systems.

The AMI-300 is the latest generation automated chemisorption analysis instrument offered by Altamira Instruments. Developed by and for catalyst researchers, it and its predecessors, the AMI-1, AMI-100, and the AMI-200, were first in the industry to offer a fully automated system capable of performing all the major dynamic techniques required for fully characterizing a catalyst. The AMI-300 utilizes our proven technology for performing the following dynamic procedures:

Temperature programmed desorption (TPD)

Temperature programmed reduction/oxidation (TPR/O)

Temperature programmed reaction (TPRx)

Pulse chemisorption

Catalyst treatment

Flow BET surface area

Pulse calibration

FTIR

Up to 99 procedures can be linked together consecutively to provide a complete characterization experiment. All experimental procedures can be designed and stored for easy retrieval.



// AMI-300 Features

/ EIGHT (8) STANDARD PROCEDURES

Pulse chemisorption, TPR, TPO, TPD, TPRx, treatment, pulse calibration, and flow BET. Ability to link 99 procedures into one experiment.

/ THREE INDEPENDENT GAS SOURCES

In addition to a carrier gas and a treatment gas, the AMI-300 provides one additional independently controlled auxiliary gas inlet which can be blended with the carrier gas or treatment gas. Extensible to 4 mass flow meters.

/ TEN (10) GAS PORTS

Gas ports located on the back of the instrument minimize the time expended changing gases. Four ports each for treatment and carrier gases. Two ports are available for gas blending or auxiliary gases. Additional ports can be added. Extensible to 12 gas ports.

/ TRAP

A trap that may be filled with a desiccant or used as a cold trap is provided downstream of the sample holder in order to remove condensables before the TCD.

/ LIQUID VAPORIZER

Unit is equipped with a heated sparger-type saturator for easy introduction of volatile liquids.

/ AIR COOLING

Cools the furnace rapidly for quick sample turn around.

/ HEATED NULL STATION

Ensures accurate calibration pulses without contact with the sample.

/ THERMAL CONDUCTIVITY DETECTOR

Highly reliable 4-filament TCD used to quantify gas uptakes. Excellent linearity, accuracy, sensitivity, and stability. Several filament options are available.

/ HEATED LINES

All lines, valves, and parts of the liquid vaporizer are heated to prevent condensation.

/ DIRECT MASS SPECTROMETER LINK

MS data can be integrated in real-time with AMI-300 data using Direct Data Exchange (DDE).

/ SAFETY FEATURES

Among others: independent over-temperature protectors for furnace, resealable pressure relief valves, check valves, circuit breakers, and fuses. System is designed to fail in safe mode.

/ HIGH TEMPERATURE FURNACE

Temperature up to 1200°C; with sub-ambient cooling, the lower limit is -130°C. Furnace can be linearly ramped from 1°C/min to 50°C/min.

/ VARIOUS SAMPLE HOLDERS

Unit accommodates a variety of quartz U-tubes sized to accommodate various catalyst volumes and sizes: straight, bubble, preheat, monolith. Samples may be powders, pellets, extrudates or honeycomb cores.

/ INTERCHANGEABLE VALVE LOOPS

The 13 models are optional and provide an easy way to meet the absorption requirements of different samples. There are 5, 10, 15, 20, 23, 50, 100, 250, 500 uL micro upgrades, 1, 2, 5, and 10 mL for milli-upgrades.

/ ELECTRONIC FLOW CONTROLLERS

Unit uses high quality linear mass flow controllers to display and control gas flows. Flow rate span is 0-50 sccm (standard). Other ranges are available upon request.

/ EASY SAMPLE LOADING

A movable furnace allows easy removing and loading of the sample holder.

/ SAMPLE TEMPERATURE

Measured by a moveable thermocouple placed at the top of the sample bed.

/ INJECTION PORT

A syringe injection port is provided for exact loop volume calibration.

/ AUXILIARY DETECTORS

Can accept any auxiliary detector providing a voltage analog output, such as a flame ionization detector (FID, FTIR, MS, GC, GC-MS).

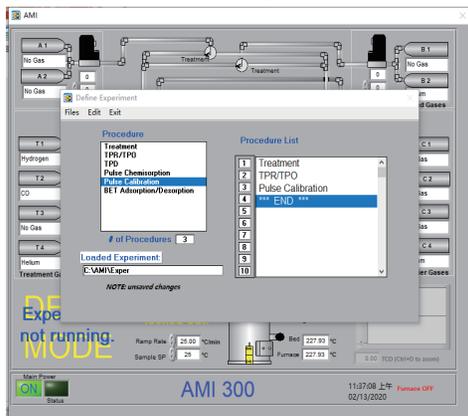
/ LOW INTERNAL VOLUME

Low volume valves and 1/16" lines are used to reduce void volume and minimize peak spreading.

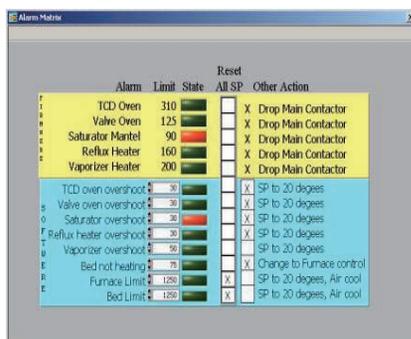
/ MATERIALS OF CONSTRUCTION

Seals and materials are custom engineered to meet your specifications.

// Computer Control and Data Acquisition



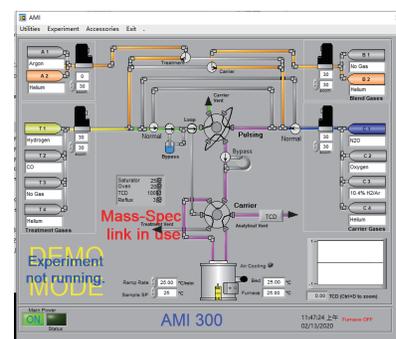
The AMI-300 is fully automated and computer-controlled for ease of operation and reliability. It is designed so that experiments can be run on an unattended basis. This PC, supplied with a Windows based operating system, can be networked and is capable of managing other laboratory tasks in addition to operation of the instrument.



The control and data acquisition functions are performed by LabVIEW applications software. Using this software, a complete experiment can be set-up in minutes, and it can be saved for future use or modification.



The control portion of the software controls and regulates all valve positions, temperatures, flow rates, and detector parameters. The software also allows for the use of an alarm matrix. Data acquisition occurs at a selected rate for optimum performance.



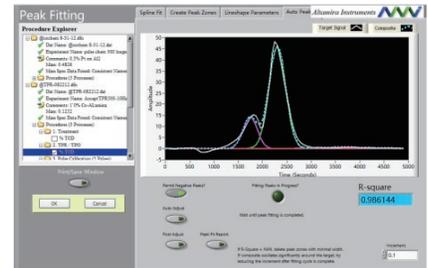
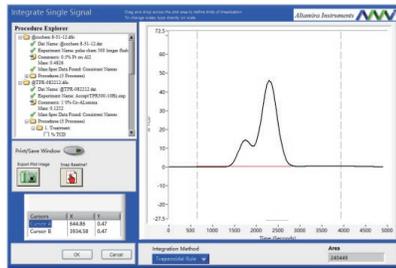
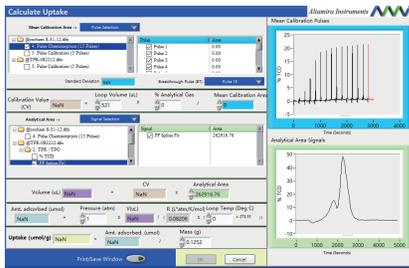
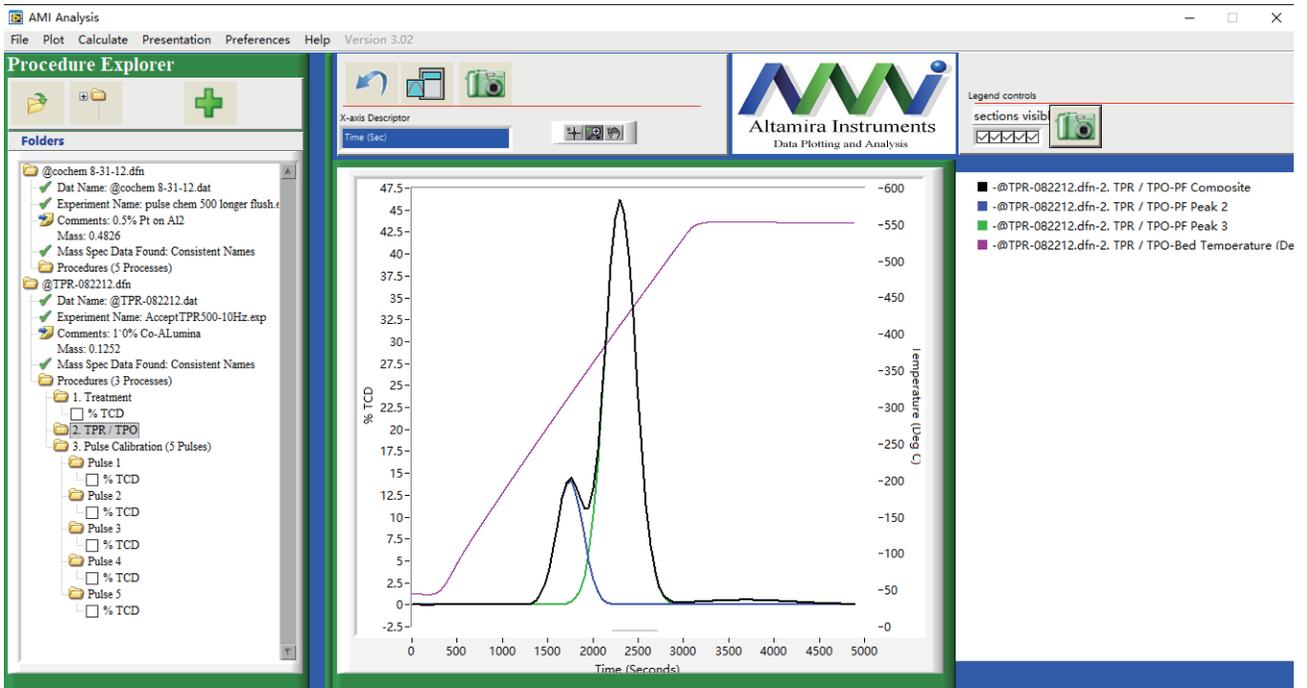
An "Overview" screen shows the status of the unit at a glance, providing information on the position of all valves, type of gas connected to each port, temperatures, and detector signal. Lines change color to illustrate the current flow path. In manual mode any valve can be switched just by a click of the mouse on its icon. Gas flow and temperature set points can be entered from this screen.

Software

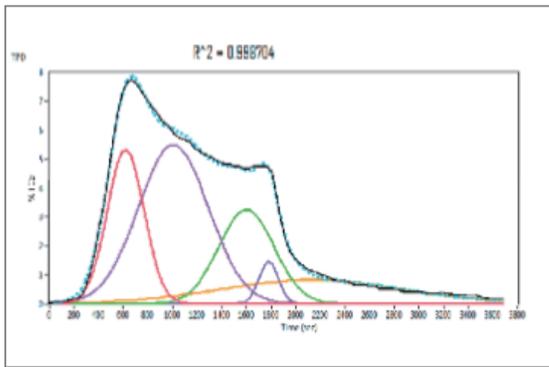
The temperature of the saturator is controlled by the software. In applications where condensation of heater is available to ensure that no condensation takes place.

A highly linear Thermal Conductivity Detector (TCD) is standard. The resolution of the TCD is operator defined, and is controlled by the software.

A choice of TCD filaments is offered to maximize sensitivity and chemical compatibility of the instrument

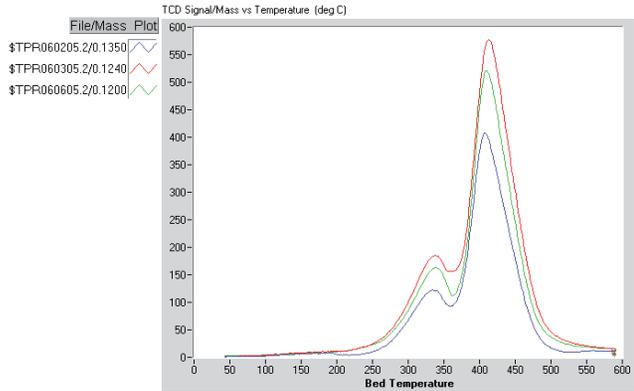


Application

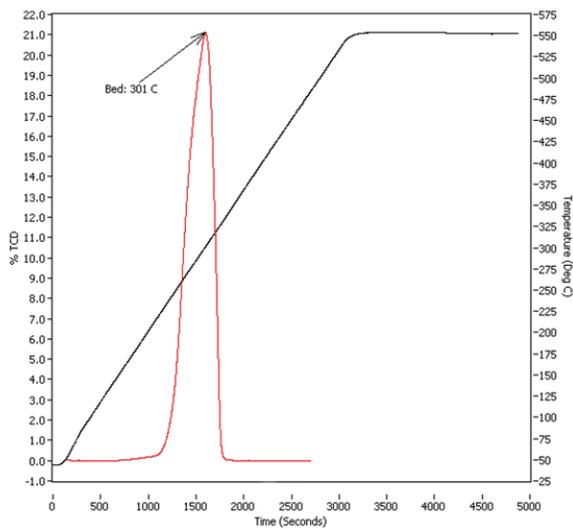


Deconvolution of hydrogen TPD from a 64% Ni/SiO₂ catalyst. Different peaks correspond to different adsorbed species

The software has the functions of automatic peak separation and fitting

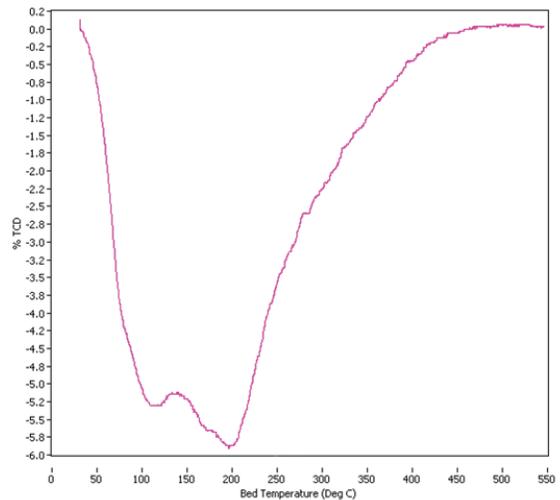


The software can stack multiple data for comparison



CuO TPR

TPR experimental results of CuO



Ni Silica TPD

TPD experimental results of Ni Si

// AMI-300 LITE

Based on our successful AMI-300 instrument, the AMI-300Lite provides rapid catalyst characterization in a compact, affordable package. The AMI-300Lite was designed specifically for the price-conscious customers with applications that are more routine or less demanding. As always, full automation and powerful data-handling software assure data accuracy and improve laboratory efficiency.

The AMI-300Lite utilizes proven technology for performing the following procedures



- Temperature programmed desorption (TPD)
- Temperature programmed reduction/oxidation (TPR/O)
- Pulse chemisorption
- Catalyst treatment
- Pulse calibration
- Single point BET

// AMI-303

The AMI-303 is a masterpiece created by the structural engineers and design engineers of the AMI. Without changing the size of the chassis, there are three independent detection systems.



Fully independent detection system can detect three samples simultaneously without interacting with the results of different detection channels. The three detection channels share the same heating furnace and perform excellently when the test requirements are high.

// AMI-300HP



AMI-300HP is a high temperature and high pressure chemisorption analyzer developed on the basis of AMI-300 to meet higher scientific research needs. In addition to the basic experiments that can be done with AMI-300, the performance of the catalysts can be further investigated at high pressures. This type of instrument can be tested at atmospheric pressure up to 100bar.

// AMI-300IP



The developer of AMI has developed a more efficient AMI-300IP based on the concept of user perspective. This model has two separate heating furnaces that allow the first sample to be tested while the second sample is being pretreated. When the first sample completes the test, the test program for the second sample automatically starts running. This method greatly improves the efficiency of the instrument. AMI-300IP is the best choice when each sample to be tested has different experimental conditions.

// AMI-300IR



Chemisorption and thermal desorption techniques, such as TPD (temperature programmed desorption), have been widely used for the characterization of catalysts. These techniques rely solely on the observation of evolved gases from a catalyst surface as detected by a thermal conductivity detector (TCD) or, in some cases, a mass spectrometer. With these techniques it is possible to learn about the number and strengths of sites but not about the nature of the sites, the type of adsorption, or whether there exist multiple types of sites.

In order to overcome this drawback, Altamira has now developed the AMI-300IR which combines all the standard AMI techniques with real-time observation of the catalyst surface by Fourier Transform Infrared (FTIR) spectroscopy. This combination of techniques allows for the direct observation of the adsorbed species and thus expands the knowledge of the nature of the adsorption/desorption process.

// AMI-300TKA



Steady state isotope transient kinetic analysis is an effective method to study the kinetics and mechanism of heterogeneous catalytic reaction. This technology can not only qualitatively obtain the information about the reaction mechanism, but also obtain the quantitative in-situ kinetic information, including the amount, coverage, surface life of intermediate species adsorbed by different reactions, the rate constant reflected by primitives, the number and distribution of active sites and so on.

In order to meet the needs of users, through years of technology accumulation, we have launched ami-300 TKA series equipment, which can be perfectly suitable for such reactions and provide our customers with reliable and efficient testing equipment.

// AMI-300S



At Altamira Instruments we are constantly encountering requests for reaction units and characterization equipment that can handle reactants and/or products that are corrosive, reactive or unstable. We typically consider these to contribute to a "harsh" environment for our testing equipment.

Ami-300s can effectively address this concern. The anti-corrosion treatment is completed inside the instrument to ensure that the instrument can conduct experiments stably and for a long time even in a "harsh" environment.

// Specification

	AMI-300	AMI-300LITE
Catalyst Charge	0.1 - 1 g	0.1 - 1 g
Temperature Range	-130 to 1200°C (Optional)	-130 to 1200°C(Optional)
Ramp rate	1 - 50°C/minute	1 - 50°C/minute
Operating pressure	Atmospheric pressure or up to 100bar(Optional)	Atmospheric pressure
Gases	4 carrier 4 treatment, 2 blend (Others Available)	5 carrier/treatment 2 pulse gases
Gas flow rates	5 - 50 scc/minute	5 - 50 scc/minute
Reactor types	quartz u-tubes 1/4", 3/8", 1/2" optional	quartz u-tubes 1/4", 3/8", 1/2" optional
Detector	4 filament TCD with choice of filament type (W, Au/W)	4 filament TCD with choice of filament type (W, Au/W)
Materials of construction	Kalrez	Kalrez
Dimensions	W:56 cm H: 60 cm D: 61 cm	W:56 cm H: 60 cm D: 61 cm
Weight	48kg	45 kg
Mass flow controllers	3(4 upgrades optional)	1(2 upgrades optional)
High Temperature Oven	Up to 80°C (150°C upgrades optional)	None
Gas saturator system option	optional	None
is5 FTIR option	optional	None

BenchCAT

The BenchCAT by Altamira Instruments represents a complete, bench-top reactor for catalytic studies. All the components required for either gas-phase or liquid-phase reaction studies are contained in a fully automated compact package. A variety of options makes the BenchCAT suitable for a wide range of studies.



SYSTEM FEATURES

- Maximum Operating Temperature: 650 C or 1200 C, depending on reactor material
- Maximum Operating Pressure: Atmospheric, 30 bar, or 100 bar
- Number of Gas Feeds: Up to 6
- Number of Liquid Feeds: 0, 1, or 2
- Reactor Material: Stainless steel, quartz, or Incoloy
- Wetted Materials Include: Stainless Steel, PEEK, Kalrez, Viton, Incoloy, and Quartz
- Isothermal oven housing most process components
- Full automation of process using LabVIEW
- Redundant safety features

// Hardware

● REACTOR FEED

Up to 6 gases and 2 liquids can be used in the standard configuration of the BenchCAT. Each gas train incorporates a filter, electronic mass flow controller (MFC), check valve, and positive shut-off valve. The range and gas calibration of each MFC is specified by the customer. Liquids are delivered using high precision HPLC pumps.

● HEATED OVEN

Most process components are housed inside an isothermal oven operated at up to 200 °C. The following components are found in the heated oven:

- Integral gas preheater and liquid preheater/vaporizer operating at up to 300 °C
- Feed mixer
- Reactor by-pass valves
- Reactor furnace with measuring and safety-switch thermocouples
- Reactor with internal thermocouple
- Pressure transducer isolator
- Lines leading to pressure transducer and pressure relief valve mounted outside the oven

● CONDENSER

A tube-in-tube condenser is located outside the oven at the outlet of the reactor. A thermocouple is used to monitor the coolant return.

● GAS/LIQUID SEPARATOR

The gas/liquid separator is found downstream of the condenser. Two level switches (high and low) activate an automatic valve and serve to maintain level control.

● PRESSURE CONTROL

Exit pressure is measured with a separate pressure transducer and the pressure is controlled using an automatic tapered needle valve.

● PRODUCT SAMPLING VALVE

An optional product sampling valve can be used to route an effluent sample to an external analytical device.

// Computer Control

The BenchCAT is fully automated for ease of operation and reliability. It is designed so that it can be run unattended. The operator simply inputs process parameters as a series of steps and schedules a start time. Valve positions, flow rates, temperatures, pressures, and product sampling are controlled by the operating software. Data readback of the process are monitored at a rate specified by the user. The data are saved in a text-delimited format for easy transfer to other programs. The control and data acquisition are performed using a LabVIEW application software specifically written for the BenchCAT. Complete experiments can be written in minutes and saved for future use.

// Connection to External Detectors

The product effluent can be directed to an external detector, such as a gas chromatograph, via an optional heated or unheated sampling valve.

// Safety

A number of safety features are built into every BenchCAT. These include:

- Check valves in all gas and liquid feed lines to prevent backflow;
- Software-coded alarms that monitor temperatures and pressure for possible excursions. These alarms are based on the equipment safety limitations, and are configured by Altamira Instruments;
- User-defined alarm matrix where the user can specify lower and upper limits of process parameters and what actions to take in the event that these limits are reached;
- Hardware over-temperature limit switch for the furnace;
- Firmware-level alarms on all heaters;
- Preset relief valves to prevent over-pressurization;
- Power switch mounted on the front of the instrument to control power output to the instrument in case of an emergency;
- Double fusing in all 220 VAC process equipment.





ALTAMIRA INSTRUMENTS



4620 Hurt Bridge Road , Cumming, GA 30028

Email: support@altamirainstruments.com

Altamira Instruments LLC