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Agilent Technologies

Value Added Reseller

The CDS 5000 Series Pyroprobes

Thermal GC Injection Systems for Pyrolysis, Thermal Desorption, Dynamic Headspace and Evolved Gas

FAST **RELIABLE** **FLEXIBLE** **UPGRADEABLE**




A TRUE POLYMER CHARACTERIZATION SYSTEM ABLE TO ANALYZE VOLATILES, SEMI-VOLATILES AND ORGANIC SOLIDS.

Choose from the **world's widest selection** of options;
unmatched flexibility means there's a CDS solution for any application.

INSPIRATION MEETS INNOVATION!

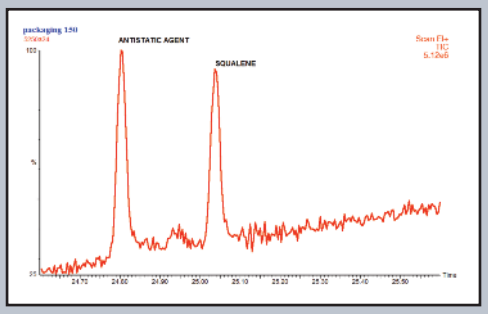
Who We Are

CDS Analytical is a leading manufacturer of laboratory instruments for organic sample introduction. For 40-plus years our exclusive focus has been conceiving, developing, manufacturing, and supporting superior instrumentation able to meet the most exacting challenges our customers face.

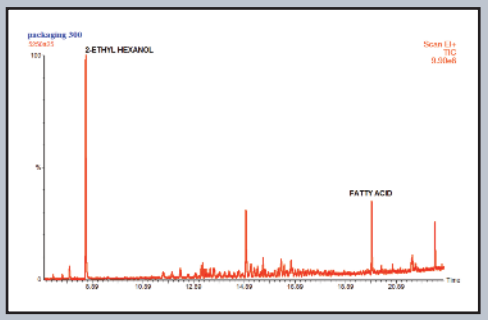
Today we offer a comprehensive suite of front-end GC equipment for pyrolysis, purge and trap, headspace, and thermal desorption. These sturdy, field-tested instruments deliver the entire range of temperature, heating rate, and multi-step manipulations required by today's most demanding analytical laboratories.

As customer challenges and expectations evolve, CDS Analytical will continue to lead the way, developing the next wave of innovative sample analysis instruments. Our 5000 Series, the only pyrolysis system capable of 8 automatic runs on one sample, is the latest example of this time-tested commitment.

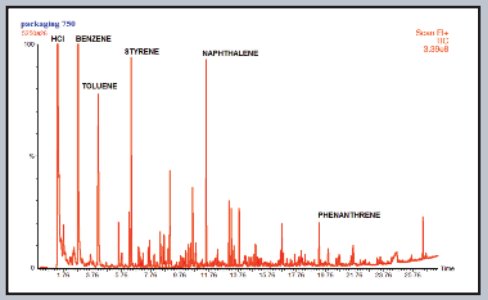
3-Step Run of an Unknown Plastic Packaging



At 150°C there is a peak for an antistatic agent, plus squalene, a contaminant.



At 300°C there is a solvent and a fatty acid, probably from a lubricant.



At 750°C the HCl and aromatics identify the polymer as polyvinyl chloride.

How and Why Pyrolysis Works

Pyrolysis is the process of applying heat to large, complex molecules in order to break them into smaller, more analytically useful fragments. When coupled with GC, GC/MS, Direct MS, or FTIR, pyrolysis enables quantitative and qualitative analysis of vastly divergent sample types, without lengthy extractions or derivatizations. Many organic solids are unsuitable for analysis by any other means.

Mass spectrometers use electron impact to shatter complex molecules in a reproducible manner. The resulting molecular ion separation creates a spectrum that is both qualitative and quantitative. Pyrolysis works almost identically, simply by substituting heat for electron impact. Samples are exposed to temperature levels exceeding the energy of their specific bonds, causing molecules to fragment in measurable, reproducible ways.

The resultant fragments are separated by an analytical column to produce a chromatogram (pyrogram) which offers precise, detailed information. Peak quantity, relative intensity, and resolution by capillary GC, enable users to discriminate between similar formulations, making pyrolysis a powerful resource in the identification of unknown samples.

Thermal Desorption/Dynamic Headspace

All Series 5000 instruments offer multi-step temperature programming; up to 8 GC runs per sample. By programming in analysis temperatures below 350°C as the first step, users can thermally extract volatiles and semi-volatiles for analysis before pyrolyzing the remaining polymer. Multi-step programming is invaluable for detecting solvents as well as residual monomer and polymer additives. The Model 5200 includes a ¼-inch Thermal Desorption chamber, and/or an optional 25mL Dynamic Headspace vessel, which enable volatile analysis of larger samples.

Evolved Gas Analysis

All CDS pyrolyzers allow users to program the heating rate. Ramping up filament temperature slowly makes it possible to send evolved compounds directly to the MS. Doing so determines the temperature at which volatile compounds desorb and the polymer starts to break down.

The Evolution of Excellence – The 5000 Series Product Family

- Best Guaranteed Accuracy < 2% RSD*
- System Fully Upgradeable
- Analyze Any Sample Matrix
- Replace Solvent Extraction with Thermal Extraction
- Libraries to Interpret Data
- Desorb Sorbent Tubes for VOC in Air Analysis
- Optional Catalyst Reactor
- Optional High Pressure Operation

Advanced Capabilities

CDS 5000 Series pyrolyzers set the standard of excellence for quality construction and advanced functionality. These sturdy, durable instruments are designed for easy upgrading, meaning your instrumentation investment is always protected and can be leveraged as and when your requirements change.

Multi-Step Runs

All CDS pyrolyzers have the ability to program in 8 steps per sample, with a GC run for each. This allows users to look for volatile and semi-volatile compounds first, before analyzing the remaining polymer. The result is a chromatogram that is easy to interpret. Additionally, the GC helps confirm that your pyrolysis fragments are from the polymer, not residuals, additives or contaminants in the sample.

Ease of Use

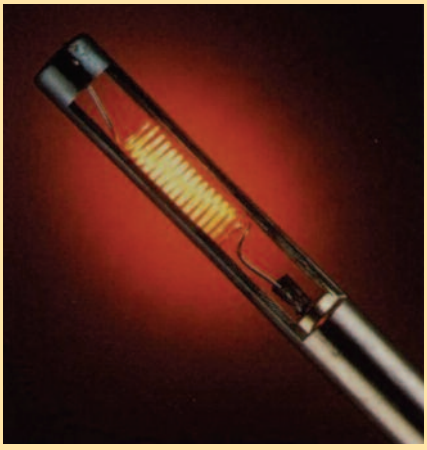
Intuitive PC-control facilitates operation and ensures accuracy. Samples are loaded into a probe, (coil or ribbon), or a thermal desorption chamber (optional). Sample analysis occurs via thermal desorption or pyrolysis. Conduct up to eight temperature experiments on one sample!

Probes for Every Application

CDS offers sample probes in various sizes and configurations. Platinum filaments can be configured as a ribbon or coil.

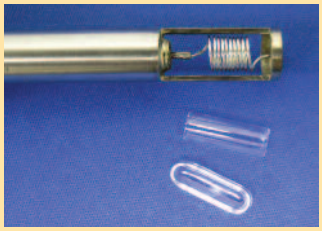
- Coil Element – Best for samples held in reusable quartz tubes or boats.
- Ribbon Element – Ideal for film and solvent deposited solids.
- Optional ½"probes for heating oversized samples (up to 350mg). Useful for geological and low organic content samples.

Probes



All Series 5000 models contain platinum filaments.

Precision heat control is assured.



1/2" Filament

*When comparing trimer/monomer ratios for polystyrene.

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The CDS 5000 Series

The most advanced thermal sample preparation instrument available.

5000 Series

The leading edge technology you see here is available regardless of which 5000 Series instrument you select.

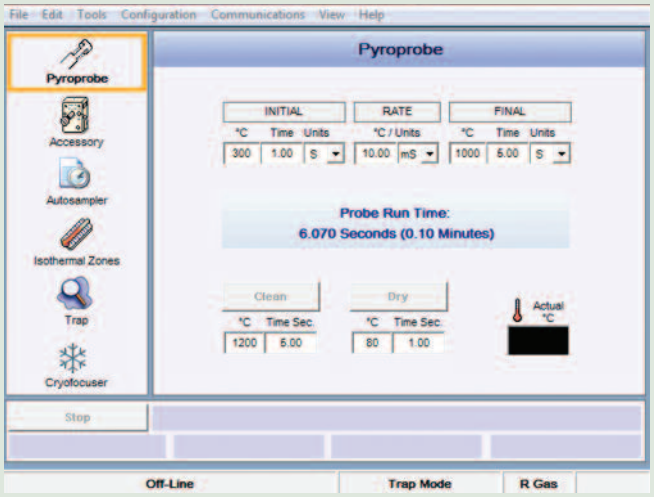
- Windows-based PC Control
- Programmable interface
- Simplified sample loading
- Interfaces directly to injection port or with heated sample line
- Three, User-Selectable Operation Modes: Run, Dry, Clean
- Platinum filament pyrolyzer for pulse, and multi-step, programmed pyrolysis
- Optional easy transfer line connection
- Optional trapping zone for:
  - Thermal Desorption of Sorbent Tubes
  - Reactant Gas Operation
  - Slow Rate Pyrolysis with Trapping

Simple, Intuitive PC Management

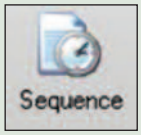
All parameters are presented in an easy to program Windows™ PC environment, permitting method development, storage, notation, and editing.

Wide, Precisely Controllable Heating Range

Platinum filaments heat rapidly during pulse pyrolysis, slowly during programmed analyses. Wide heating range and precise temperature control multiply your options; set temperatures in 1°C increments up to 1400°C. Runs allow up to 8 steps per sample, automatically controlling an on-line valve, interface temperature, GC-ready sensing, and GC-start for each step.



Windows-based CDS 5000 DCI Control



Specify up to 8 GC runs per sample – automatically. Multiple temperature runs allow you to analyze for volatiles before pyrolyzing the actual polymer.

www.cdsanalytical.com

5000 SERIES PYROLYZER TABLE

Find Your Ideal Instrument Right Here

Use this handy table to locate the 5000 Series pyrolyzer perfectly suited to the specific challenges and requirements of your application.

All instruments listed here boast the robust functionality of our base model, the 5000. As model numbers rise, capabilities and specialized strengths increase accordingly, reflecting advanced, high-performance functionality.

Align your needs with the features listed below and identify the CDS 5000 Series pyrolyzer made for you!

Pyrolysis Feature Comparison	5000	5150	5200	5200 HPR	5250	5250T
PC Control of All Features	•	•	•	•	•	•
Pulse Pyrolysis and/or Multi-step Programming with Auto GC Start	•	•	•	•	•	•
Silcosteel Interface	•	•	•	•	•	•
Pulse Pyrolysis Programmable in 1° Increments to 1400°C	•	•	•	•	1300°C max	1300°C max
Programmed Pyrolysis Heating Rates: 0.01°C/ms to 20°C/ms 0.01°C/sec to 999.9°C/sec 0.01°C/min to 999.9°C/min	•	•	•	•	•	•
Easily Removable Transfer Line to Inlet of GC		•	•	•	•	•
Injection Port Mounted System	•				•	
Temperature Programmable Interface Settable in 1°C Increments to 350°C; Programmable at 1°C/min. Increments to 100°C/min.		•	•	•	•	•
Reactant Gas Option (Py-trapping)			•	•		•
Second Heated Zone for Sorbent Trap (Py-trapping)			•	•		•
Thermal Desorption of Solid and Liquid Samples		•	•	•	•	•
Thermal Desorption of Sorbent Tubes – VOC in Air			•	•		•
Evolved Gas Analysis (EGA)	•	•	•	•	•	•
Thermal Cutting		Need Cryofocuser	•	•	Need Cryofocuser	•
High Pressure (500psi Max; 3400kPa) Reactant Gas Option (5200 – HP)				•		
Catalyst Reactor (up to 800°C)				•		
Autosampler Capability – 36 Samples					•	•
Optional Test Tube Desorber – Dynamic Headspace			•			
Optional Polymer, Additives & Biofuel Libraries	•	•	•	•	•	•
Optional Cryofocusing (liquid N_2)		•	•	•	•	•
Optional Cryotrapping (liquid N_2)			•	•		•

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The CDS Pyroprobe Model 5000

Injection Port Mounted

Pulse Pyrolysis Filament Temperature: Programmable in 1°C increments to 1400°C
Heating Rates: 0.01°C/ms to 20.0°C/ms
0.01°C/sec to 999.9°C/sec
0.01°C/min to 999.9°C/min
Clean and Dry: User-selectable
Steps: Up to 8 temperature profiles with a GC start per step. Allows for multiple thermal desorption or pyrolysis steps on each sample.
Interface (Model 1500): Temperature programming in 1°C increments to 350°C Silco-Steel™ lined.
Dimensions: 23cm W x 24cm H x 31cm D

The CDS Pyroprobe® Model 5150 Pyrolyzer

Includes All Base Functionality Plus These Value-Added Features:

Interface Type: Low-mass programmable zone
Interface Temperature: Settable in 1°C increments to 350°C
Interface Heating Rates: Programmable in 1°C/min to 100°C/min
GC Connection: Heated sample line through injection port
Valve Oven: Settable in 1°C increments to 350°C
Transfer Line: Settable in 1°C increments to 350°C

Connects with heated sample line for easy on and off installation. Low-mass programmable interface allows for thermal desorption of volatiles before pyrolyzing sample.

The CDS Pyroprobe® Model 5200 Pyrolyzer

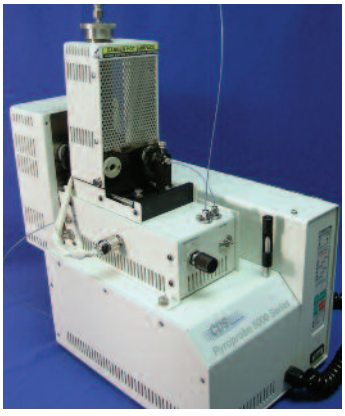
Includes All 5150 Functionality Plus These Value-Added Features:

Trapping option enables instrument to collect analytes using slow rate pyrolysis, reactant gas pyrolysis, or thermal desorption. Unique interface design permits direct pyrolysis path to GC inlet, or heating and transfer to trap, with no interruption of GC pneumatics. Optional test tube desorber can be heated up to 300°C.

Pyrolysis Filament Temperature: Programmable in 1°C increments to 1400°C
Heating Rates: 0.01°C/ms to 20°C/ms
0.01°C/sec to 999.9°C/sec
0.01°C/min to 999.9°C/min
Clean and Dry: User selectable
Steps: Up to 8 temperature profiles with a GC start per step. Allows for multiple thermal desorption or pyrolysis steps on each sample
Interface Type: Low-mass programmable zone on 5200
Interface Temperature: Settable in 1°C increments to 350°C
Interface Heating Rates: Programmable in 1°C/min to 100°C/min
GC Connection: Heated sample line through injection port
Valve Oven: Settable in 1°C increments to 350°C
Transfer Line: Settable in 1°C increments to 350°C

Trapping and Reactant Gas Pyrolysis Capabilities

Interface Type: Pyrolysis to built-in trap or direct to GC
Trap Heating Rate: 800°C/min
Trap Temperature: Ambient to 350°C
Trap Packing: Tenax-TA™ standard; other packings available



Dynamic Headspace Option

Type: 25 ml test tube chamber
Heating capabilities: Up to 300°C
Purge time: Up to 999.99 minutes
Flow path: Purge to built-in trap

Optional Cryotrap

Liquid N_2 cooled cryotrap can be added

The 5200 is the only instrument available that can pyrolyze, desorb thermal desorption tubes, and perform dynamic headspace.

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The Model 5250 Pyrolysis Autosampler

Automated Analysis Boosts Productivity and Efficiency

The Model 5250 provides hands-free analysis of up to 36 samples, with the option of expanding to 44. Solids, viscous liquids, and powder samples are pyrolyzed directly into the GC, eliminating the need to perform lengthy extractions and derivatizations.

Our patented heating method enables unprecedented flexibility, allowing users to perform thermal desorption and pyrolysis using only one sample.

Quality control and method development applications benefit from the autosampler's proven high reproducibility level. Microsoft Windows™-compatible software facilitates method development and allows standard operating procedures to be written for GLP/GMP compliance.

- Thermally Desorb Volatiles Before Pyrolyzing Sample
- Competitively Priced
- Unique Capabilities
- Upgrade Any 5000 Series Unit
- Universal Connectivity
- Dimensions: 48cm H x 28cm W x 43cm D

Filament Temperature: 1°C increments to 1300°C
Heating Rates: 0.01°C/minute to 20,000°C/second
Heating Times: 0.01 second to 999.99 minutes
Interface: 1°C increments to 350°C
Steps per Sample: Up to eight temperature profiles with a GC start per step. Allows for multiple thermal desorption or pyrolysis steps on each sample.

The Model 5250T Trapping Pyrolysis Autosampler

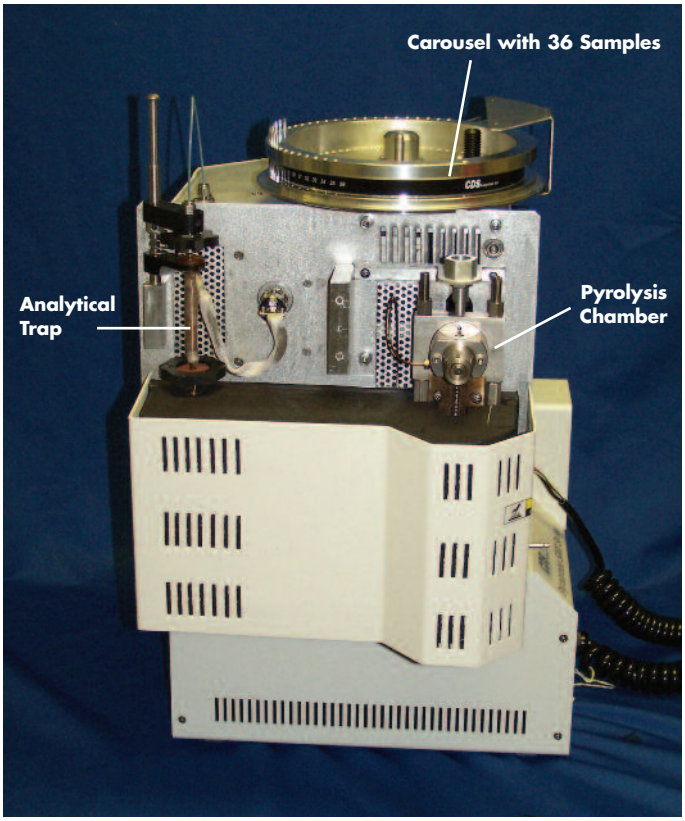
Includes all 5250 features plus a built-in analytical sorbent trap or cryotrap.

Competitively priced and easy to operate, our 5250T delivers the convenience of automation and performance flexibility of trapping. This dynamic instrument offers many unique features unavailable anywhere else, for example; **pyrolysis in reactant gas (not carrier gas), slow rate pyrolysis studies, and combustion studies**.

Comes equipped with all standard 5250 autosampler features and can be used as a normal pyrolyzer, if you wish, by bypassing the trap. You can use any background gas you like for pyrolysis, O_2, H_2 or air. Connects to any model GC through our convenient heated sample line. Comes with a standard sorbent trap and can be ordered with an optional cryogenic (N_2) trap.

Trap Temperature: Ambient to 350°C
Trap Heating Rate: 600°C/min

Please note that all CDS 5000 series instruments can be upgraded to the 5250T any time, thereby protecting and leveraging your investment in CDS quality.



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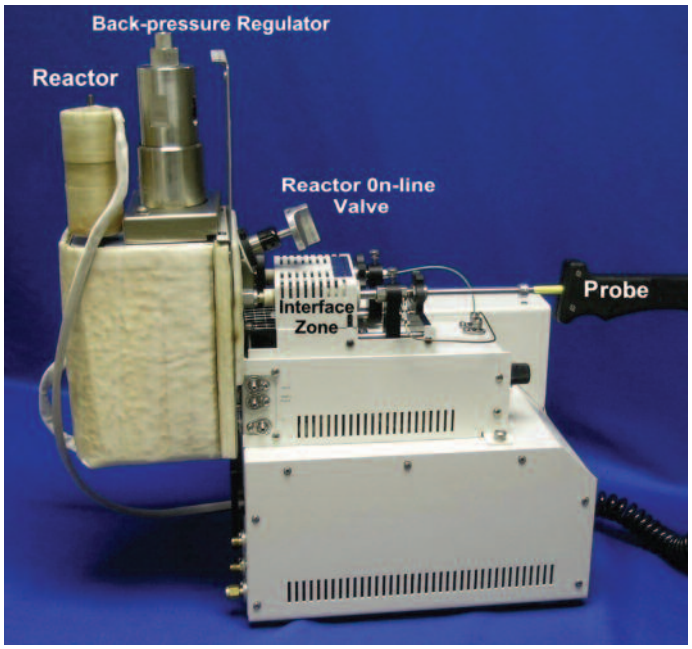
The Model 5200HP-R High Pressure Pyrolysis Mini-Reactor System



Scientists studying new biomass feedstock, coal, catalysts or chemical reactions need to know how these materials break down in a variety of conditions. Historically this has been a cumbersome, expensive, and time-consuming process. Now there's a better way, the world's first, and only, mini high-pressure pyrolysis reactor system – complete with catalyst reactor.

The Model 5200HP-R enables users to study both high temperature and pressure on a small scale, with the convenience of results sent directly to their GCMS. Scientists and chemical engineers alike see the consequences of scaling up for pilot reactor tests up front, boosting efficiency and productivity. Convenience and adaptability are built in, for example, users can choose carrier or a reactant gas as the background to pyrolyze in.

The unit is built on the rugged 5200 platform modified with a backpressure regulator and heated catalyst bed. Samples can be pyrolyzed at elevated pressures (500 PSI/3400 kPa), passed through a user-selectable catalyst bed, and collected onto the built-in trap. When sample pyrolysis is complete, analytes are transferred from the trap to the GC at normal operating conditions.

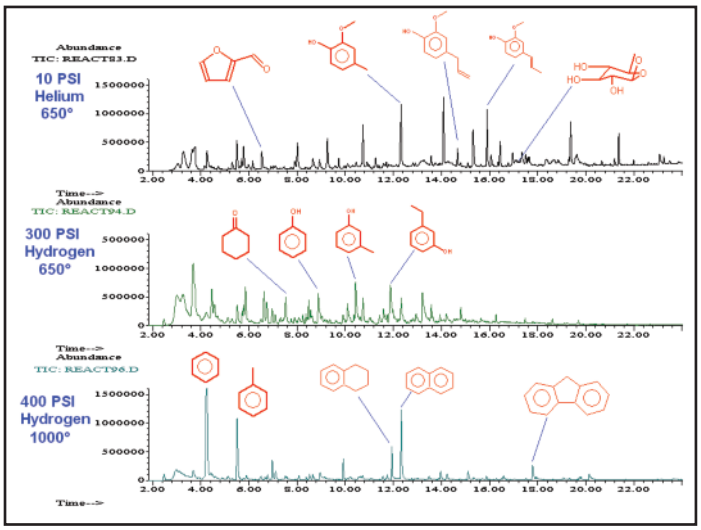
The Model 520HP-R is compatible with all GC and GCMS makes and models.

Filament Temperature: 1°C increments to 1400°C
Heating Rates: 0.01°C/minute to 20,000°C/second
Heating Times: 0.01 second to 999.99 minutes
Interface: 1°C increments to 350°C
Trap: 1°C increments to 350°C
Trap Heating Rate: 800°C/min
System Pressure: To 500 PSI (3400 kPa)
Reactor Conditions:

Temperature: 1°C increments to 800°C
Catalyst tube: 3" x 1/4" 316 stainless steel (6 mm x 75 mm)
User-interchangeable with different catalyst types

Built-in trap allows the user to pyrolyze in a reactant atmosphere, such as air, trap the pyrolyzed components and then desorb them to the GC for analysis. The trap can also be used to do slow evolved gas studies on samples and be used as a thermal desorption chamber.

Trap Temperature: ambient to 350°C



Wood biomass pyrolyzed at temperature and pressures as noted in either He or H_2. Runs two and three were passed through a Pt catalyst at 200°C.

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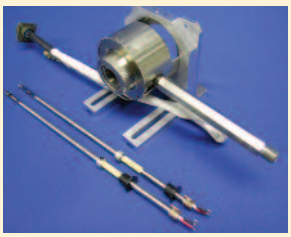
The Pyrolysis FTIR System – For In-Beam Thermal Processing

Use your FTIR to analyze fibers, laminates, coatings, polymers, pigmented and opaque samples, small irregular samples, composites, and more.

Adaptable to most FTIR benches, center or side focus. Window assembly removes easily for cleaning while cell remains installed. Independent purge for optical path and sample cell. The FTIR interface is manufactured from 316-SS and offers programmable heating up to 250°C. High-pressure cell available. Includes bracket, mounting plate, purge flow controller, shut off valve and sample compartment cover. Works with any CDS pyrolyzer.

- Identify polymers with no sample preparation.
- Fast, easy analysis of finished goods.
- Easily interfaces to most FTIR instruments.



FTIR Pyrolysis Interface

FTIR Interface Mounted in Instrument

- Available for most manufacturers of FTIR Benches, center focus or side focus
- Uses standard 25.4mm windows (2, 3 or 4mm thickness)
- ZnSe or KBr may be specified
- Window assembly removes easily for cleaning while cell remains installed
- Independent purge for optical path and sample cell
- Heated stainless steel sample cell
- High-pressure cell, Teflon lining available
- Flow controller and shut-off valve for cell purge

Application of the Pyroprobe FTIR System

Identify Polymers with No Sample Preparation

Small (200ug) samples of polymeric materials are placed directly onto probe and pyrolyzed in FTIR light path. Figure 1 shows the pyrolysis of poly(methyl methacrylate) at 700°C for 10 seconds, with instantaneous FTIR.

Figure 1: Pyrolysis Infrared Spectrum of PMMA Temp. 700°C

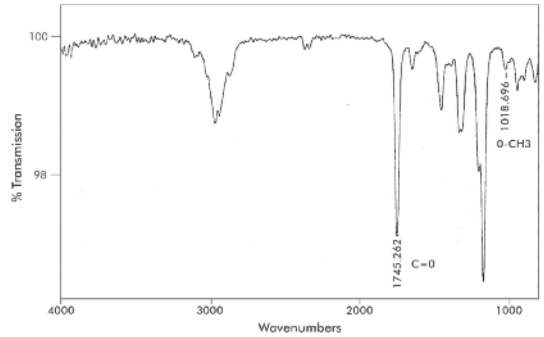
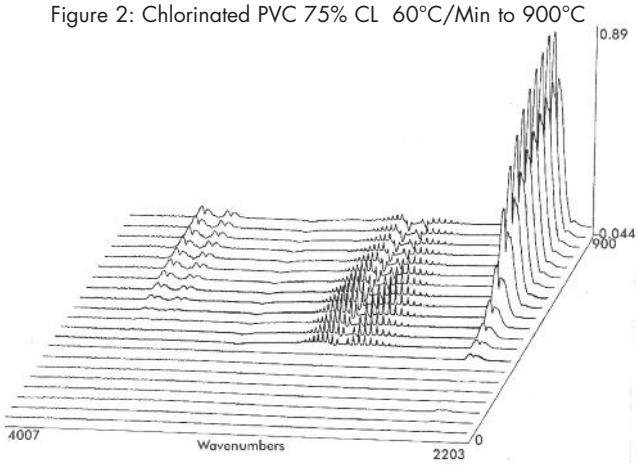


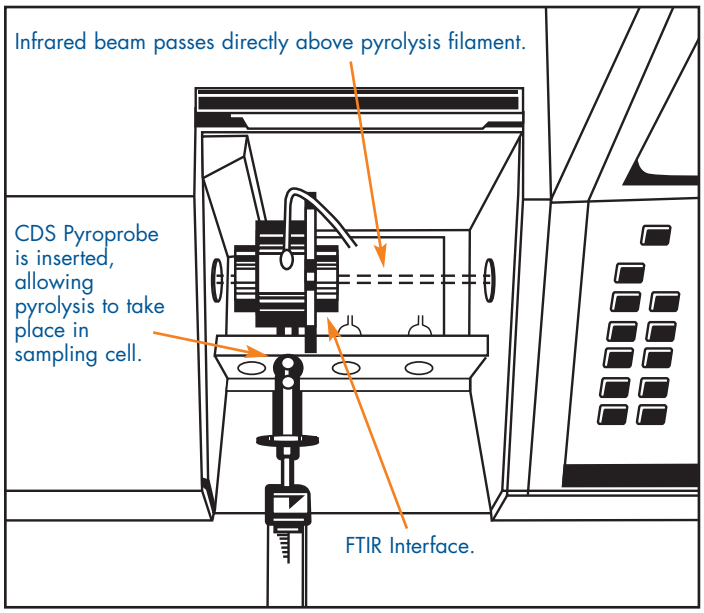
Figure 2: Chlorinated PVC 75% CL 60°C/Min to 900°C



Time-Resolved Analysis

Time-resolved analysis using programmed thermal processing of the Pyroprobe 5000 to heat at rates as low as 0.01°C/min permits multiple scans to identify evolved compounds, degradation products, etc. Figure 2 shows PVC being heated at 60°C per minute to 900°C, scanning once a minute. The pyrolysis products include, HCL (the large peaks) and several bonds from aromatics.

CDS Analytical FTIR Interface Cell and Pyroprobe 5000



Libraries

Let Our Libraries Help You Analyze Your Data

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Polymers, Additives and Biofuel Compounds

- Identify Polymers Using Our Library
- Easily Find And Identify Trace-Level Additives
- Compatible With Most GCMS Systems
- Add Your Compounds To Our Libraries
- Free Software Upgrades for the Life of Your Instrument!

Polymer Identification

By utilizing the full potential of a mass spectrometer, CDS has developed an effective means of searching unknown pyrograms. Standard mass spectrometer software allows users to average spectra beneath a peak, producing a single spectrum representative of the chromatogram. The "averaged" spectrum can be stored in a searchable library and retrieved as needed in order to identify unknown polymers.

To take advantage of this, CDS has built a polymer library containing 400 averaged spectra we see most often. Now you can use the power of your MS to search for ID's of unknown polymers.

Combining averaged mass spectra with pyrogram TIC creates a powerful two-prong method of polymeric material analysis. The technique allows analysis of individual pyrogram peaks using standard searching libraries while offering the polymer's chromatographic pattern characteristic. It also allows users to apply existing computer searching techniques to the polymer as a whole.

Current compounds in the library include most of the common industrial polymers in use today, copolymers and even biopolymers. The library is designed so that the user can expand it by adding their own spectra of polymers into the library.

Polymer Additives in Complex Sample Matrixes

The number of polymer additives today is vast, and growing constantly, making it increasingly difficult to detect trace additives in unknown polymer samples. Our library, which contains hundreds of additives, used with leading deconvolution software packages, addresses this challenge head on. That means you get more accurate data than was possible before, and you get it sooner.

By pairing deconvolution software with the CDS Additive Library users can search chromatograms (from pyrolyzed or thermally desorbed samples) by specific compound or compound categories. Our library is compatible with Agilent-Chemstation, AMDIS, and a program from Ion Signature. The software searches and identifies additives stored in the library. This robust search capability allows users to identify most commercially available additives to the low PPM level.

Compatible with most major MS systems, the library is available stand-alone or as part of an Ion Signature deconvolution package. Supplement the knowledge base yourself, and take advantage of the regular stream of CDS updates as you wish. Since additives are grouped by category you can limit searches to ones of interest only. Note that the current version contains many additives not found in the standard NIST or Wiley MS libraries, giving you an immediate head start.

Typical additive compounds contained in the library include:

- Plasticizers
- Light Stabilizers
- Antioxidants
- Corrosion Inhibitors
- Lubricants
- Fragrances
- Flame Retardants
- Antistatic Agents

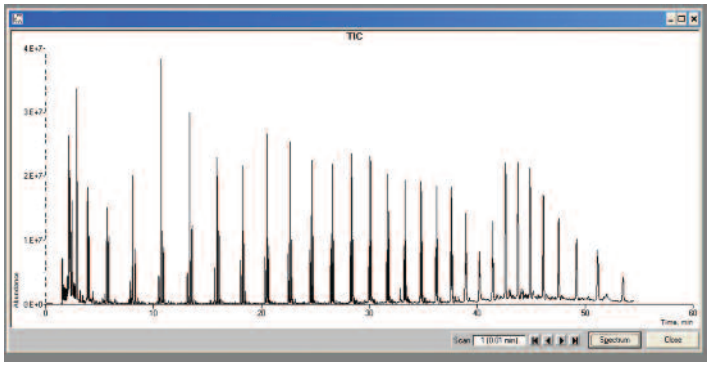

Figure 1 shows a pyrolysis-GC run of Polyethylene with a trace amount of an antioxidant.

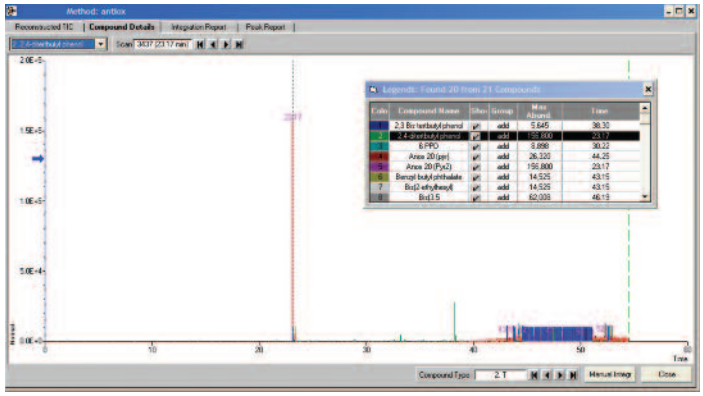

Figure 2 demonstrates the additive search using the CDS library and the Ion Signature software. As can be seen in the search window, additive 2, (4 ditertbutyl phenol), was found at 23 minutes into the GC run.

Make CDS Your Universal Inlet Partner

Worldwide Headquarters
465 Limestone Road
P.O. Box 277
Oxford, PA 19363-0277 USA
Toll Free 800-541-6593
610-932-3636
Fax 610-932-4158
www.cdsanalytical.com

CE Approved

Headquarters

JSB Group
Beemdstraat 17-A
5653 MA Eindhoven
T +31 (0) 40 251 47 53
F +31 (0) 40 251 47 58

Sales and Service

JSB Netherlands
Apolloweg 2-B
8239 DA Lelystad
T +31 (0) 32 087 00 18
F +31 (0) 32 087 00 19

JSB Belgium
1831 Diegem
Grensstraat 7 Box 3
T +32 (0) 85 252 405
F +32 (0) 85 845 898

JSB Germany
Max-Planck-Strasse 4
D-47475 Kamp-Lintfort
T +49 (0) 28 42 9280 799
F +49 (0) 28 42 9732 638

JSB UK & Ireland
Cedar Court,
Grove Park Business Est.
White Waltham, Maidenhead
Berks, SL6 3LW
T +44 (0) 16 288 220 48
F +44 (0) 70 394 006 78

info@go-jsb.com
www.go-jsb.com

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