



Thermo Scientific GC-IRMS



Discover More
using the Next Generation
of GC-IRMS

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Discover More . . .

using the Next Generation of GC-IRMS



Add Isotope Ratio Information to Your Research

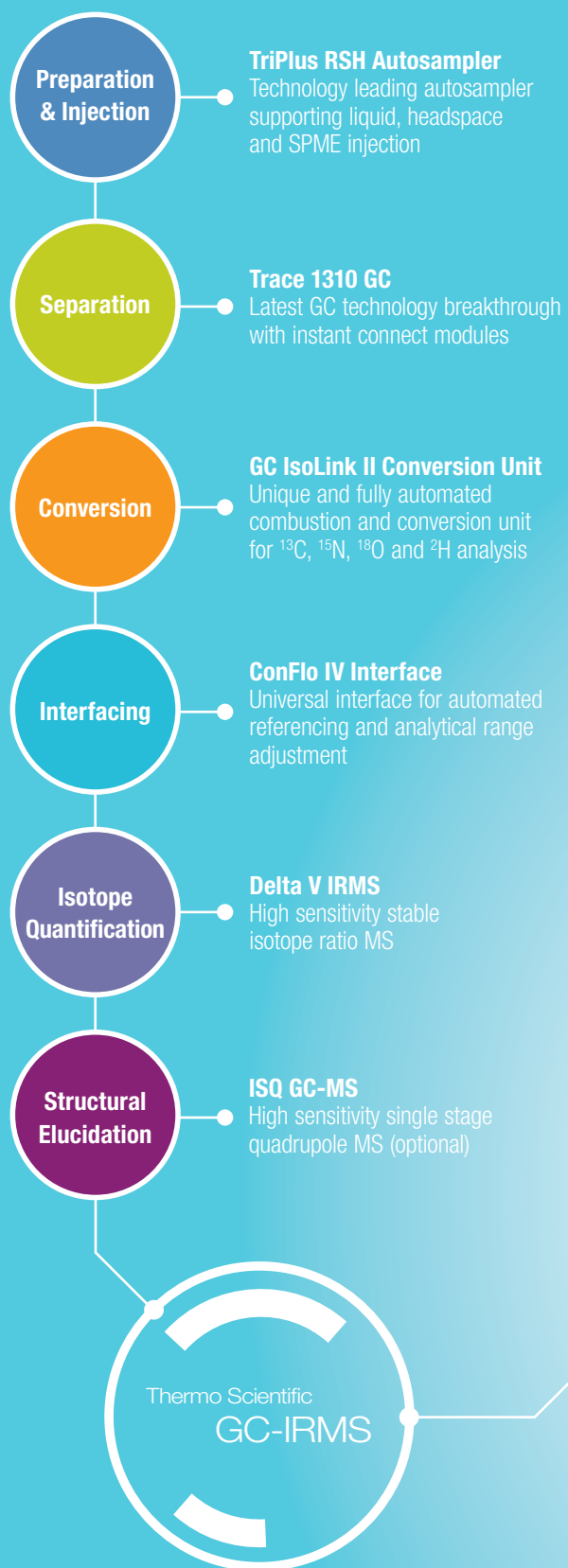
Chemical and physical processes can change the natural isotope composition of organic compounds. The carbon, nitrogen, oxygen and hydrogen isotope ratios preserve a trace to these events in every molecule of a compound. These isotope signatures reveal information not accessible in any other way. The isotopes ^{13}C , ^{15}N , ^{18}O and ^2H in complex GC mixtures provide scientists with a wealth of information on uncovering:

- Origin of compounds
- Metabolic pathways
- Synthesis and diagenetic pathways
- Conditions at a compound's formation
- Unknown compounds

Next GC-IRMS Generation

Our GC-IRMS solution provides a significant step forward in analytical performance and capability. Harnessing the combined power of the Thermo Scientific™ TRACE™ 1310 GC, GC IsoLink II™ preparation device and the ConFlo IV™ reference interface with our powerful Delta V™ isotope ratio MS at its core, builds a seamless solution to meet the analytical challenges of today's rapidly expanding isotope ratio world.

The system can additionally incorporate any benchtop MS from our portfolio of GC/MS technologies. From a single injection, the identity and isotope ratio of each target compound can be qualified by a hyphenated GC-MS-IRMS system.



Discover More . . . in Your Samples

Energy Exploration

Isotopic signatures of natural gas show that many petroleum reservoirs have complex fill histories.

$\delta^{13}\text{C}$ and $\delta^2\text{H}$ values of light hydrocarbons and CO_2 can uncover the history of natural gas accumulations determining the origin and thermal maturity which are the required information for gas generation.



? What is the fill history of natural gas accumulations?



Paleoclimate Research

Reconstructing changes in vegetation, rainfall patterns and temperature is possible by measuring C, H, N, S and O stable isotopes. By extracting organic and inorganic materials from archives such as sediments, ice cores and speleothems, it is possible to understand climate changes on timescales from decades to millions of years. For example, $\delta^{13}\text{C}$ of sedimentary organic matter can be related to changes in vegetation and $\delta^2\text{H}$ to changes in precipitation.

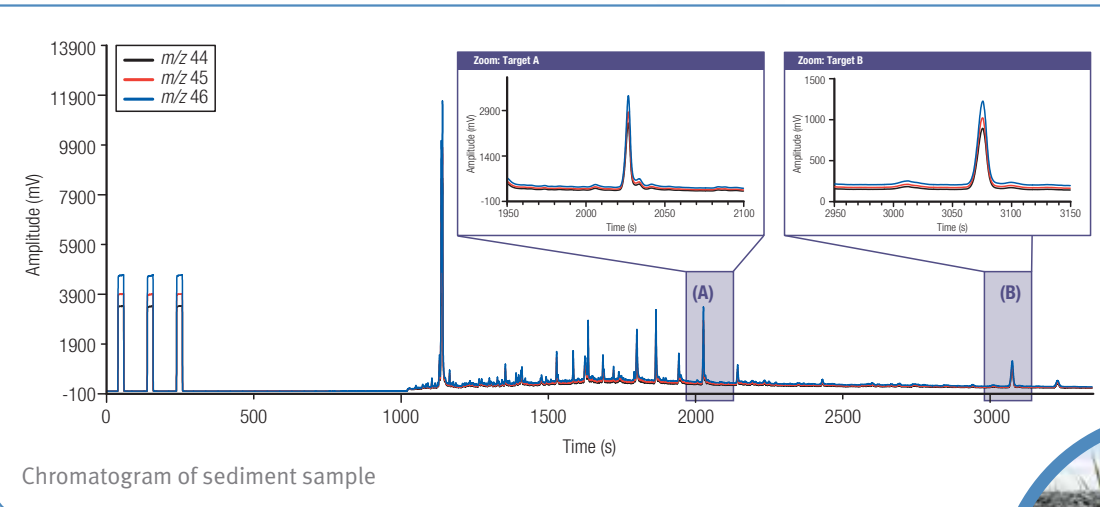


? What was the climate like 500,000 years ago?

Environmental Forensics

Changes in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ of individual organic pollutants correlate with their level of degradation in soil profiles.

Due to kinetic isotope effects, parent compounds carrying heavy isotopes (^{13}C , ^{15}N) become enriched in the course of degradation: this isotopic enrichment allows the assessment of soil and ground water contamination. Consequently it can suggest remediation strategies.



? What is the degradation profile of organic pollutants in soil and ground water?

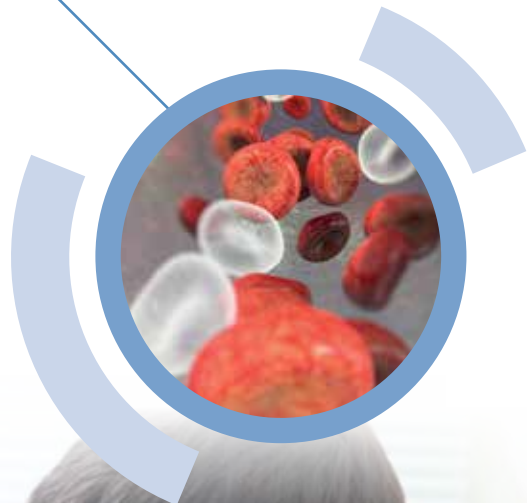


Discover More . . . in Your Samples



Healthy Lifestyle

Stable isotopes with low enrichments are more and more used in clinical diagnosis and research. Stable isotopes close to natural abundance such as ^{13}C , ^{15}N , ^{18}O and ^2H have no adverse effects and are safe for clinical trials. Metabolic problems can be detected and addressed early by nutritional or other medical treatment.



? What are the precursors of the target compounds?



Food Authentication

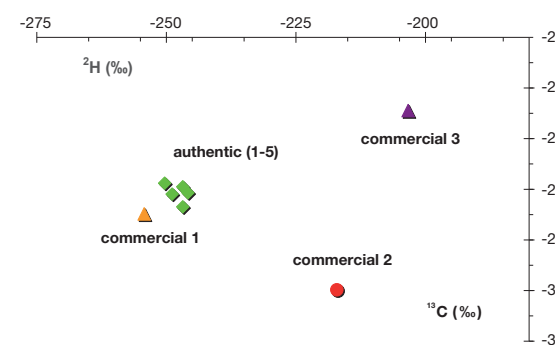
Stable isotope ratios of carbon, nitrogen, oxygen and hydrogen can serve as endogenous parameters for the authenticity assessment of food, flavors and essential oils. Isotope signatures of natural compounds are imprinted by biochemical reactions and physical processes. Geographical, climatic and agricultural parameters affect the isotopic compositions of plants and animals providing a basis for isotope fractionation.

Isotopic ratios measured by GC-IRMS allow the differentiation between synthetic and natural products as well as geographical provenance preventing frauds in food products. These data provide isotopic fingerprints as a robust tool for food authenticity.

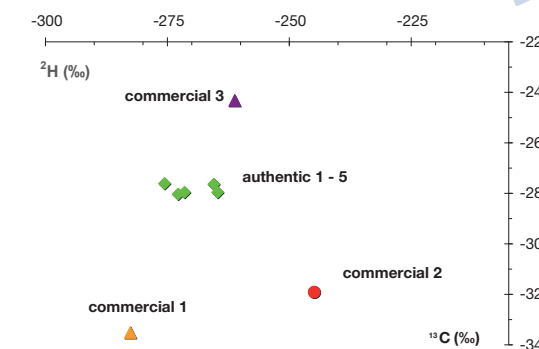
? What is the origin of food, flavors and essential oils?



Linalool



Linalyl Acetate

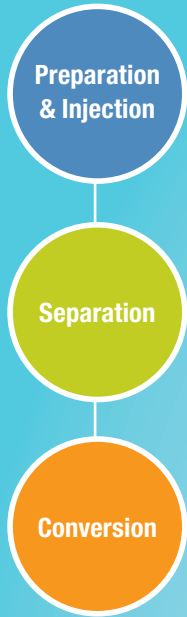


Authenticity control of bergamot oil: Isotopic profiles of the main compounds linalool and linalyl acetate



Discover the . . .

Next Generation of GC-IRMS



GC-IRMS
Solution

Discover More . . . using the Next Generation of GC-IRMS

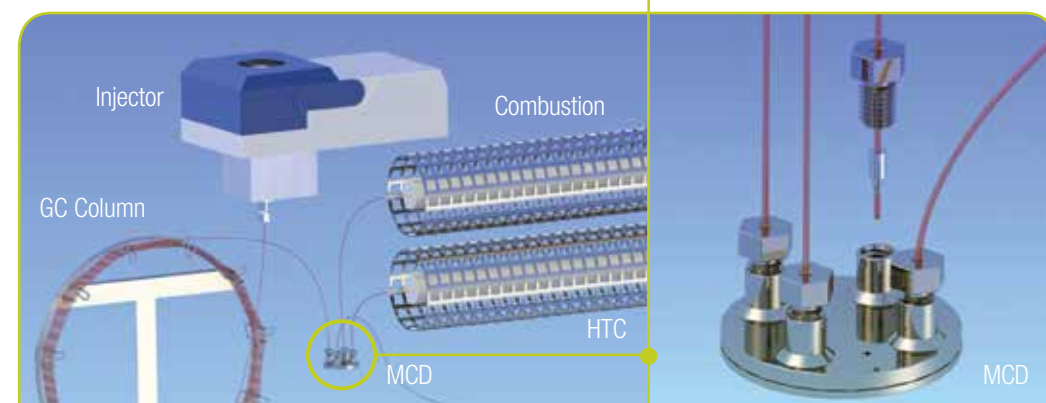
Maximize Your Isotopic Information

True high resolution gas chromatography with the Trace 1310 GC enables maximal separation of constituent components in complex mixtures. To faithfully reproduce this separation within the isotope ratio mass spectrometer (IRMS) demands the highest standards in hyphenation. Utilizing our unique on-line GC IsoLink system, chromatographic integrity is maintained maximizing your information content.

Micro Channel Device (MCD)

Attain Higher Resolution and Sensitivity by Full Connectivity to Reactors

Unleash true capillary GC for GC-IRMS by connecting reactors with the GC system via micro channel devices.



Benefits of Micro Channel Devices

- **Chemically deactivated internal channels** - Inertness results in analysis with enhanced quantitative accuracy and high reproducibility. When incorporated into the GC chromatography system, there is no impact on chromatography.
- **Low dead volume connections** - A reliable zero dead volume system gives optimized peak shapes.
- **Superb operational stability** - Thermal lag is negligible as the GC tracks the oven temperature up to 20 °C/min alleviating cold spots and sample condensation. There is no practical temperature limit (≤ 420 °C).
- **Easy to install and leak free** - Each device is easy to set up and can be tightened using finger force to achieve a perfect, reliable seal, even for the most sensitive MS systems. No wrenches are required.

TriPlus RSH Autosampler

Flexible Autosampler Platform Configurable for Simple Liquid Injection to Extended Sample Preparation

The Thermo Scientific™ TriPlus™ RSH autosampler utilizes robotic sample handling to expand automated capabilities beyond liquid, headspace and solid-phase micro-extraction (SPME) injections to advanced sample handling cycles. Results benefit from improved precision and reproducibility, while your laboratory gains unique advantages from the system's unattended operations and sample handling flexibility.

ConFlo IV Interface

Optimize Transfer to IRMS, Automated Referencing and Adjustment of Reference Gas Signal

In combination with the ConFlo IV universal interface, the utilization of the GC effluent is maximized using an optimized open split flow transfer for low GC flows. Reference gas provides the link between samples and international standards. All reference gases are automatically available and adjusted by He dilution.

Delta V IRMS

Analyze the Smallest Samples with Ultimate Sensitivity of IRMS

The GC-IRMS solution allows you to capture the isotopic information on compounds in the low fmol range. The Delta V is the most sensitive instrument in its class. The ion source comprises of a unique combination of the Thermo Scientific™ Omega™ Ion Volume and an integrated quadrupole focusing element. The Omega Ion Volume has been specifically designed to extract the maximum number of ions generated. A quadrupole focusing element of the Delta V Plus system allows maximum transfer of ions into the magnetic analyzer while minimizing dispersive energy spreads.

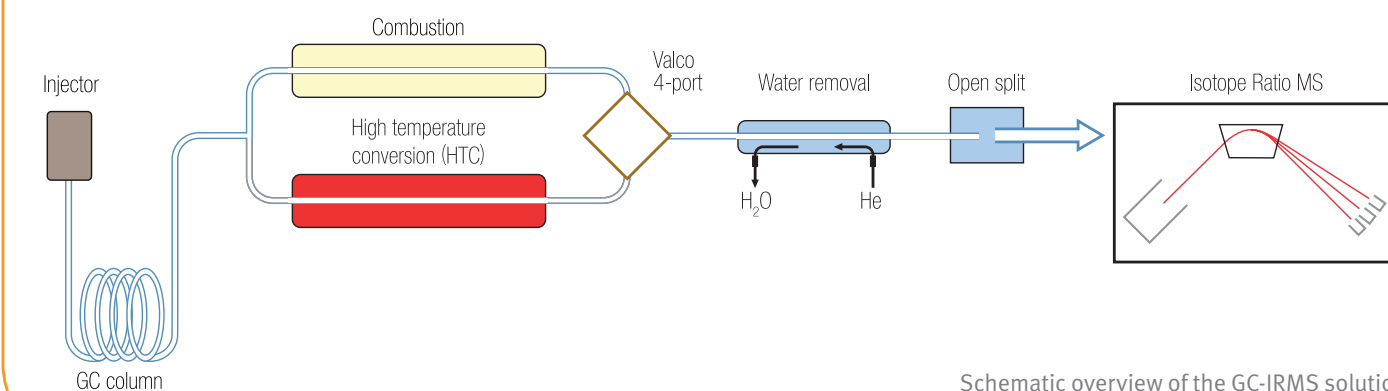
GC IsoLink II Conversion Unit

The GC IsoLink II conversion unit contains a holistic capillary design system built on our unique high temperature combustion and conversion technology ensuring complete conversion of compounds by combustion into CO₂ and N₂ containing their entrained ¹³C and ¹⁵N signatures. High temperature conversion provides H₂ and CO imprinting ²H and ¹⁸O signature of compounds.

Effluent from the GC passes through a ferrule free region maintaining laminar flow avoiding unnecessary turbulences at the critical interface to the integrated reactors.

Based on the success of the first GC IsoLink design the new system provides a seamless GC-IRMS solution with latest innovative GC components incorporating a micro channel device for coupling GC with reactors and a temperature-controlled backflush system. The post-column backflush ensures quantitative removal of solvents in front of the reactors for highest conversion efficiency and reactor capacity.

- Leverage unrivaled accuracy and precision
 - by quantitative high temperature combustion at 1000 °C
 - by quantitative high temperature conversion at 1420 °C
- Attain sharper peak shape and higher sensitivity in GC by true capillary design
- Experience robust, easy to use automated system for ¹³C, ¹⁵N, ²H, ¹⁸O



Schematic overview of the GC-IRMS solution

Trace 1310 GC

Innovative Solutions to Optimize GC and Tailor Configurations to Application Needs

Unique and innovative breakthroughs featured on the TRACE 1300 Series Gas Chromatograph elevate performance while empowering the user.

Enable Quick Customization with GC Modularity: The Advantages of Instant Connect Injectors

Interchangeable modules free your laboratory from the challenges and constraints of the past. Remove the complexity and eliminate the need for specialized service assistance or new system requirements with modular injectors and detectors. Transcending the traditional GC design model, the Instant Connect injector and detector modules are independent GC components which are fully self-sufficient sub-units of the instrument, incorporating all electronic circuits and pneumatic controls together with the injector body or detector cell, for exceptional results consistency.

The TRACE 1300 Series GC is an extremely fast, easy to use, compact GC, delivering incredibly high lab productivity at a much reduced cost of ownership.

Benefits of the TRACE 1300 Series GC

Maximize System Uptime

- Remove dirty injectors or detectors, replace them with clean ones, and start running samples in a few minutes
- Resume GC-IRMS operations quickly
- Postpone maintenance when the laboratory schedule allows
- Make troubleshooting easy

Tailor Configurations to Application Needs and Workload Requirements

- Ensure constant laboratory response time – even when work schedules change unexpectedly
- Always choose the best configuration for any application
- Quickly switch from an SSL to a PTV injector

Discover . . .

the Next Generation of Hyphenated GC-MS-IRMS

Sports Performance

The misuse of endogenous anabolic steroids can be detected by measuring the $\delta^{13}\text{C}$ values of the steroid itself or its metabolites which show depleted isotopic composition while the endogenous reference compounds are not affected.

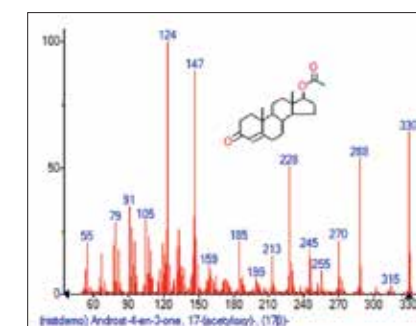
Samples showing suspicious steroid profile parameters are isotopically characterized in order to prove the origin of urinary steroids.



Confidently Qualify Your Isotopic Results within a Single Analysis

Concomitant data is essential or even mandatory in a court of law to qualify the true identity of a compound. The combination of IRMS and quadrupole MS hyphenated to a single Trace 1310 GC provides vital complimentary information. From a single injection, the structure and isotope ratio of each compound can be determined.

In challenging matrices, identification of minor components masked by dominant co-eluting compounds brings major uncertainty in data confidence. Isotope ratio MS is an invaluable tracer for identifying these minor and unknown components, allowing unambiguous compound identification in data simultaneously generated from a full GC/MS scan.



Metabolite Identification Studies

Comprehensive studies on the metabolism of therapeutic agents and drugs with misuse potential are required to identify metabolites.

Direct coupling of IRMS and the Thermo Scientific™ ISQ™ single quadrupole GC-MS system can be used to identify unknown metabolites and provide structural elucidation and confirmation.



Discover . . . the Next Generation of GC-IRMS



For over 60 years Thermo Fisher Scientific has been the leading supplier of isotope ratio instrumentation to scientists across the world.

Our GC-IRMS systems have enabled some of the most exciting pioneering discoveries in the study of metabolic pathways and the history and origin of all kind of samples.

Our foundations are based on strong collaborative partnerships that have allowed us to become the leading provider of gas chromatography.

Over 1000 isotope ratio mass spectrometry systems hyphenated with gas chromatography (GC-IRMS) have been successfully integrated into customers' laboratory workflows during the last 25 years.

Thermo Fisher Scientific offers a proven global distribution, support and service network with thousands of satisfied customers in the field of isotope analysis.

Thermo Scientific Isotope Ratio Analyzers

Thermo Scientific™ Delta Ray™ Isotope Ratio Infrared Spectrometer



Delta V Isotope Ratio MS with Elemental Analyzer



Delta V Isotope Ratio MS with Gas Chromatograph



Thermo Scientific™ MAT 253™ Isotope Ratio MS



www.thermoscientific.com/GC-IRMS

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