Rigaku

Thermo Mass *Photo*

Simultaneous measurement system of TG-DTA-Photoionization Mass Spectrometer

Power is demonstrated over a wide range of analysis from hydrogen storage materials, ceramics to polymers

Thermo Mass *Photo*

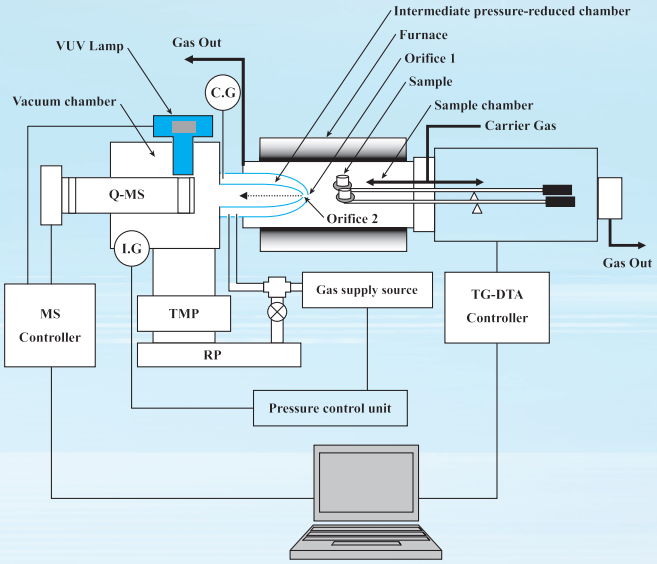
Simultaneous measurement system of TG-DTA-Photoionization Mass Spectrometer

The world's first, Skimmer-type TG-DTA-MS coupled with fragment-free photoionization technology is achieved with high precision evolved gas analysis.
It can also clearly detect minute amounts of hydrogen.
It is an essential tool which strongly supports development of new materials, establish manufacture technology, quality control as well as basic research and can also measure under water vapor atmosphere.

Applications

- Analysis of Hydrogen Storage Alloys
- Inorganic gas analysis associated with catalyst reaction
- Minute evolved gas analyses from high tech materials such as epoxy resins for sealing, polymer films for electronics, etc.
- Minute evolved gas analysis from plastics used for food and medical purposes; or safety confirmation test upon heating
- Thermal degradation characterization of polymers
- Safety evaluation of pharmaceuticals

TG-DTA-PIMS system equipped with Skimmer-type interface

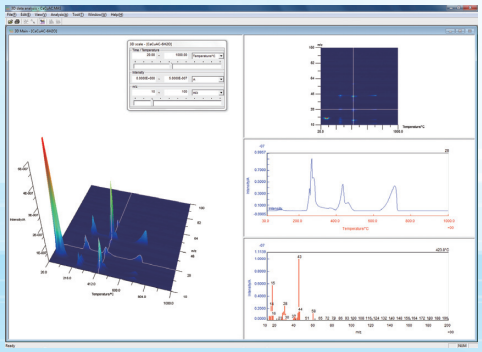


Feature

- **Adopts the photoionization principle which is a fragment free and a soft ionization method**
  (Patent pending)
- **Selective ionization modes of electron impact ionization method and photoionization method**
- **The highly reactive gases are caught at a high sensitivity through the Skimmer principle having two orifices structures**
- **Detection range from hydrogen up to *m/z* 410 at high sensitivity**
  Gases with low molecular weights such as H_2, H_2O, CO and inorganic gases up to a mass range of *m/z* 410.
- **Detection unexpected gases under high sensitivity**
  In order to detect all evolved gases, it is equipped with high speed TIC scan mode as a standard.
- **Separation of complex reactions through simultaneous measurement of dynamic TG and MS**
  Understanding complex multi-stage reactions and translational reactions through simultaneous measurements of dynamic TG and MS. ThermoMass Photo is equipped with 3 dynamic TG measurement modes namely dynamic rate control (DRC), constant reaction control (CRC) and stepwise isothermal analysis (SIA).
- **Improved operation**
  Using the installed guidance function software, the measurement is easily performed and provide a far greater efficiency.
- **All-in-one style**
  Space-saving and safety are achieved by its structure considering also maintenance.

3D Display and Analysis Software for Thermally Evolved Gas Analysis

Support your analysis and evaluation for combined information in thermal analysis and gas analysis

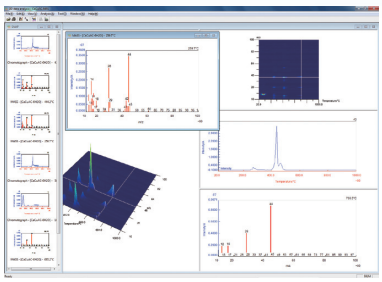


Using the combined thermal analysis method, the obtained matrix data is shown in an easy-to-see 3-dimensional diagram, selection of 2-dimension data from various angles, easy extraction, data analysis and speedy evaluation of data.

- **Analysis results are shown in 3-dimensional matrix data, allows to operate freely on all angles (360° rotation) and the gas evolution behavior can observed from the wide range of temperature (Patent).**
- **Enables you to freely select and extract a mass spectra of an arbitrary temperature or a mass number from the ion chromatogram of the 2-dimensional data by the use of the mouse cursor.**
- **A multiplot of the thermal analysis and the ion chromatogram data can be easily created by selecting the mass number ion and the direct drag & drop operation of the mouse.**
- **Each selected two-dimensional data can be stored and managed as a bit map image on the「Snap Shot Display」allowing the user to revise and analyze the data freely (Patent).**
- **The mass spectrum selected at an arbitrary temperature is directly linked to the NIST-MS library search software and qualitative analysis can be automatically performed.**
- **Measurement data obtained from Thermo Plus/ Evolved gas analysis module series, simultaneous TG-DTA-MS (Thermo Mass) and other temperature programmed desorption (TPD) module series.**

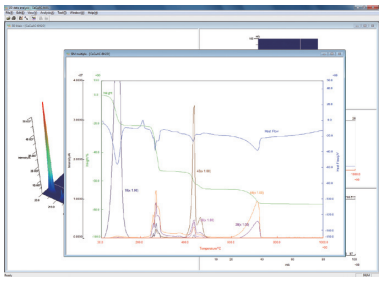
Snapshot Function

Displays the 3-dimensional data, it allows not only operation but also selection from arbitrary angle or temperature; extracted mass spectra or ion chromatograms are stored as bit map images and「Snap Shot Display」images are manageable. Analytical data processing is thoroughly performed on the target data by revising this image display using the mouse click operation.



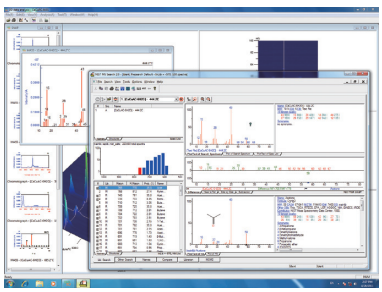
Multiplot display of thermal analysis data (TG-DTA) and MS data

The multiplot display of the thermal analysis data (TG-DTA) and MS ion chromatogram is easily processed from all screens (3D analysis screen, snap shot and ion chromatogram analysis display) using the mouse allowing a smooth and convenient data processing. In addition, the mass number in a mass spectrum display is clicked directly and several selected drag and drop access is possible.



Automatic qualitative analysis of the mass spectrum

The qualitative analysis of the mass spectrum at an arbitrary temperature can be automatically performed by directly linking to the NIST-MS Library search software (option).

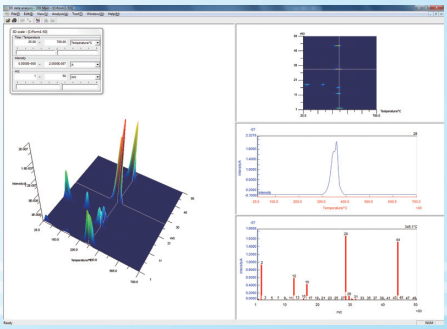


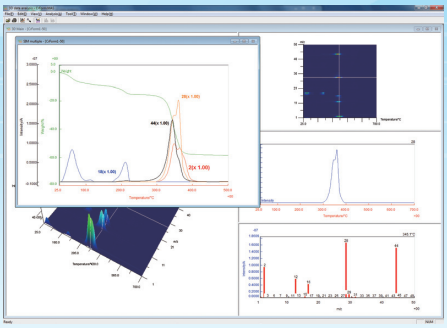
Example analyses

The formation of metallic oxide through thermal degradation of metal organic salt

The formation of chromium(III) oxide by thermal degradation of chromium(III) formate pentahydrate

One way of creating an ultra fine ceramics is by the thermal degradation that makes an metal organic salt as a precursor. Most of this metal organic metal salt continues to dehydrate and the anhydrate passes through several reaction stages producing an oxide. However, most of these reactions are unclear. Using the TG-MS, mass changes due to thermal degradation quantified by the thermogravimetry and corresponding to these thermal changes are simultaneous generation of degradation evolved gases and since gases from hydrogen (*m/z* 2) are qualitatively analyzed by mass spectrometry, the thermal process of the organic salt can be analyzed specifically.



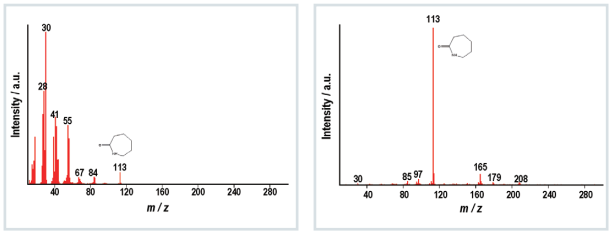


Characterization of thermal degradation in polymers

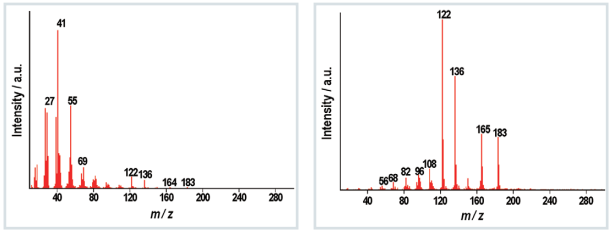
Thermal degradation of nylon

Depending on the amide bonds, nylon is a polyamide composed of several monomer bonds forming a resin backbone. The following figures show the comparison of TG-DTA-PIMS measurement results of 3 typical nylons with similar structures. Thru the conventional electron impact ionization (EI) method, in the EI mass spectra (EMS) the fragment ions of degradation components mutually overlap each other resulting to difficulty in identifying the nylons individually. On the other hand, the PI (photoionization) mass spectra (PIMS) show the differences in backbone structure composed of degraded components of molecular ions only. The nylon spectra exhibited clear differences among samples and can be distinguished from each other. Caprolactam (*m/z* 113), undecanlactam (*m/z* 183), lauryl lactam (*m/z* 197) are the respective monomers of Nylon 6, Nylon 11 and Nylon 12 which are clearly characterized on the mass spectrum. In this way, the fragment-free feature of the PIMS is to sensitively catch the minute changes among samples, therefore, it is useful for fingerprint analysis thru the mass spectrum.

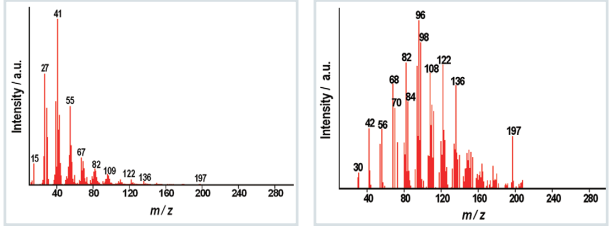
Nylon 6



Nylon 11



Nylon 12



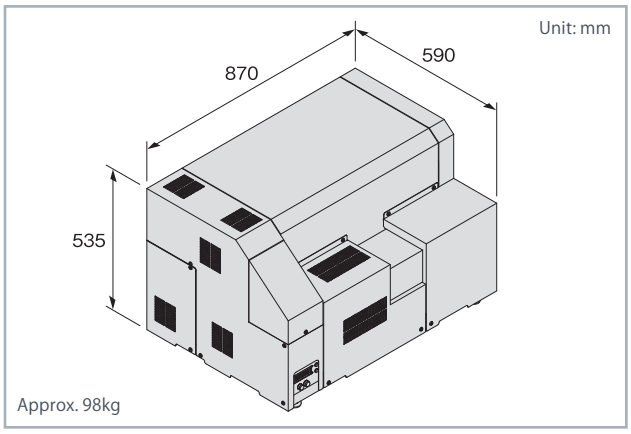
Specifications

Differential thermo balance		Horizontal differential thermogravimetric-differential thermal analyzer (TG-DTA)
Skimmer-type Interface	Principle	Jet separator principle installed within the electric furnace
	Material	Quartz type
	Temperature range	Room temperature to 1,000℃
Mass spectrometer	Mass detector	Quadrupole type
	Mass range	*m/z* 1～410
	Minimum detection pressure	1.5×10^{-12} Pa or less
	Detector	Channeltron electron multiplier (CEM)
	Measurement mode	TIC scan, SIM (maximum 16 channels), partial pressure mode (10 types)
	Ionization method	Electron impact ionization (EI) 20～70eV, Photoionization method (PI) (arbitrarily selected)
	Exhaust system	Turbo molecular pump 58L/s (He), Rotary pump (External) 135L/min

※ For specifications of TG-DTA, please refer to the thermal analysis module catalog.

Utility

Required power supply	1φAC100V±10% 50/60Hz 20A 5m long solderless terminal cord
Gas supply	Secondary pressure 100kPa (1kgf/cm²) or less



Excluding the external rotary pump

*Figures of performance in this catalog are results from tests by Rigaku Corporation and are not guaranteed to be reproduced under other test conditions.

*Company names and product names in this catalog are trademarks of the companies and/or registered trademarks.

Specifications and appearance are subject to change without notice.

Rigaku

Rigaku Corporation Tokyo Branch

4-14-4, Sendagaya, Shibuya-ku, Tokyo 151-0051, Japan
Phone:+81-3-3479-0618 Fax:+81-3-3479-6112 e-mail:rinttyo@rigaku.co.jp **www.Rigaku.com**

Rigaku Corporation
Head Office
3-9-12, Matsubara-cho, Akishima-shi, Tokyo 196-8666, Japan
Phone:+81-42-545-8189 Fax:+81-42-544-9223
e-mail:rinttyo@rigaku.co.jp

Rigaku Americas Corporation
9009 New Trails Drive,The Woodlands, Texas 77381-5209, USA
Phone:+1-281-362-2300 Fax:+1-281-364-3628
e-mail:info@rigaku.com

Rigaku European SE
Gross-Berliner Damm 151, 12487 Berlin, Germany
Phone:+49-30-6264035-0 Fax:+49-30-6264035-10
e-mail:rese@rigaku.co.jp

Rigaku Corporation
Osaka Factory
14-8, Akaoji-cho, Takatsuki-shi, Osaka 569-1146, Japan
Phone:+81-72-693-7990 Fax:+81-72-693-6746
e-mail:rinttyo@rigaku.co.jp

Rigaku Beijing Corporation
2601A, Tengda Plaza, No. 168, Xizhimenwai Avenue,
Haidian District, Beijing 100044, P.R.China
Phone:+86-010-8857-5768 Fax:+86-010-8857-5748
e-mail:info@rigaku.com.cn

0000000000000000000