열전도도측정기 · 열분석기 · 열량계 ARC · 고온고압 점도계 · DTA/DSC 핫스테이지 · SThM probes · Dilatometer · 열확산율측정기 · 분석서비스

CALORIMETER

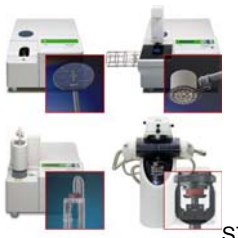
Thermal Analysis http://www.yeonjin.com

Accelerating Rate Calorimeter, es-ARC
Battery Calorimeter, EV-ARC
(World wide bench marking product)
Reaction Calorimeter, μRC, MRC™
Rapid Screening Device – RSD™

World Wide Bench Marking Products

Micro RC


ARC


STAR^{e}

DSC, TGA/DSC, TMA, DMA
(High Resolution / High Sensitivity)
FP (Hotstage, Melting, Softening)

Valuable Application

Thermal Conductivity Meter
Dilatometer (Thermal Expansion)
Thermal Diffusivity Analyzer

Customized for your needs


FlashLine™-2000


Dual Hot stage

Microscopic Hot/cold Stages
Liquid crystal measurement instruments

Various application for thermal microscopy

Dilatometer (Quenching, Deformation)
High Temp. DSC/DTA, STA, TMA
High Temperature Viscometer
Plastometers

Versatile and Easy to Use


Quenching / Deformation Dilatometer DIL805A


High Temperature Viscometers

YEONJIN
(주)연진코퍼레이션

Thermal properties solution provider!
We serve only thermal properties solutions.

Find out more our high techniques

For more information, visit our website

www.yeonjin.com

주식회사 연진코퍼레이션

(150-805) 서울특별시 영등포구 당산동 4가 32-141번지 연진빌딩 3층

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http://www.yeonjin.com

㈜연진코퍼레이션 취급 제품

열전도도측정기 / 열저항측정기

Thermal Conductivity / Thermal Impedance

QuickLine™-10, Unitherm™-2022, QuickLine™-50

고온시차주사열량계

Differential Scanning Calorimeter

High Temperature **DTA / DSC**

DSC/DTA701, DSC/DTA703

열팽창계수측정기

Dilatometer

Unitherm™-1000, DIL801, DIL802-, DIL803

Quenching / Deformation dilatometer; DIL805A/D

열확산율측정기 / 열전도도측정기

Thermal Diffusivity / Thermal Conductivity Analyzer

FlashLine™-2000, FlashLine™-3000, FlashLine™-4010, FlashLine™-5000

나노유체 열전도도측정기

Nanofluid thermal conductivity meter

LAMBDA 2, LAMBDA 1

점 도 계

Viscometer / Rheometer

Quartz Laboratory Viscometer, Smallest sample volume

공정용점도계 Quartz Process Viscometer

고압점도계 MicroPVT

고온점도계

High Temperature Viscometer

Rotation viscometer

Fibre elongation viscometer

Beam bending viscometer

Thermal properties solution provider!

열분석기 Thermal Analyzer

시차주사열량계 DSC1
열중량분석기 TGA/DSC1
열기계분석기 TMA840-841E
동적기계분석기 DMA861E

열량계 Calorimeter

Lithium Battery Calorimeter
쾌속발열량계 Rapid Screening Calorimeter, RSD
가속속도열량계 Accelerating Rate Calorimeter, ARC
EV-ARC 대용량배터리열량계, Multi-point BPC
마이크로반응열량계 Micro Reaction Calorimeter, uRC
코인형배터리열량계 Isothermal Battery Calorimeter

용융특성측정기 Fusion Point Apparatus, FP series

Melting point determination MP50/7-90
Melting -, cloud – and clear point
Microscopic Hotstage
Softening / dropping point

핫스테이지 Microscopic Hot/cold stages

핫 척 Hot/cold Chucks

핫플레이트 Hot/cold plates

SThM (Scanning Thermal Microscope) 용 **Thermal Probes**

열분석서비스 Test service of Thermal Analysis (DSC, TGA/DTA/DSC, TMA, DMA)

열분석워크샵 Thermal Analysis Workshop

TGA/DSC/DTA Alumina pan, Aluminum pan

For more information, visit our website: http://www.yeonjin.com

Index for this product guide booklet

THERMAL CONDUCTIVITY

Anter, USA

열전도도측정기, 열저항측정기

QuickLine™ -30 is a very low cost thermal properties analyzer with interchangeable surface and needle probes for a wide variety of materials in environments from –20°C to 70°C. Portable operation for field use or process control. Test times in minutes.

MODEL 2022 Guarded Heat Flow Meter for testing of polymers, ceramics, metals and other materials of low to medium thermal conductivity. Also capable of testing viscous fluids. *Temperature Range* –20°C to 300°C. Available as a manually operated instrument or fully computerized system. Conforms to ASTM E1530.


Unitherm™ Model 2022

QuickLine™-10 is a lower cost guarded heat flow meter instrument for operation at ambient temperature. An automated version is available for QA applications. Conforms to ASTM E1530.


QuickLine™-50

QuickLine™ -50 is a device specifically developed for measuring **interface thermal resistance of thin film**. It is based on a newly developed transient technique (patent pending) that is a magnitude faster than steady state measurements, and can also readily measure very low impedance combinations. *Temperature Range* RT to 150°C.

FireLine™ -1000 is a fully automated computer controlled instrument specifically designed to measure the thermal conductivity of certain fire resistive materials and general purpose insulating materials. It uses a **direct / absolute method** that requires no calibration. *Temperature Range* RT to 1000°C

MODEL 6000 Guarded Hot Plate for testing of thermal insulations and other materials of low thermal conductivity. Models cover ranges from -180°C to 550°C. Sample size 300mm square, maximum sample thickness 75mm. Fully computerized system. Conforms to ASTM C177 and ISO 8302.

1700 Universal Road, Pittsburgh, PA 15235-3998 USA

anter corporation

THERMAL DIFFUSIVITY

Anter, USA

열확산율측정기 / 열전도도측정기

FLASHLINE™- 2000

FLASHLINE™- 2000 is suitable for research and development programs, as well as quality control. It is easy to maintain and very economical to operate in terms of consumables. The pulse module is integral, forming a compact bench top unit. The output of the HSXD is channeled through a proprietary patented wave guide to any of the specimens. Pulse delivery through the wave guide produces outstanding flux uniformity that greatly improves the data. It covers a temperature range from RT to 300°C.

FLASHLINE™- 3000 is a moderately priced system for temperatures from –180°C to 1000°C. It uses a high speed xenon discharge (HSXD) pulse source to test larger, coarse-grained materials (refractories, carbons, rocks, etc.) and composites. Multiple sample capability allows specific heat capacity measurement and thermal conductivity determination.

FLASHLINE™ - 5000 series is a modular laser flash system that can be configured to satisfy the most diverse requirements from insulators to highly conductive materials.
It can be supplied with one or several different furnaces to cover a temperature range from -180°C to 2700°C, and to accommodate single or multiple specimens. The state-of-art high speed electronics and the extensive dedicated software based on the best available theoretical and practical foundations generated in the past twenty five years. Highly accurate specific heat capacity measurement and thermal conductivity determination.

1700 Universal Road, Pittsburgh, PA 15235-3998 USA

anter corporation

CALORIMETRY

Thermal Hazard Technology, UK

열량계 – 가속속도열량계(ARC), 발열량계, 반응열량계

The Accelerating Rate Calorimeter; ARC™

The world's benchmark adiabatic calorimeter. Giving full adiabatic runaway information for both temperature and pressure events. Also the EV-Accelerating Rate Calorimeter the worlds only purpose designed adiabatic battery calorimeter.

The EV-Accelerating Rate Calorimeter; EV-ARC™

The world's only purpose designed adiabatic calorimeter for batteries. Capable of looking at storage and EV batteries the EV-Accelerating Rate Calorimeter retains the high sensitivity and adiabacity of the original instrument.

Rapid Screening Device - RSD™

A new instrument to give you rapid access to exothermic data. This instrument allows you to run up to 6 samples simultaneously.

Micro Reaction Calorimeter - μRC™

A new reaction calorimeter - working with small volumes giving rapid and accurate enthalpy data and enabling rapid access to reaction kinetics.

Micro Multicell Calorimeter - mMC™

Our latest reaction calorimeter permits up to 8 samples (plus 2 reference) to be measured simultaneously. Ideal for excipient compatibility, food spoilage, microbial growth, denaturation and chemical stability studies.

www.thermalhazardtechnology.com

thermal hazard technology

DILATOMETRY

Baehr-Thermo, Germany

Quenching / Deformation dilatometer

This special dilatometer is used for the determination of deformation parameter and for the creation of continuous cooling and isotherm TTT-diagrams.

High heating rates of up to 4000K/s and cooling rates of 2500K/s as well as deformation rates of 0,01 to 125 mm/s are the main features. The following parameters are e.g. determined: deformation way, flow stress, strain rate, true strain, HF-power, change of length, temperature, time.

The entire electronics operate digitally and with an own processor system to control the HF generator, the hydraulic system, the measuring data recording, the gas supply, the vacuum units and the safety devices.

The professional 32-Bit software WinTA 9.0 runs under Windows® NT,2000, XP. An extensive software accurately and efficiently deals with both routine tasks and comprehensive evaluations. Export functions as tables in ASCII and Excel format as well as graphic file outputs in the formats BMP, JPG, TIF, EMF etc. enable a cross-platform work.

열팽창계수측정기 Dilatometer

We offer a wide range of various horizontally and vertically operating dilatometers for measurements in different temperature ranges. The high measuring accuracy and the comfortable handling form outstanding features. A very high quality standard has been reached by constant innovation, e.g. digital amplifier technique, 32-Bit software and a new temperature stabilization of the measuring heads. More than 900 satisfied customers use and measure with our dilatometers every day.

VISCOMETER

Baehr-Thermo, Germany

Rotational Viscometer VIS403

Viscometers (high temperature) serve the measurement of the dynamic viscosity (η) of materials with Newtonian behaviour of e.g. glasses, slags or mould powder.

As the viscosity of these materials changes over many decimal powers (1 to 1014,5 dPa s), it is only possible to record the complete range by using different measuring methods.

For this BÄHR-Thermoanalyse GmbH offers three viscometers for different temperature ranges.

Rotation viscometer 1 to 107,5 dPa s

Fibre elongation viscometer 108 to 1012 dPa s

Beam bending viscometer 109 to 1014,5 dPa s

고압점도계 (Pressurized viscometers)

F5 Technologie, Germany

Physical, rheological and thermodynamic properties of a fluid are determined by measuring the change pressure of a sample under applied volume change and at different temperatures: the p,V,T diagram.

Pressure function
Relative volume
Specific volume
Density

Derivatives aV / 0P and 0P
Compression ratio
Bulk modulus
Strain relaxation times

- The MicroPVT can be used to investigate **hydrate formation** and **paraffin content**.
- Linking the MicroPVT with a second unit can provide a **high pressure capillary viscometer.**
- The MicroPVT can be used to measure **wax crystallisation temperature and pressure** on live fluids and on petroleum products.

PLASTOMETER

Baehr-Thermo, Germany

Plastometer serve the simulation in high temperature ranges of hot deformation processes (torsion, tension and pressure) for electrically conductive materials, such as steel, iron, non-iron metals. The plastometer is mainly used for the examination of the forge ability and for the simulation of rolling processes. High strain rates and a high true strain are distinctive features of this equipment.

Determined parameters

- **deformation way**
- **torque**
- **angle of torsion**
- **flow stress**
- **true strain**
- **strain rate**
- **HF-power**
- **change of length**
- **temperature**
- **time**

Plastometer STD810

Thermal Hot/cold stages

Instec, USA

INSTEC designs, manufactures, and markets high precision temperature controllers, microscope heating and cooling stages, and microscope warm stages, which have been used in a variety of research area.

INSTEC also manufactures precision hot chuck systems, and thermal platform systems for probing, characterization, and failure testing of liquid crystal displays (LCDs) and semiconductor wafers.

Hot/Cold Stages
Hot/Cold Chucks
Hot/Cold Plates
LCD Instruments & LC Cells

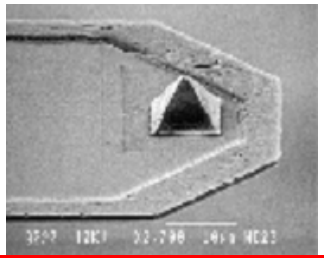
SThM Thermal probes

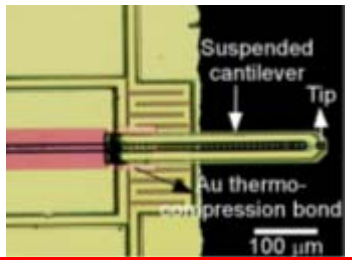
PICOCAL, USA

PICOCAL is a technology-based venture whose objective is to provide novel measurement solutions to its customers. The company's first product is a MEMS scanning thermal probe that enables users to quickly and clearly view and measure thermal properties at the nanoscale. PICOCALs products are designed to help researchers and manufacturers view critical characteristics that were not detected before. PICOCAL's team has more than 14 years of technical experience in scanning thermal microscopy and more than 20 years of microfabrication expertise.

In almost every technology there is a need for enabling instrumentation at the nanoscale. The fields that gain from PICOCAL's technology are: semiconductor, nanotechnology, biomedical, and advanced materials.

Thermal Probes
SPM modules
SThM Technical Notes
High Speed Probes
Frictional Probes





나노유체 열전도도측정기

F5 Technologie, Germany

By combining a high precision thermal conductivity sensor with an special heating device, a new standard on the field of thermal conductivity measurement of fluids could be set. The system is very suitable for measuring nanofluids.
The measurement priciple is based on a resistance measurement at a hot-wire with a diameter of only 100 um.

- Optimization of fluid development
- Optimization of fluid application
- Quality control
- In-field Fluid analysis
- Nanofluids

DTA/DSC 고온시차주사열량계

Baehr-Thermo, Germany

DTA/DSC701

Sensitivity:	20µV/mW
Measuring range:	1µV - 100µV
Accuracy:	+/- 3,0%
Resolution:	T=0,05°C, ΔT=0,01°C
Signal time constant:	10 s
Atmosphere:	inert gas, air
Temperature range:	-160°C - 600°C; RT - 1450°C; 120°C - 1700°C
Heating rate:	0,01 - 20 K/min

The differential thermal analysis (DTA/DSC) serves the measurement of the temperature difference (ΔT) between a sample and an inert sample in function of the temperature (T).

The sensitive sensor and the homogeneous temperature profile are excellent features of this DTA/DSC.

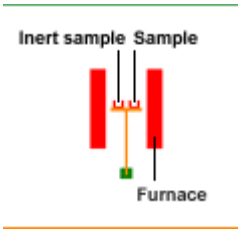
There is a good heat transfer between the DSC sensor and the sample crucible, whereas there is a high thermal resistivity towards the furnace room. This causes a high sensitivity and low time constants thus resulting in an exact determination of enthalpy, specific heat and transformation points.

The disc-shaped furnace shows an excellent and homogeneous temperature profile guaranteeing a straight and flat base line.

DTA/DSC703

Outstanding features of this DTA/DSC are the newly developed sensitive sensor, the stable base line and high heating- and cooling rates.

There is a good heat transfer between the DSC sensor and the sample crucible, whereas there is a high thermal resistivity towards the sample room. This causes a high sensitivity and low time constants thus enabling an exact determination of enthalpy, specific heat and transformation points.



The bifilar-coil furnaces show an excellent temperature profile thus guaranteeing a very good base line.
With cooling rates of 15 min (1400°C to 100°C) these furnaces are also designed for a high sample throughput.

Accuracy:	+/- 2,0%
Atmosphere:	vacuum, inert gas, air
Temperature range:	-160°C - 700°C; RT - 1450°C; 120°C - 1650°C
Heating rate:	0,01 - 100 K/min
Cooling rate:	1400°C to 100°C in 15 min

THERMAL ANALYZER : DSC, TGA

METTLER TOLEDO, Switzerland

시차주사열량계 _ DSC

DSC1

DSC1, Thermal Analysis Excellence Line is the best choice for manual or automatic operation, from quality assurance and production through to research and development. The DSC utilizes an innovative patented DSC sensor with 120 thermocouples which guarantees unmatched sensitivity.

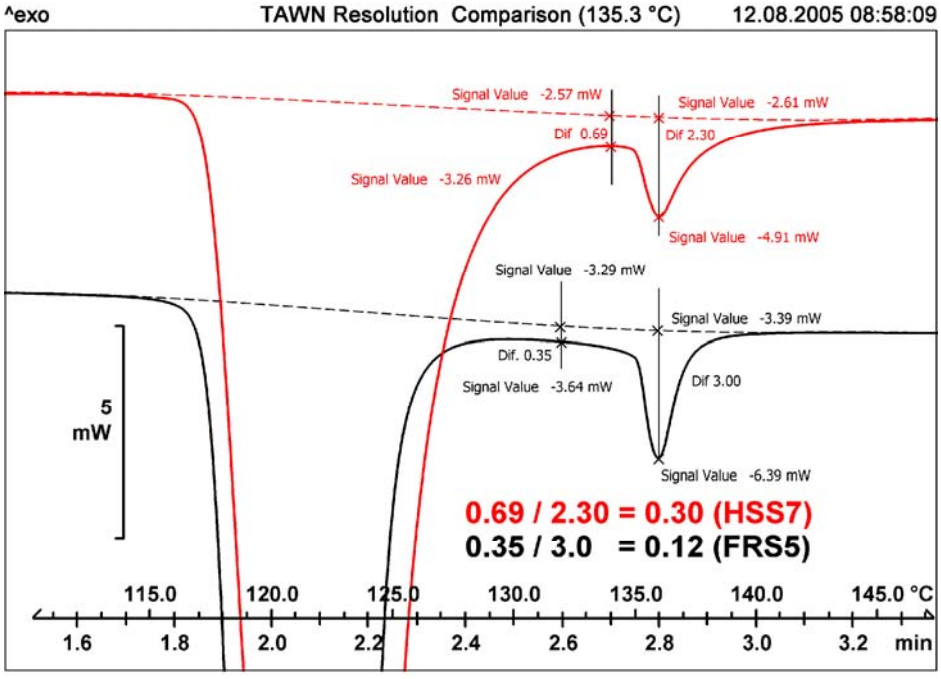
Amazing sensitivity – for the measurement of weak effects
Wide temperature range – from –150 °C to 700 °C in one measurement

열중량분석기 _ TGA/DTA

The heart of a TGA is the balance cell. Our TGA instruments use the world's best micro and ultra-micro balances. By using one of the three removable sensor types the TGA/DSC1 simultaneously measures heat flow in addition to weight change. Thanks to its modular design, the TGA/DSC1 is the ideal instrument for manual or automated operation in production and quality assurance through to research and development.

METTLER TOLEDO ultra-micro balance – the balance technology leader
Hyphenated techniques – evolved gas analysis using MS and FTIR

TGA/DSC1



DSC Application

Glass transitions
Crystallinity
Melting behavior
Melting point

Purity of materials
Phase transitions
Polymorphism
Desorption and vaporization

Chemical reactions
Kinetics (e.g. curing)
Thermal stability
Specific heat capacity
Ageing and
thermal history

THERMAL ANALYZER : TMA, DMA

METTLER TOLEDO, Switzerland

열기계분석기 _ TMA

With the TMA/SDTA840 you can measure dimensional changes of a sample as a function of temperature. It is widely used in the analysis of polymers and composites to measure expansion coefficients, melting and softening temperatures.

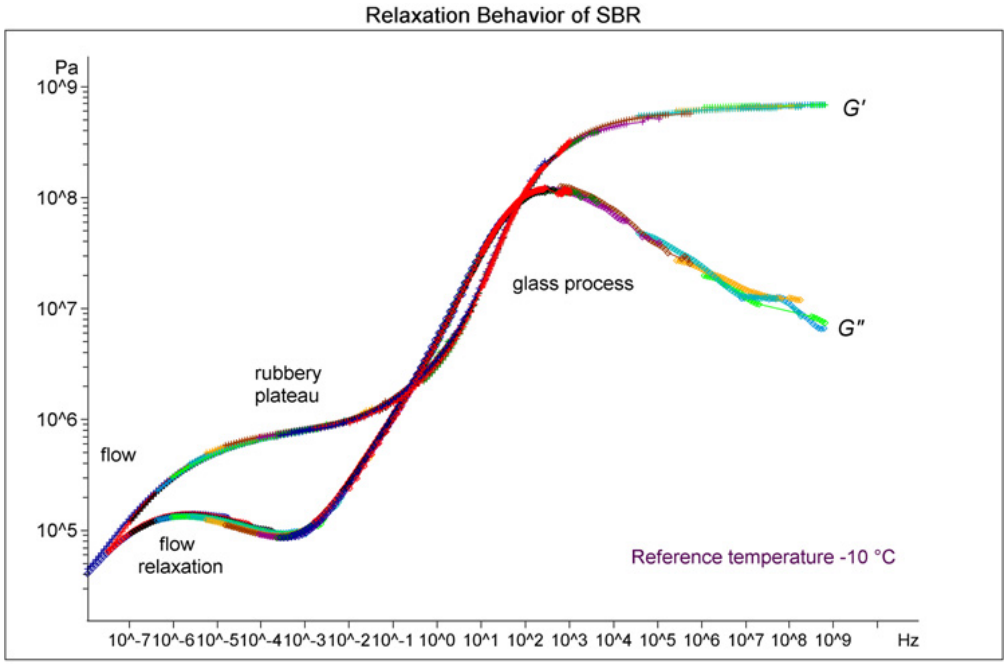
-150 - 600 °C / RT ~ 1100 °C Temperature range
0.6 nm (over the whole range) TMA resolution

▣ Dynamic load TMA (DLTMA mode)
▣ Expansion ▣ Penetration ▣ Tension
▣ Bending (3-point bending) ▣ Swelling

동적기계분석기 _ DMA

The METTLER TOLEDO DMA/SDTA861e is the latest DMA introduced in the market. In comparison with conventional DMA instruments it offers new and unique performance benefits:
A frequency range up to 1000 Hz for material behavior simulation and accurate determination of moduli through the presence of a dedicated force sensor.

Dedicated force sensor and unique LVDT positioning for accurate measurement of moduli and tan δ
Various deformation modes and measuring systems to accommodate any sample type and material suitable for DMA analysis



DMA Application

Young's modulus, shear modulus

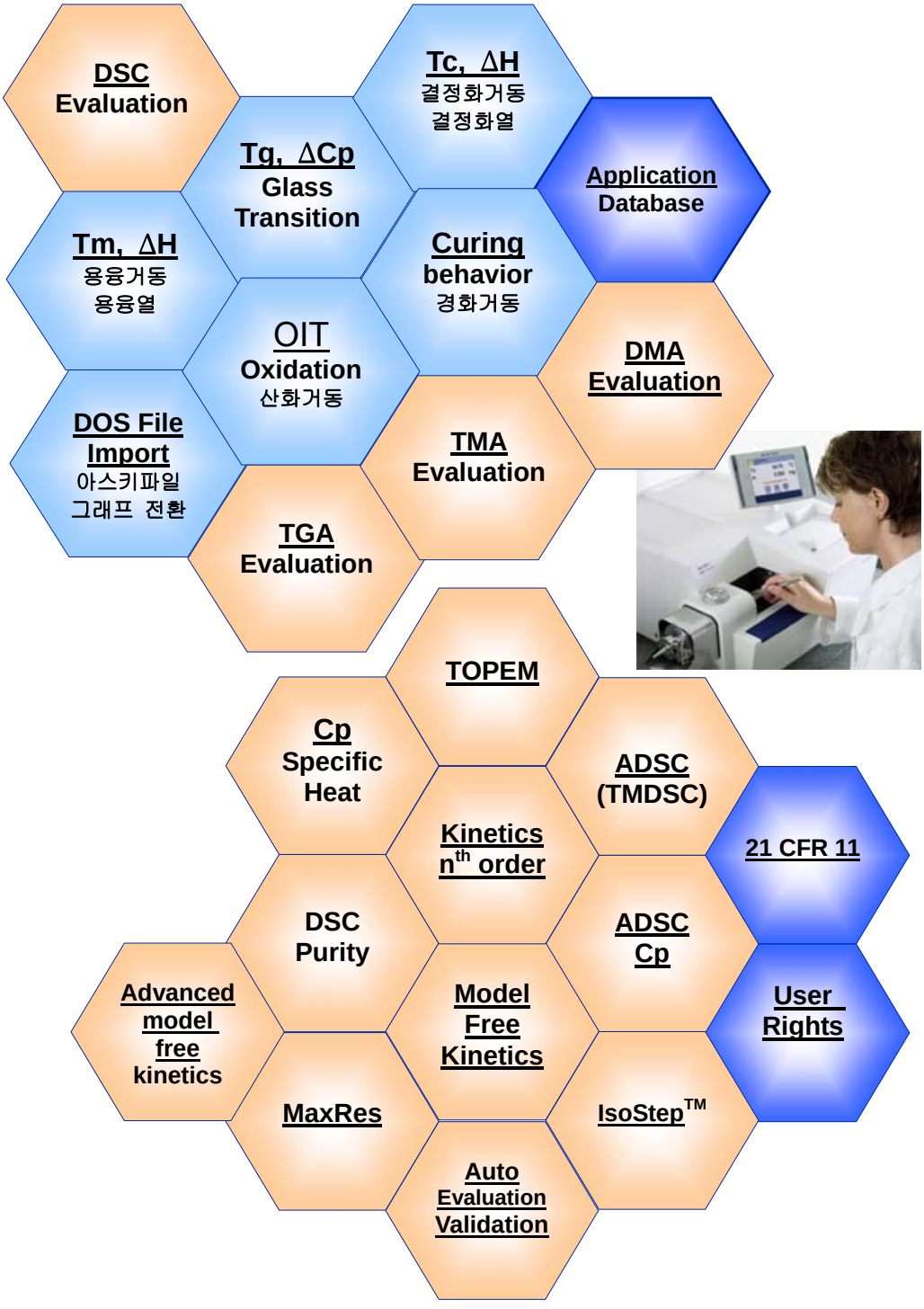
Complex modulus (storage modulus & loss modulus)
Damping behavior

Glass transition
Phase transitions
Relaxations
Curing behavior
Effects of frequency
Linearity

Thermal Analysis Excellence

DSC(시차주사열량계) 시험분석서비스

- 열분석 전문가에 의한 열분석 측정 데이터의 명쾌한 해석 !
- 정확하고 재현성 있는 고품질의 기기와 응용소프트웨어를 이용한 다양한 분석서비스 제공.
- 온도변조DSC(TMDSC), Sapphire method Cp (DIN 51007), 반응속도 모델링(Kinetics), DSC purity, 산화도입기(OIT) 등 고급분석 가능

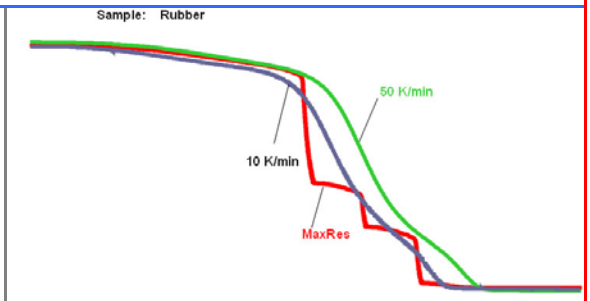


열 분 석 서 비 스

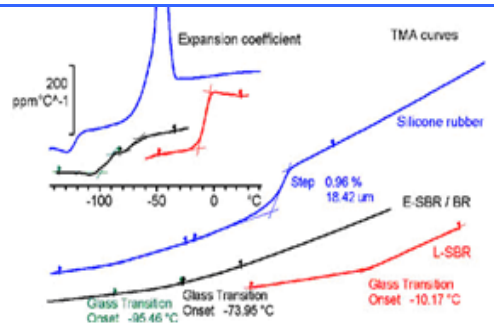
DSC는 앞장을 참고하세요.

TGA(열중량분석기; Thermogravimetric analysis)

- 조성에 따른 질량의 증감 측정
- Evaporation, desorptioon (moisture), vaporization
- Thermal decompostion (pyrolysis, depolymerization)
- Thermal stability (열안정성)
- Oxidative degradation, oxidation stability (산화안정성)
- Compositional analysis (volatiles, polymer, carbon black, ash, filler)
- DTA application with TGA/DTA, e.g. Solid-solid transition
- DSC application with TGA/DSC, STA



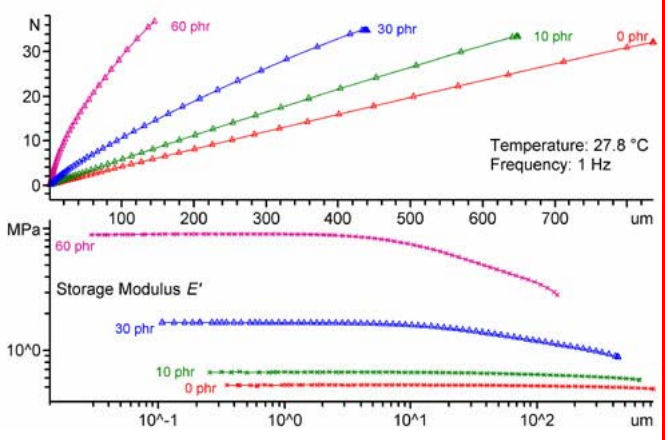
TMA(열기계분석기; Thermomechanical analysis)



- 크기(치수) 변화 (dimensional change) 측정
- Expansion and shrinkage behavior (팽창 및 수축 거동)
- Expansivity (Coefficient of linear expansion)
- Coefficient of Thermal Expansion (열팽창 계수, CTE)
- Young's shear modulus, stiffness
- Polymorphism (change of crystal modification)
- Glass transition (유리전이, Tg)
- Softening (연화점)

DMA(동적기계분석기; Dynamic mechanical analysis)

- Viscoelastic (점탄성) properties
- Shear modulus (G^*), - Young Modulus E^*
- Damping, Loss angle (delta), Loss factor (손실계수, tan δ)
- Stress relaxation test
- Tension test(인장시험), - Bending test (굴곡시험)
- Compression test (압축하중 시험)
- Storage Modulus (저장탄성율, E', G')
- Loss Modulus (손실실탄성율, E", G")
- Compliance (J^*)
- Creep behavior, Creep test
- Curing kinetics, Curing time
- Degree of reticulation
- Fatigue test
- Gel time, - Relaxation time
- Glass transition temperature (유리전이온도, Tg)
- Secondary transitions
- Impact resistance
- Linear/Non-linear behavior (선형/비선형적 거동)
- Prediction of long term mechanical behaviour
- Rheological properties



Thermal Analysis Workshop 열분석워크샵

당사는 열분석 전문회사로써 열분석에 관한 다양한 측정사례를 기반으로
열분석의 기초와 측정 데이터 해석법 강좌를 개설하였습니다.

Month	Method	Technique	Application	주관
1 월	Special course (Based on consulting, On-Site workshop available)			
2 월	**DSC/TGA**	**Crystallinity, Glass transition (Tg)**	**Polymers / Thermoplastics**	**YEONJIN**
3-4 월	Special course (Based on consulting, On-Site workshop available)			
5 월	**DMA/TMA/DSC**	**Curing, Kinetics, Glass transition (Tg), Rheology, Master curve construction (TTS)**	**Polymers / Thermosets / Elastomers**	**YEONJIN**
6-7 월	Special course (Based on consulting, On-Site workshop available)			
8 월	**DSC/TGA/DMA**	**Polymorphism, SFI**	**Pharmaceuticals / Foods**	**YEONJIN**
9 월	Special course (Based on consulting, On-Site workshop available)			
10 월	**DSC/TGA/DTA**	**Curies transition, Phase transition, Water desorption**	**Inorganics / Metal / Ceramic**	**YEONJIN**
11 월	Special course (Based on consulting, On-Site workshop available)			
12 월	**DSC/TGA/TMA/DMA**	**- Summary of most considerable techniques and application - Introduction of new thermal analysis method**		**YEONJIN**

열분석 기초 … ***Principle of Thermal analysis***

- 열분석 개론
- DSC-TGA-TMA-DMA 측정원리

열분석 측정곡선 해석 … ***Basic curve interpretation***

- 열분석에 의한 thermal effect의 구분
- Baseline 및 artifact

재료 별 열분석 측정 사례 해설 … ***Application of Thermal analysis***

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