Thermal Analysis, Calorimetry, Determination of Thermophysical Properties
The Broadest Portfolio for THERMAL

Differential Scanning Calorimetry (DSC)
Differential Thermal Analysis (DTA)

-180°C to 2000°C

The various types of NETZSCH DSC instruments all operate in accordance with the heat flow principle. They are characterized by a three-dimensional symmetrical design with homogeneous heating. Sensors with high calorimetric sensitivity, short time constants and a condensation-free sample chamber in the DSC cell ensure high detection sensitivity.

Simultaneous Thermal Analysis (STA)
TGA-DTA/TGA-DSC/TGA

-150°C to 2400°C

With the STA instrument series, NETZSCH is setting high standards. Unlimited configurations and unmatched performance are the foundations for a great variety of application possibilities in fields such as ceramics, metals, plastics and composites over a broad temperature range.

Dilatometry (DIL)/Thermomechanical Analysis (TMA)

-180°C to 2800°C/-150°C to 1550°C

Dimensional changes to the specimen as a function of temperature under a defined load can be monitored with the DIL 402 Expedis series of pushrod dilatometers. Interchangeable furnaces cover all applications for high-precision expansion control in development, basic research and quality control in a very wide temperature range. The TMA 402 F1/F3 Hyperion® series is determining the dimensional changes in solids, liquids or pasty materials as a function of temperature and/or time under a defined mechanical force. It impresses with its flexibility in sample holders and double furnace hoist.
Dynamic Mechanical Analysis (DMA) up to High Forces

-170°C to 1500°C

The robustness of the DMA 242 Artemis and the high resolution of its deformation measuring system enable precise determination of the visco-elastic properties of both rigid and soft polymers and composites. For measurements up to very high load and temperatures up to 1500°C, the EPLEXOR® series is available. It allows for, e.g., the investigation of the rolling resistance of tires or fatigue testing of composites and adhesive joints. Both DMA systems can be applied to elastomers, thermoplastics, metals, glasses, and ceramics to biomaterials and even foods. They can be equipped with a humidity generator, automatic sample changer system (EPLEXOR®), DEA sensor, etc.

Evolved Gas Analysis (EGA) Coupled to Thermal Analysis

By coupling a thermal analyzer with a Quadrupole Mass Spectrometer (QMS 403 Aéolos Quadro or SKIMMER), GC-MS and/or FT-IR (Fourier Transform Infrared Spectrometer by BRUKER Optics), the detection of evolved gases and identification of the separated components can be precisely time-correlated with the thermal analysis signals.
Calorimetry (ARC/MMC)

RT to 500°C

The Multiple-Module Calorimeter MMC 274 Nexus® measures chemical reactions and phase changes on gram-size samples for the investigation of process safety, thermal runaway reactions (Heat-Wait-Search), coin cells, etc. Additionally, the well-proven ARC 244/254, with the patented VariPhi® technology, are high-end systems investigating data relevant to processing and storage of chemicals, chemical process safety and the evaluation of thermal and pressure hazard.

Cure Monitoring by Dielectric Analysis (DEA)

-140°C to 400°C

For the investigation of thermosetting resins, composites, adhesives and paints, Dielectric Analysis has stood the test of time. An important value in describing curing processes is the ion conductivity. In order to address all possible needs, NETZSCH offers both single- and multiple-channel DEA systems.

Laser/Light Flash Analysis (LFA)

-125°C to 2800°C

Thermal conductivity and diffusivity are the most important thermophysical material parameters for the description of the heat transport properties of a material or component. The Laser/Light Flash technique has proven itself as a fast, versatile and precise absolute method for measuring thermal diffusivity. NETZSCH offers three LFA models, covering the widest temperature range for the broadest spectrum of materials.
Thermal Conductivity by Heat Flow Meter (HFM)/Guarded Hot Plate (GHP)

-160°C to 600°C

Our HFM 446 Lambda series measures the thermal conductivity/thermal resistance and specific heat capacity of insulating materials in quality control. For researchers, the GHP 456 Titan® offers outstanding reliability and accuracy across a broad temperature range. Innovative plate materials and temperature sensors, special design features and an improved data acquisition system make this GHP the new benchmark in the field of insulation testing. The unmatched software offers a report generator, contains standard reports for QA as well as the \( \lambda_{90/90} \) calculation for CE-Declaration (HFM).

Simultaneous Determination of Seebeck Coefficient and Electrical Conductivity

-125°C to 1100°C

One approach in the field of thermoelectricity is to generate electrical energy from released heat. The SBA 458 Nemesis® can accompany the development of thermoelectric materials with high working temperatures and optimized efficiency. It allows for the simultaneous measurement of the Seebeck coefficient and electrical conductivity under identical conditions.

Refractory Testing by RUL and HMOR

RT to 1700°C

Special strength-testing methods have been established for refractory ceramics. The RUL 421, Refractoriness under Load (RUL) and Creep in Compression (CIC), identifies the deformation resistance of a test piece under a defined load at a specified temperature/time program. The Hot Modulus of Rupture (HMOR 422) at high temperatures is determined as the amount of force applied to a rectangular test piece at high temperatures until failure occurs.
**Advanced Software**

**Kinetics Neo and Kinetics as a Service**

The kinetic analysis of thermal measurements allows finding the set of kinetic parameters, e.g., number of steps, contribution of each step to the total effect of the process such as step enthalpy or stepping mass loss; reaction type, activation energy and reaction order for each step. Then this information will be used for predictions of reaction progress for given temperature conditions or optimization of temperatures to get the desired reaction rate and product concentrations.

With Kinetics as a Service, NETZSCH offers a comprehensive package which supports the understanding and improving of your process without expensive trial and error.

**Temperature Modulation**

When applying temperature modulation, the linear heating rate is superimposed by a sinusoidal temperature change. This makes it possible to deconstruct the signals into reversing and non-reversing parts (DSC, DIL, TMA) and thereby separate overlapping effects – for example, glass transitions and relaxation peaks (DSC) or thermal expansions and sintering steps (DIL, TMA) – and to calculate activation energy(ies) from a measurement (TGA).

**AutoEvaluation**

*AutoEvaluation* is a unique, self-acting evaluation routine that finds and evaluates all effects in DSC and TGA curves by means of an intelligent mathematical algorithm. Experienced users can utilize the automatic evaluation result as a second opinion or employ this exceptional function to achieve results faster.

**Identify**

*Identify* gives an identification and classification of materials via database comparison for material identification and Pass/Fail testing in quality control. The NETZSCH libraries contain more than 1100 entries related to different application areas such as polymers, organics, inorganics, metals/alloys or ceramics. The additionally available KIMW database includes DSC curves of 600 commercially available polymer types.
Products

Proteus® Protect

Proteus® Protect ensures data integrity at the highest level and meets the requirements of 21 CFR Part 11 or EU Annex 11.

Super-Res® (RCM, RCS)

This software feature offers rate-controlled temperature management (mass-change-controlled TGA, i.e., RCM; and shrinkage-rate-controlled dilatometry, i.e., RCS) is well suited for increasing the resolution of superimposed effects and enhancing sample compaction for sintering processes.

Purity

For crystalline substances with known molar mass, Purity Determination serves to determine the percentage of eutectic impurities on the base of the Van’t Hoff equation (evaluation of the DSC melting peak).

Peak Separation

If your experimental curve looks very complex with several overlapping peaks then our software helps separate these peaks, presents experimental data as a sum of peaks, and analyzes each peak separately. The universal peak shape is used, which is the weighted mixture of Fraser-Suzuki and asymmetric Cauchy. In addition, following peak types are included: Gaussian, Cauchy, Pseudo-Voigt (additive mixture of Gaussian and Cauchy), Fraser-Suzuki (asymmetric Gaussian), Laplace, asymmetric Laplace and asymmetric Cauchy.
The NETZSCH Group is a mid-sized, family-owned German company engaging in the manufacture of machinery and instrumentation with worldwide production, sales, and service branches.

The three Business Units – Analyzing & Testing, Grinding & Dispersing and Pumps & Systems – provide tailored solutions for highest-level needs. Over 3,500 employees at 210 sales and production centers in 35 countries across the globe guarantee that expert service is never far from our customers.

When it comes to Thermal Analysis, Calorimetry (adiabatic & reaction) and the determination of Thermophysical Properties, NETZSCH has it covered. Our 50 years of applications experience, broad state-of-the-art product line and comprehensive service offerings ensure that our solutions will not only meet your every requirement but also exceed your every expectation.

Proven Excellence.