



ADVANCED THERMAL ANALYTICAL FACILITY UWS – Parramatta North Campus

Background. Thermal analysis includes a group of methods by which the physical determined as a function of temperature or time, while the sample is subjected to a controlled temperature program. The program may involve heating or cooling (dynamic), or holding the temperature constant (isothermal), or any combination of these.

1. Hyphenated Differential Scanning Calorimeter-Thermo gravimeter-Fourier Transformed Infrared Spectrometer (DSC-TGA-FTIR)

- DSC-TGA component: NETZSCH Jupiter 449C with Rhodium furnace operating from ambient to 1650 °C. The thermo-balance has exceptional resolution (10^{-7} g),
- Evolved Gas Analysis component: Bruker Vertex 70 Infrared Spectrometer.
- DSC-TGA component is hyphenated to the FT-IR component via interface with constantly heated at 200°C transfer line and fast and highly sensitive liquid nitrogen cooled MCT detector (7000 – 600 cm^{-1} wave number interval).

Applications:

DSC Component: specific heat capacity (Cp), melting and crystallization temperatures, transition enthalpies (heat of melting and crystallization, ΔH), heat of reaction, phase transformations, phase diagrams, crystallization temperatures, degree of crystallinity, glass transition temperatures, decomposition effects, reaction kinetics, oxidative stability, thermal stability, purity determination.

TGA component: mass changes, decomposition temperatures, dm/dt = rate of mass change/decomposition, dehydration, corrosion/oxidation, thermal stability, reduction studies, composition, reaction kinetics, purity determination.

Hyphenated DSC-TGA-FTIR:

The DSC-TGA - FTIR coupling yields a powerful analytical technique that combines the quantitative capabilities of TGA and the qualitative capabilities of FT-IR spectroscopy. For example, out-gassing of materials, detection of residuals, analysis of additives, aging and decomposition processes (oxidation, pyrolysis), characterization of natural and raw materials, desorption behaviour, extend of chemical reactions (catalysis, synthesis, polymerization).

2. Dedicated highly sensitive DSC.

- Highly sensitive 204 F1 Phoenix differential scanning calorimeter for the temperature interval: ambient temperature 700 °C.

An enthalpy-change method in which the difference in the energy inputs into a substance and a reference material is measured as a function of temperature, while the substance and the reference material are subjected to a controlled atmosphere and temperature program.

Applications:

melting point, glass transition, degree of cure, oxidative stability, heat of fusion, and crystallinity.

3. Mid-infrared spectroscopic facility

- Bruker VERTEX 70 can be used as a stand alone mid infrared spectrometer in the wave number interval of $7000 - 400 \text{ cm}^{-1}$. It is fitted with accessories such as **MIRacle**: Single reflection Attenuated Total Reflectance with ZnSe crystal and a diamond plate. It is designed for Infrared spectroscopic characterization of thin films, powders and liquids with pH varying from 1 to 14 without sample preparation, **EasiDiff**: Offers an efficient way of collecting spectra of powders and other solid materials, without the pellet preparation and **30Spec**: Measurement of film thickness by specular reflectance.
- Mid infrared microscope Hyperion 1000 attached to the Bruker Vertex 70 spectrometer.

Applications:

forensic science, product contaminants, pharmaceutical applications, biochemical description of very small samples (10-15 micron), cell clusters and tissue fragments, chemical components in very small samples, tissue abnormalities based on reference material, diagnosis and staging of diseases such as benign and malignant cancers.

For further information, please contact:

*Dr Adriyan Milev,
School of Natural Sciences, UWS – Parramatta North Campus
E-mail: a.milev@uws.edu.au
Phone: (02) 9685 9945
Fax: (02) 9685 9915*