

## High temperature solid state characterization

- The Extractive Metallurgy group of XPS possesses world class expertise and facilities to perform complete high temperature solid state characterization of minerals subjected to thermal processing.
- Smelters and metallurgical plants can optimize their thermal processes such as fluid bed roasting and calcination based on the results from our high temperature solid state test work on the minerals of interest.
- At the **pilot** scale, the main expertise is on fluid bed roasting in our 4" roaster (for the processing of small quantities) and 6" roaster (for large scale piloting or semi-production conversion of bulk material is required). The capabilities of these roasters are advertised in our **Pyrometallurgical Pilot Plant** brochure.
- At the **laboratory** scale the key expertise centers on **Thermal Analysis**.
- All materials change their physical properties and their chemical characteristics under the influence of temperature. Thermal Analysis measures these changes.
- The properties most often required are specific heat and enthalpy changes, weight loss or gain, and gas evolution.

## Key Capabilities

**Thermogravimetry (TGA)** measures changes in mass due to evaporation, decomposition and interaction with the atmosphere (e.g. TGA chemical reactions). The typical instrument mass capability from 2mg to 30g. The operating temperature range is from approximately 21 °C to 1600 °C. This can be coupled with mass spectrometry.

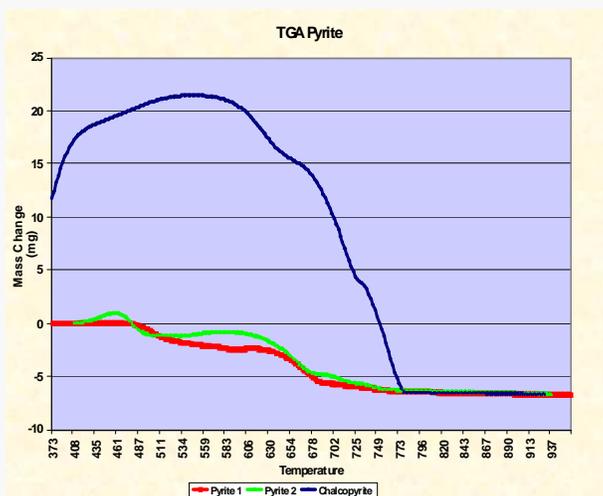
**Differential Thermal Analysis (DTA)** is a technique in which the temperature difference between the substance and a reference material is measured as a function of temperature.

**Differential Scanning Calorimetry (DSC)** measures heat flows and temperatures associated with exothermic and endothermic transitions.

**TG-Mass Spectrometer couple** (as shown to the right) provides information on the composition of the evolved gas. This technique is fast and provides easy interpretation of atomic/ inorganic vapours and standard gases (H<sub>2</sub>, H<sub>2</sub>O, CO<sub>2</sub>, CO, and SO<sub>2</sub>).



**STA or Simultaneous Thermal Analysis**, as carried out by the Extractive Metallurgy group, includes TG, DSC, and DTA, with MS coupling. TG/MS analysis is simultaneous, therefore weight loss can be correlated to evolved gas. It provides high sensitivity – gas levels in the ppm range can be detected. A typical TGA trace for sulphide material is shown below. Additional information on material properties is obtained using combinations of **Malvern particle size analysis; Scanning Electron Microscopy or X-ray diffraction**.



Once data from the above techniques is obtained, process conditions suitable for thermal processing (e.g. roasting, calcination, sintering, recrystallisation, distillation or phase transformation) can be confidently predicted prior to larger scale batch or continuous testing.

The Group possesses a laboratory scale **2" diameter fluid bed**, as shown here. It operates in batch mode only; and can be fitted with a quartz work tube which is useful for monitoring fluidisation behaviour. The unit is self-contained and portable, and suited for testing materials which produce toxic or volatile gases.

