AlexSys

High Temperature Calvet Calorimeter

- **2 TEMPERATURE VERSIONS:**
    - AlexSys 800 for operation to 800 °C
    - AlexSys 1000 for operation to 1000 °C

- **HIGH TEMPERATURE DROP SOLUTION CELL FOR CALORIMETRY IN MOLTEN SOLVENTS**

- **CALISTO** software

Calvet **3D** inside

CALISTO Thermal Analysis Software

SETARAM Instrumentation
K E P T e c h n o l o g i e s

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The AlexSys is a high-sensitivity Calvet calorimeter optimized for high temperature solution calorimetry in molten solvents at temperatures to 1000 °C. It is run isothermally to study heats of formation, reaction, and mixing. Transposed temperature drop calorimetry can also be performed to measure heat content, heats of phase transition and decomposition. The AlexSys is based on Prof. Alexandra Navrotsky's (University of California - Davis) High Temperature Calorimeter which has many years of development, use, and application.

The HIGHLIGHTS

- **Sensitivity, stability, flexibility and precision:** The **AlexSys** calorimeter features a **3D Calvet sensor**, providing high sensitivity and exceptional precision. The calorimeter block and furnace design ensures a high signal-to-noise ratio, temperature and signal stability, and low detection limit permitting low energy and slow reactions to be measured. The sensitivity of the **AlexSys** does not change by more than 2% with:

  - weight, shape and nature (powder, pellet, fiber, liquid, etc.) of sample,
  - contact between sample and crucible,
  - crucible material,
  - sweeping gas (inert or oxidizing) and its flow rate.

The sample chamber is big enough (working volume 20-30 cc depending on sample cells) to contain a variety of assemblies, to provide mixing and gas bubbling through the solvent, and to design experiments to simulate different thermochemical processes at high temperature.

- **Ease of operation:** The leading **CALISTO** software provided with the calorimeter is intuitive and powerful, enabling any typical or special-design experiment and data analysis to be performed. The calorimeter operates isothermally, with temperature and sensitivity stable over many months. Sample loading and handling is straightforward.

PRINCIPLE

The **AlexSys** is based on a differential 3D Calvet sensor made of an array of thermocouples (thermopile) which completely surrounds the measuring zone and is connected to a constant temperature block. This design captures over 90% of the heat flow in or out of the sample. The system is twinned (two thermopiles per calorimeter) for additional signal stability and greater experimental throughput. The calorimeter is calibrated using a drop method in which a sapphire pellet (or other calibrant) is dropped into an assembly similar to that used for the experiment.

AlexSys sensor

Such calibration can be done periodically rather than after each experiment because the calibration factor is accurate and stable over time.
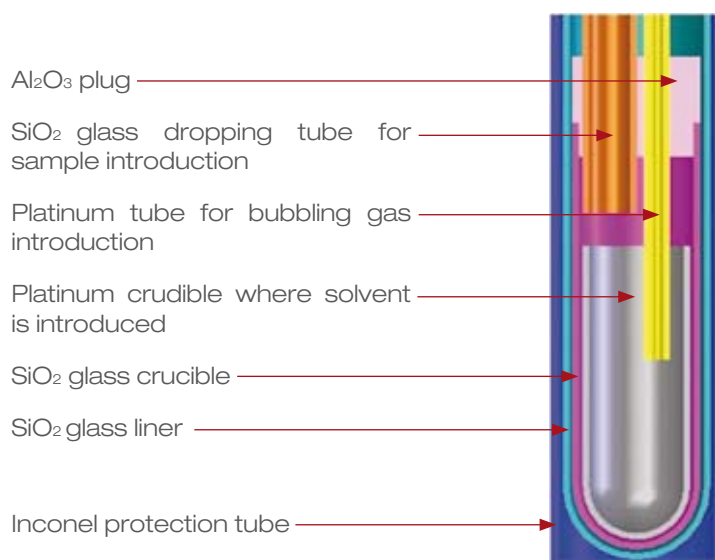
Applications

The unique feature of this calorimeter is a large sample chamber in which one can carry out chemical reactions at high temperature. Applications include drop solution calorimetry with gas flow above the sample and/or gas bubbling through the molten solvent, direct reaction calorimetry to form alloys and compounds, aluminothermic and other oxidation-reduction reactions, gas-solid, gas-liquid, and liquid-liquid reactions. More specifically, the instrument permits the measurement of the energetics of crystalline oxides, glasses, amorphous, and nanophase and porous materials, of hydrous phases and carbonates, of metals and alloys, of semiconductors, and of carbides, nitrides and oxynitrides. The thermochemical data obtained are essential to understanding materials compatibility and reactivity in both technological and geological application, and, more fundamentally, the energetics offer insight into chemical bonding, order-disorder reactions, and phase transitions. Relevant research disciplines and industries include:

- Ceramics
- Nuclear energy
- Semiconductors, superconductors
- Glass technology
- Metallurgical processes, high strength alloys
- CO_2 sequestration
- Solar energy materials
- Thermoelectrics
- Ferroelectrics, piezoelectrics, multiferroics
- Catalysts
- Micro- and mesoporous materials, zeolites
- Nanomaterials
- Mineralogy, mineral physics, geochemistry, petrology, geophysics

Vessels

The calorimeter vessels are designed to receive a sample dropped through a drop tube, and may contain a molten solvent to conduct solution experiments at high temperature with optional bubbling to assist dissolution.

Al_2O_3 plug

SiO_2 glass dropping tube for sample introduction

Platinum tube for bubbling gas introduction

Platinum crucible where solvent is introduced

SiO_2 glass crucible

SiO_2 glass liner

Inconel protection tube

Specifications

	AlexSys – 800	AlexSys – 1000
Calorimeter type	Isothermal Differential Heat Flow	Isothermal Differential Heat Flow
Temperature range	500 – 800 °C	500 – 1000 °C
Number of cells	2	2
Vessel Volume	28 ml (quartz cell) 20 ml (platinum crucible)	28 ml (quartz cell) 20 ml (platinum crucible)
Temperature accuracy	+/ -0.1 %	+/ -0.1%
Enthalpy accuracy	+/- 1 %	+/- 1 %
Resolution	12.5 µW	50 µW
Dimensions (Φ, H)	800 mm, 880 mm Separate electronics	800 mm, 880 mm Separate electronics
Weight	300 kg	300 kg
Power requirements	230 V - 50/ 60 Hz	230 V - 50/ 60 Hz

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