# *High-Temperature DSC: AMI-made precision to 1500 °C*

## 1. Background and Overview of DSC 1200/1500 from AMI

Differential scanning calorimetry (DSC) is a fundamental technique used to study phase transitions, heat capacity, and thermal stability in materials.[1-4] However, most conventional DSC systems are limited to temperatures below 700 °C. For advanced materials research—such as ceramics, metals, high-performance polymers, and oxides—thermal transitions often occur well above 1000 °C.[5-9]

To meet this need, **Advanced Measurement Instruments (AMI)** has developed the **DSC 1200** and **DSC 1500**—two high-temperature DSC systems built on a proven STA platform. This application note outlines the advantages of using a hang-down STA-derived architecture for DSC-only measurements and highlights the capabilities of both models for demanding thermal analysis.

The STA platform is typically used for simultaneous TGA/DSC measurements, but when adapted for DSC-only functionality, it offers significant advantages:

- ✓ Elimination of the microbalance simplifies the system, reduces thermal interference, and focuses entirely on calorimetric precision
- ✓ Hang-down geometry ensures superior thermal isolation from the furnace environment, enhancing signal stability and minimizing baseline drift
- ✓ A vertical lift furnace ensures consistent sample positioning and safe high-temperature operation

| Model | Maximum Temperature | Heating Rate | Shared Features |
|---|---|---|---|
| **DSC 1200** | 1200 °C | 0.1 to 60 °C/min | ✓ Calorimetric accuracy within ±1%<br>✓ Type R thermocouples (sample and reference), cold-junction compensated<br>✓ Platinum-rhodium DSC sensor with integrated sample/reference cups<br>✓ Static or dynamic atmosphere control<br>✓ Water-cooled furnace with integrated safety interlocks<br>✓ Tool-free access for pan replacement and calibration<br>✓ InfinityPro software for instrument control, method development, calibration, and real-time data visualization<br>✓ Safety features: Factory-limited lift range, over-temperature protection, and water flow alarm |
| **DSC 1500** | 1500 °C | | |

*Table 1: Specification and shared features of the **DSC 1200** and **DSC 1500** from **AMI***

- ✓ The use of high-purity platinum components and precision-machined sensor assemblies ensures consistent sensitivity and durability at elevated temperatures

This architecture allows **AMI's** high-temperature DSC systems to achieve the same thermal range and mechanical robustness of an STA, while offering the clarity and simplicity of a pure DSC system.

An overview of unique features and specifications of the DSC 1200 and 1500 are shown in Table 1.

## 2. Applications

**AMI's** high-temperature DSC systems are ideal for advanced thermal characterization in materials that require extended temperature range and stability. Application areas include:

- ✓ Ceramics and oxides: Phase transitions, sintering behavior, and glass crystallization
- ✓ Refractory materials: Fusion and degradation temperatures
- ✓ Metallic alloys: Solid-state transformations and oxidation
- ✓ High-performance polymers: Thermal degradation and glass transition above 600 °C
- ✓ Battery materials: Decomposition and thermal runaway characterization

The high sensitivity and stable baseline make these instruments suitable for both large enthalpic events and subtle thermal transitions.

Silver offers an excellent benchmark for high-temperature DSC calibration due to its well-defined melting point and heat of fusion. Shown in Figure 1a, the sharp endothermic peak at 961.8 °C illustrates the system's sensitivity and temperature accuracy. The flat baseline and low noise level emphasize the DSC's thermal stability and precision over extended high-temperature ramps.

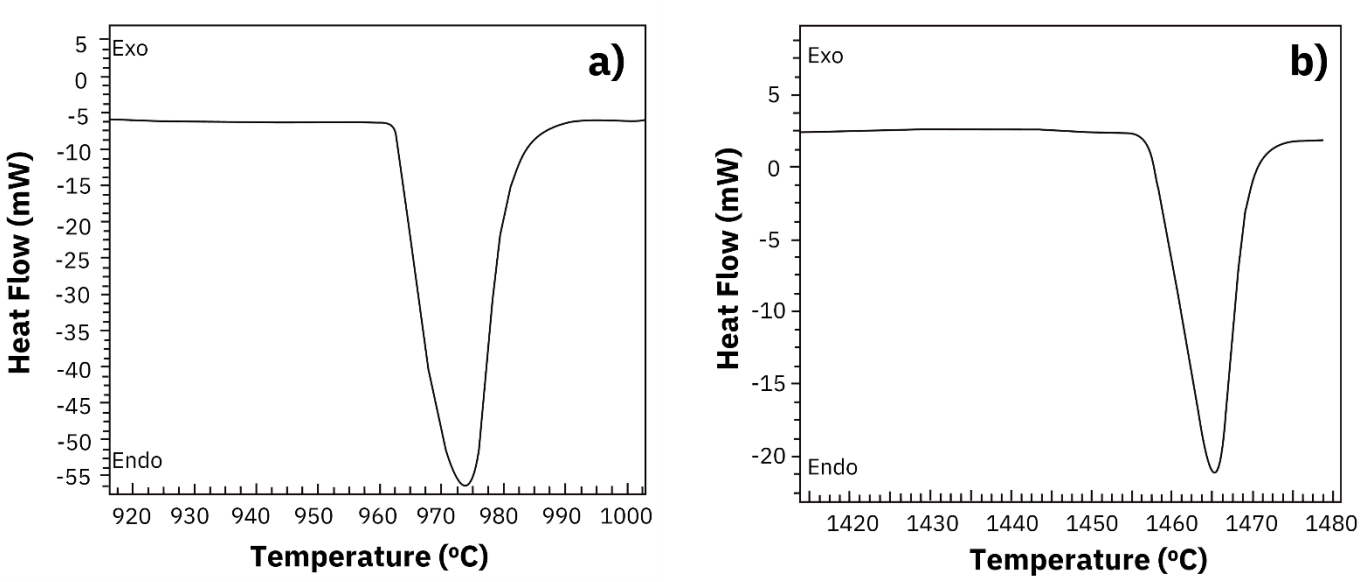


*Figure 1: a) DSC curve of high-purity Ag showing a sharp endothermic melting peak starting at 961.8 °C and b) DSC curve of high-purity Ni showing a sharp endothermic melting peak starting at ~1455 °C*

Figure 1b demonstrates the DSC system's capability to operate at elevated temperatures with excellent resolution. The melting of nickel, a refractory metal, is clearly resolved even near the upper range of the instrument's performance. The signal clarity underscores the robustness of the sensor design and heating system for demanding thermal analysis applications.

## 3. System Configuration and Installation

Each **AMI** DSC system is shipped with:

- ✓ Main module with vertically lifting furnace
- ✓ Dedicated DSC sensor and standard sample/reference pans
- ✓ Gas inlets
- ✓ InfinityPro software license
- ✓ Start-up accessory kit: sample holders, tools, thermocouples, communications cable
- ✓ Remote installation support, unlimited virtual training, and application support

## 4. Conclusions

The **AMI DSC 1200** and **DSC 1500** systems provide powerful, stable, and high-precision platforms for thermal analysis beyond the limits of conventional DSC. By leveraging the mechanical strength and thermal performance of STA architecture, without the complexity of a balance, **AMI** delivers research-grade solutions for laboratories working at the forefront of materials science.

## 5. References

(1) Fatahi, H.; Claverie, J.; Poncet, S. Thermal characterization of phase change materials by differential scanning calorimetry: A review. *Appl. Sci.* **2022**, *12*, 12019.
(2) Abd-Elghany, M. and Klapötke, T. M. A review on differential scanning calorimetry technique and its importance in the field of energetic materials. *Phys. Sci. Rev.* **2018**, *3*, 20170103.
(3) Schick, C. Differential scanning calorimetry (DSC) of semicrystalline polymers. *Anal. Bioanal. Chem.* **2009**, *395,* 1589-1611.
(4) Zheng, Q.; Zhang, Y.; Montazerian, M.; Gulbiten, O.; Mauro, J. C.; Zanotto, E. D.; Yue, Y. Understanding glass through differential scanning calorimetry. *Chem. Rev.* **2019**, *119*, 7848-7939.
(5) Sunitrová, I. and Trnik, A. DSC and TGA of a kaolin-based ceramics with zeolite addition during heated up to 1100 °C. AIP *Conf. Proc.* **2018**, *1988*, 020046.
(6) Chang, Y.-S.; Chang, Y.-H.; Chen, I.-G.; Chen, G.-J.; Chai, Y.-L.; Fang, T.-H.; Wu, S. Synthesis, formation and characterization of $ZnTiO_3$ ceramics. *Ceram. Int.* **2004**, *30*, 2183-2189.
(7) Navrotsky, A. High-temperature oxide melt calorimetry of oxides and nitride. *J. Chem. Thermodyn.* **2001**, *33*, 859-871.
(8) Rowolt, C.; Milkereit, B.; Andreazza, P.; Kessler, O. Quantitative high temperature calorimetry on precipitation in steel and nickel alloys. *Thermochim. Acta*, **2019**, *677*, 169-179.
(9) Chapman, L. A. Application of high temperature DSC technique to nickel based superalloys. *J. Mater. Sci.* **2004**, *39*, 7229-7236.