

**Name of the facility: Thermal Analyzer**  
**Total cost: 65 lakhs**  
**Support provided by CARE: 40 lakhs**  
**(Rest support from DST and ISRO)**  
**Location: ADVANCED NANOENGINEERING**  
**MATERIALS LABORATORY(ACMS-208)**  
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## **Differential Scanning Calorimeter**\_\_\_\_\_

The DSC (Diamond DSC made by Perkin Elmer) actually consists of two separate furnaces for the sample and the reference sides. The system can be divided into two control loops, the average temperature loop and the differential temperature loop. The average temperature loop ensures that the sample and reference sides are heating at the programmed rate. The differential temperature loop maintains identical temperatures



between the reference and sample pans regardless of the different amount of heat needed to enter the sample side. This process ensures that the sample is always kept at the same temperature of the reference regardless of any changes that occur within the sample requiring more or less heat flow. When an endothermic process occurs such as softening or melting, more heat is added to the sample side relative to the reference to make up for a difference in temperature. With an exothermic process less heat is added to the sample relative to the reference side.

Temperature limit: -140°C to +350°C

## Thermogravimetric Analyzer



This Thermo-Gravimetric Analyzer (Diamond TGA/DTA) made by Perkin Elmer measures the weight loss of a sample as a function of temperature. This is done by placing a sample into a sample holder that hangs from a micro-gram balance during the entire experiment. The balance mechanism consists of a sample pan holder suspended by a long hang down wire. The hang down wire is connected to the balance lever by a small quartz link to prevent static build up. The weight of the sample holder configuration is electromagnetically balanced on the other side so that the balance can be zeroed before each run. Temperature limit: +25 to +800°C

## Dynamic Mechanical Analyzer

The following analysis and measurements would be possible from this facility: 1. Viscoelastic properties like, Storage modulus, Loss modulus, Complex modulus, Loss tangent, Storage compliance, Loss compliance, Complex compliance, Storage viscosity, Loss viscosity, Complex viscosity, Creep compliance, Relaxation modulus, Static/dynamic force, Sample stiffness, etc. over a range of Frequencies, Strains, Stresses and Temperatures under Shear, Three point bending, Tensile both single and dual cantilever and compression modes.

2. Transition temperatures like, Solid-solid transition, Glass transition, Crystallization, Melting, Thermal stability, Oxidation onset, Cure onset, Polymorphic transition, Liquid crystal, etc

Technical specifications of Dynamic mechanical thermal analyzer (Diamond DMA, made by Perkin Elmer: Minimum force: 0.001N; Force resolution: 0.0001N; Strain resolution: 1 nanometer; Modulus range:  $10^3$  to  $3 \times 10^{12}$  pa; Modulus precision: +/- 1%; Tan delta range: 0.0001 to 10; Tan delta sensitivity: 0.0001; Tan delta resolution: 0.00001; Frequency range: 0.01 to 200 Hz; Dynamic sample deformation range: +/- 0.5 to 10,000 millimeter; Temperature range: -150 to 600°C; Heating rate: 0.1 to 20°C/min; Cooling rate: 0.1 to 10°C/min; Isothermal stability: +/- 0.1°C.

