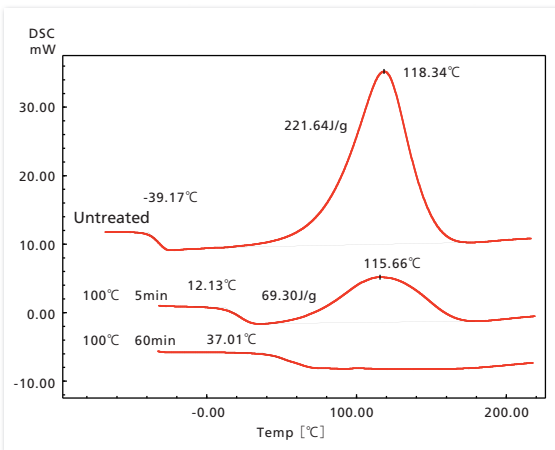
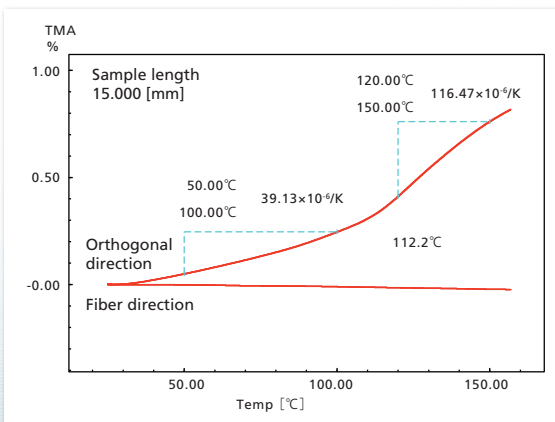


CFRP Thermal Expansion Measurements

Thermal analysis instruments are used to measure a variety of physical and chemical changes including fusion, transition, crystallization, expansion, contraction, decomposition and combustion, while the sample is heated or cooled. Typical analysis methods include DSC, TGA and TMA, which are effective for evaluating the thermal properties of thermoplastic resins, thermosetting resins and composite materials.



The hardening reaction of epoxy resin, used as a matrix, was evaluated via DSC. After the glass transition of the untreated sample was observed at -39.1 °C, significant heat generation due to the hardening reaction was observed, with a peak at 118 °C. With the sample treated for 5 minutes at 100 °C, hardening had already progressed, so less heat was generated. With the sample treated for another 60 minutes, hardening had virtually finished, and heat generation was not observed. In this way, it is possible to use DSC to investigate heat treatments and the rate of hardening. In addition, it is evident that as hardening progresses, the glass transition shifts to higher temperatures.



Changes in the size of a CFRP sample in the carbon fiber direction and orthogonal direction were measured during heating. In the orthogonal direction, thermal expansion in accordance with heating was evident, but in the fiber direction, virtually no extension was evident. Also, in the orthogonal direction measurement, changes due to glass transition were measured in the vicinity of 110 °C.

DSC-60 Plus Series Differential Scanning Calorimeter

Differential scanning calorimeters provide a useful means of quickly and easily determining the changes in enthalpy and specific heat associated with the first-order transition or relaxation phenomena of substances. In addition to a maximum noise level of 1 μ W and high sensitivity analysis, this new DSC system offers many other unique features as well.



High-Performance General-Purpose DSC

- High sensitivity and high resolution
- Stable baseline from ultra-low to high temperatures

The new detector in the DSC-60 Plus series and the unique furnace construction achieve a stable baseline across the entire measured temperature range (-140 to 600°C) as well as top-class calorimetric sensitivity for a DSC.

Diverse Measurements by Simple Operations

- Cooling chamber installed as standard
- Sample loading temperature function is convenient for sample replacement

Complies with Analytical Laboratory Regulations

The DSC-60 Plus series complies with various guidelines involving analytical laboratories, such as the PIC/S GMP guidelines, and electronic record/electronic signature (ER/ES) regulations, including the US FDA 21 CFR Part11. In addition, it is compatible with other analytical instruments and connected network systems.

Temperature range	-140 to 600 °C (Liquid nitrogen used below room temperature)
Calorimetric measurement range	\pm 150 mW
Baseline noise	0.5 μ W max. (rms, when held at 150 °C using blank)

Shimadzu Thermomechanical Analyzer TMA-60

- Multiple types of measurement methods are available to accommodate a diversity of sample shapes
- Utilizes a new type of displacement sensor with high precision and low drift
- Accurate automatic length measurement

Thermomechanical analyzers are able to use various types of measurement methods (expansion, tension and penetration) to evaluate material characteristics of samples with a wide variety of shapes. With features such as an automatic length measurement function and safety mechanisms, this model offers a higher order of high performance and high functionality, combined with ease of operation.



Temperature range	Ambient to 1,000 °C/1,500 °C from -140 °C with an optional adapter
Measurement range	Displacement : \pm 5 mm Load : \pm 5 N
Sample size	ϕ 8 x 20 mm, 5 x 1 x 20 mm (60 type)



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