

Specifications

| Load system                                  |                                                                                                                                                           |                                                        |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Load                                         | High load unit: 5 μN to 2,000 mN                                                                                                                          | Low load unit: 0.5 μN to 10 mN                         |
| Load resolution                              | High load unit: 5 nN                                                                                                                                      | Low load unit: 0.03 nN                                 |
| Loading method                               | Electromagnetic                                                                                                                                           |                                                        |
| Indenter displacement measurement system     |                                                                                                                                                           |                                                        |
| Measurement range                            | ±50 μm                                                                                                                                                    |                                                        |
| Measurement resolution                       | 0.3 μm                                                                                                                                                    |                                                        |
| Measurement method                           | Optical                                                                                                                                                   |                                                        |
| Stage                                        |                                                                                                                                                           |                                                        |
| Sample size (typical)                        | φ 50 × t 3.5 mm                                                                                                                                           |                                                        |
| Measurable area                              | X 50 mm, Y 40 mm                                                                                                                                          |                                                        |
| Min. increment                               | 0.1 μm                                                                                                                                                    |                                                        |
| Optical observation system                   |                                                                                                                                                           |                                                        |
| Objective lens                               | ×20 * standard specification (×10, ×50, ×100 as option)                                                                                                   |                                                        |
| Monitor magnification                        | ×500 * standard specification (×2,000 with digital zoom)                                                                                                  |                                                        |
| System                                       |                                                                                                                                                           |                                                        |
| Number of load units that can be mounted     |                                                                                                                                                           | 1 unit                                                 |
| Vibration isolation method                   |                                                                                                                                                           | Active vibration isolation table                       |
| Temperature control                          |                                                                                                                                                           | Control temperature with 0.1degree step in the shield. |
| External dimensions/Environmental conditions |                                                                                                                                                           |                                                        |
| External dimensions                          | 650 mm (W) × 650 mm (D) × 1,200 mm (H) (main unit only)                                                                                                   |                                                        |
| Power supply                                 | 100 to 120 V (Plug connection), 220/230/240 V (Switchboard connection or Plug connection<br>* Installat on prepared by end-user or distributor), 50/60 HZ |                                                        |
| Temperature                                  | 20 to 25°C (No sudden temperature changes)                                                                                                                |                                                        |
| Humidity                                     | Less than 60%                                                                                                                                             |                                                        |
| Floor vibration                              | Below 0.5 gal p-p (Less low frequency vibration)                                                                                                          |                                                        |

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<https://www.elionix.co.jp/english>

**ELIONIX** ELIONIX INC.

NANO INDENTATION TESTER  
**ENT-5**

Nanoindentation Tester

Visualizing hardness and elastic modulus  
in the ultra-micro ranges

High data reproducibility using proprietary technology



Made in Japan

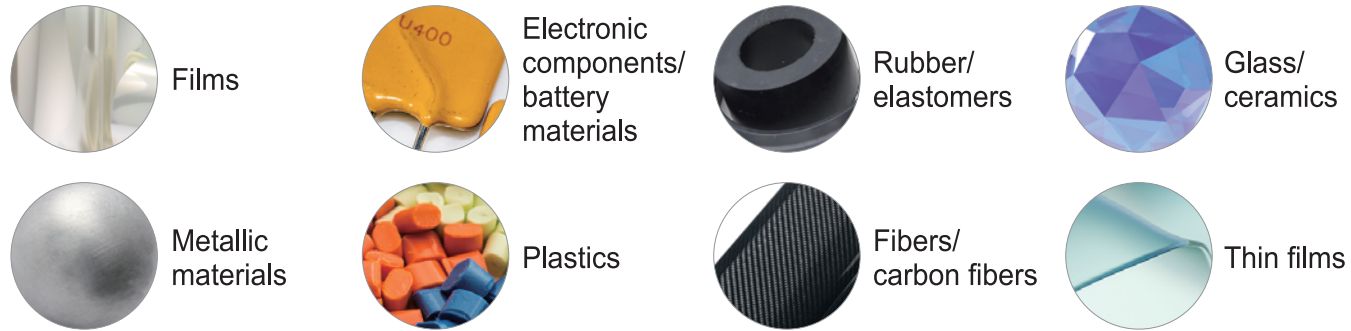
Wide test load range capability from 0.5  $\mu$ N to 2,000 mN

## What Can Nanoindentation Testing Measure?

### Nanoindentation testing provides the following:

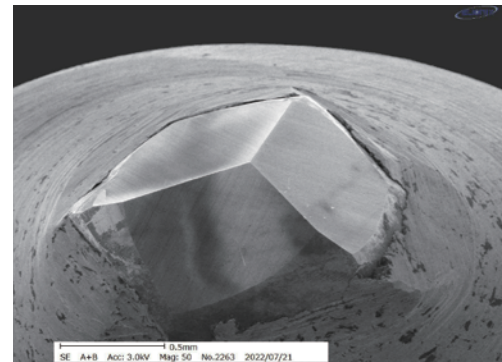
- ▽ Mechanical properties such as hardness and elastic modulus (ISO 14577-1 and JIS Z 2255)
- ▽ Hardness of a wide range of solid materials—from bulk to film, fiber, and particles

### Examples of materials that can be tested



### Various indenter tip geometries available

- ▽ Three-sided pyramid (Berkovich)
- ▽ Four-sided pyramid (Vickers)
- ▽ Spherical
- ▽ Flat

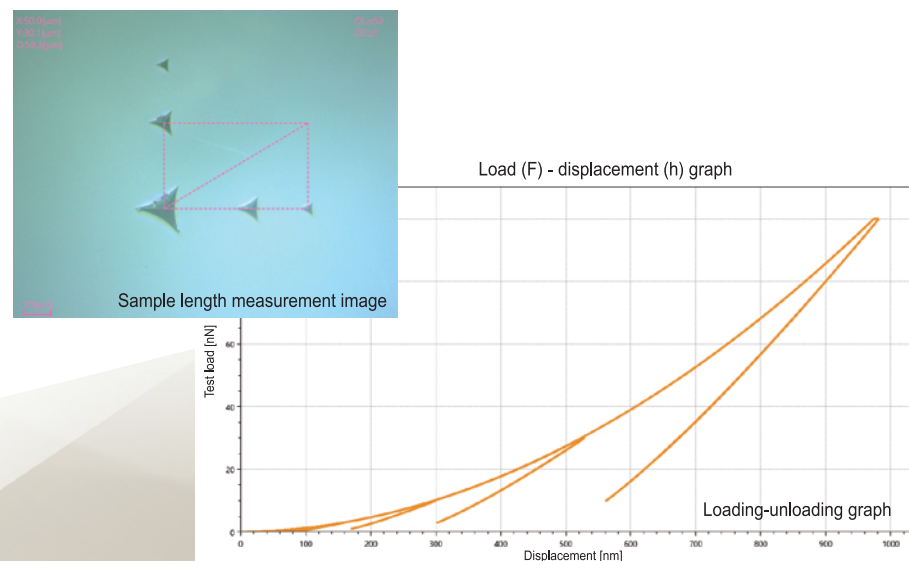


Three-sided pyramid (Berkovich) indenter tip

### Various output data supported

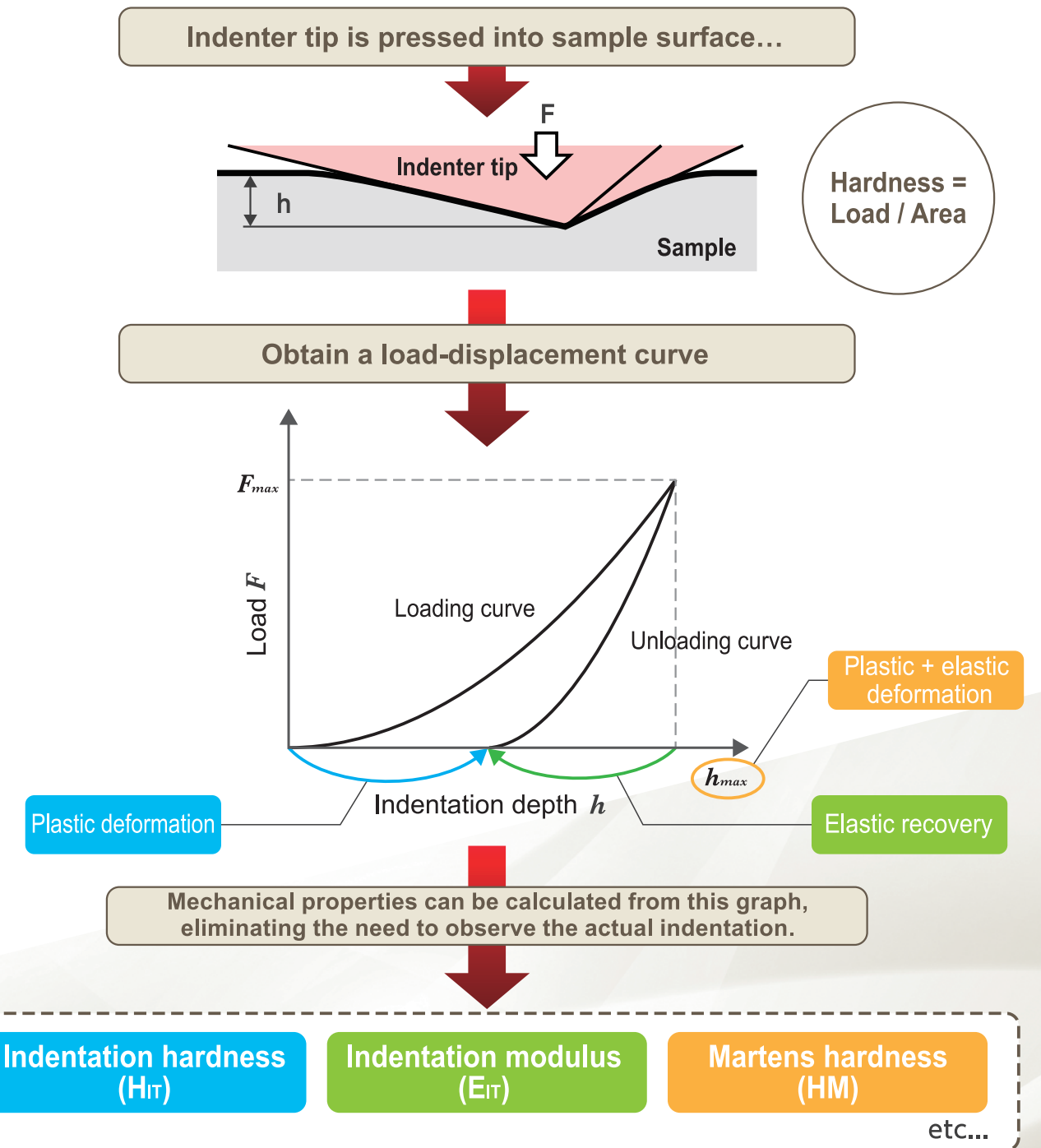
#### Acquired data can be exported in the following formats: bmp, jpg, png, tiff, pdf, and CSV.

- ▽ Sample observation images
- ▽ Loading-unloading graph
- ▽ Analyzed values
- ▽ Analyzed value graphs and maps
- ▽ Test conditions
- ▽ Instrument settings



## What is Nanoindentation Testing?

Nanoindentation testing evaluates the mechanical properties of a sample surface (e.g., hardness, elastic modulus) by pressing a diamond indenter into the surface using an ultra-small load and continuously measuring indentation depth. Indentation depth can be measured to the order of nanometers, and mechanical properties can be calculated from the load-displacement curve, eliminating the need to observe actual indentations. This makes it ideal for evaluating the mechanical properties of thin-film materials, including plating, hard coatings, DLCs, functional resin films, and surface-modified layers.



#### Allows analysis even if indentation marks are not visible.

This makes the method ideal for nanometer-order testing of thin-film materials such as plating, hard coatings, DLCs, functional resin films, and surface-modified layers, as well as testing of near-surface regions.

The method is also useful for evaluating the mechanical properties of rubber and other materials that do not retain clear indentation marks and exhibit significant elastic recovery.

## 01 Data Reproducibility

Allows consistent data acquisition even during continuous measurement.

### 1 Temperature management system

- Minimizes thermal expansion with following features.
- ▽ Manages the temperature inside the shield cover.
- ▽ Uses low thermal expansion material for measurement components.
- ▽ Minimizes the effects of external airflow with the shield cover.

### 2 High-precision positioning stage

- ▽ Incorporates proprietary ELIONIX Electron Beam Lithography system XYZ high-precision stage technology. The compact, highly accurate, and highly rigid stage contribute to hardness testing accuracy.
- ▽ Allows positioning in 0.1  $\mu\text{m}$  increments.
- ▽ Allows specification of any location at an observation magnification of 2,000 $\times$  (using standard 20 $\times$  objective lens combined with digital zoom).

### 3 Vibration isolation system

- ▽ Incorporates active vibration isolation table as standard.

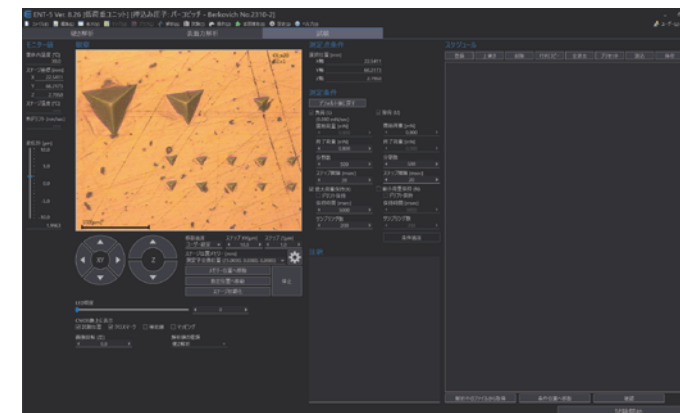


Sample block (actual size, 50 mm diameter)



## 02 Ease of Use

- ▽ Features selectable high/low-load unit for wide load range coverage.
- ▽ Features intuitive easy-to-use software refined through years of proven experience.
- ▽ Features English, Japanese, and Chinese language options.
- ▽ Auxiliary functions include indenter tip correction, thermal drift correction, and daily inspection reminders.
- ▽ Supports a wide range of analysis methods.



\* The actual product software may differ from that shown here.

## 03 Maintainability

- ▽ User-replaceable load unit
- ▽ Swappable pre-calibrated replacement units to minimize instrument downtime

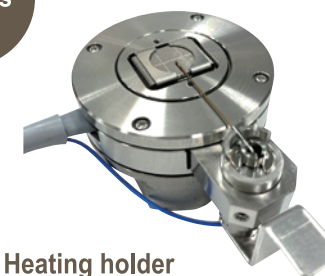
### HOLDERS AND STAGES

Standard specifications



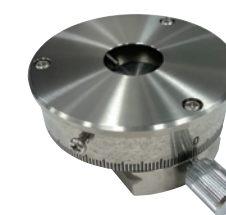
Sample holder \* Sample size: 50 mm diameter  $\times$  3.5 mm thick

Options



Heating holder

- \* Sample size: 10 mm  $\times$  15 mm  $\times$  3 mm thick
- \* Temperature range:  
Room temperature to 250  $^{\circ}\text{C}$  (high load)  
Room temperature to 180  $^{\circ}\text{C}$  (low load)



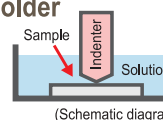
Resin-embedded sample holder

- \* Sample size: outer diameter 25 to 40 mm, height 9 to 14 mm



Underwater holder

- \* Sample size:  
20 mm diameter  
 $\times$  3 mm thick



(Schematic diagram)

Please feel free to contact us for other custom specifications.

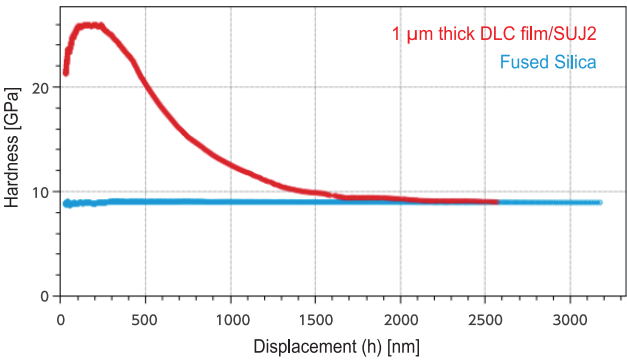
Measurement Examples

Dynamic Instrumented Indentation Test (standard function)

▽ Testing is done by applying minute vibrations to the indenter, enabling continuous acquisition of hardness distribution in the direction of indentation depth.

Fused Silica, DLC film/SUJ2

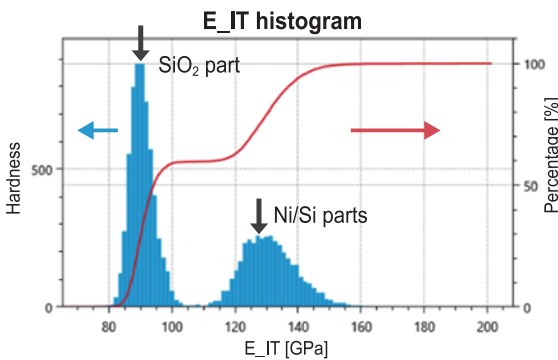
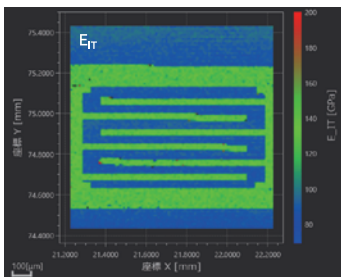
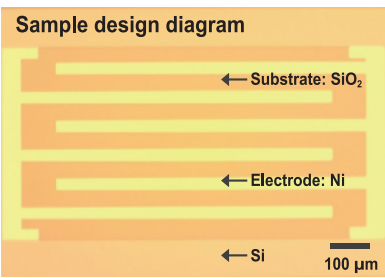
Compared to homogeneous materials (Fused Silica) that show near-constant hardness regardless of depth, a clear change in the hardness of the two-layer material (DLC/SUJ2) due to the influence of the substrate can be observed.



"EXAM" Extremely Accelerated Mapping (standard function)

- ▽ This function optimizes conventional test operations to allow ultra-high-speed testing at more than 200 times the speed of conventional testing.
- ▽ The High-speed mapping EXAM acquires mapping data of hardness and elastic modulus to visualize distribution of hardness and elastic modulus of the sample.

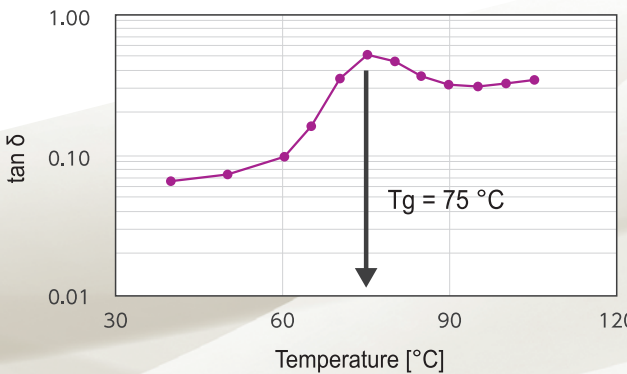
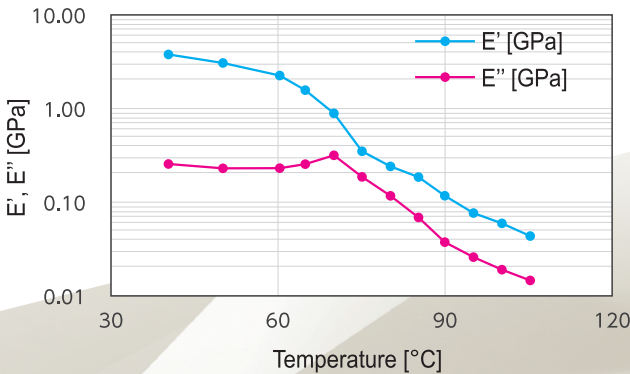
Comb electrodes Acquires 100 × 100 points at 10 μm pitch in approximately 3.3 hours (1.2 seconds per point).



Heated Viscoelasticity Test (option)

▽ The load is generated at a user-specified frequency as the indenter is pressed into the sample to allow calculations of storage modulus  $E'$  and loss modulus  $E''$ .

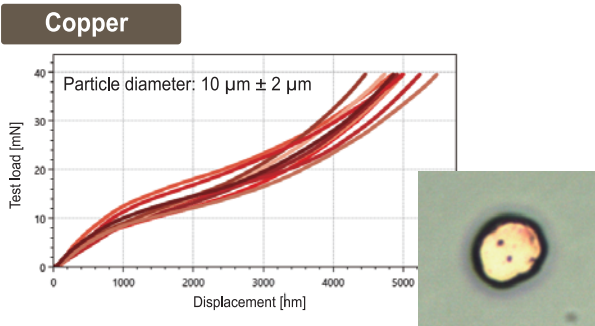
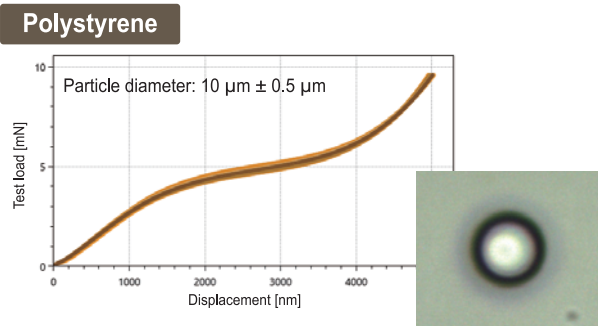
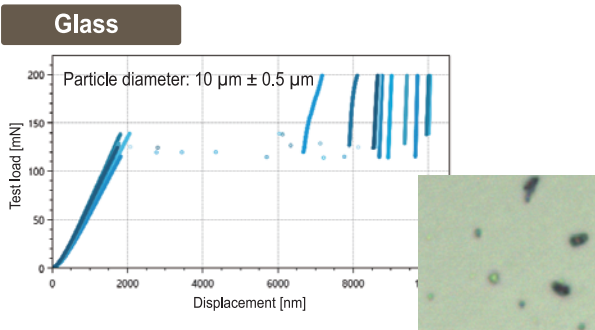
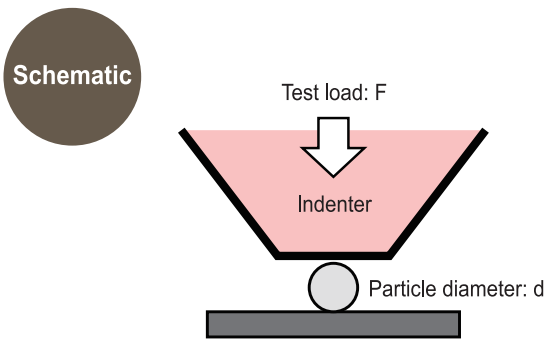
PVC  $T_g = 75\text{ }^{\circ}\text{C}$  from peak of  $\tan \delta$  (reference value:  $81\text{ }^{\circ}\text{C}$ , from the *Handbook of Chemistry*)



Micro-sized Particle Strength Test (High Load Unit Option)

▽ This method involves applying a load to a particle using a flat indenter and then determining the fracture strength and deformation strength from the resulting load-displacement relationship.

JIS Z 8844:2019 "Test method of fracture and deformation strength of a fine particle"



With ductile materials like polystyrene and copper, displacement varies continuously as load increases. In contrast, with brittle materials like glass, the curve becomes discontinuous midway during loading, indicating that the particle has fractured. The images at the lower right of each graph show the particles after testing.

- ▽ Automatic particle detection: Additional option for Particle Strength Test. Automates the sequence of particle detection, particle size measurement, testing, indenter cleaning, and data analysis. Automating particle strength testing dramatically reduces time and effort compared to conventional methods.

Other Standard Functions

- ▽ Stress-strain analysis: Repeats loading and unloading at the same point while increasing the load to calculate stress and strain during the transition from elastic to plastic deformation.
- ▽ Adsorption force test: Measures the force required and displacement when pulling the indenter away from the sample after indentation.
- ▽ Arbitrary test: Allows configuration of the output load and time distribution to suit requirements.
- ▽ Displacement controlled test: Performs indentation testing based on a user-set displacement rate.
- ▽ Indentation depth setting test: Allows testing in which the target indentation depth is set to user-specified test conditions. Loading stops once the target value is reached, and the load is retained, before proceeding to the unloading phase.
- ▽ Other analysis methods: Other analytical methods include the Tangent depth method, which calculates the elastic modulus more accurately without relying on standard samples.

Other Options

- ▽ Softening temperature test: Testing in which the indenter is brought into contact with the sample under constant load, after which the temperature is increased using the heating holder to measure the temperature at which the sample softens.