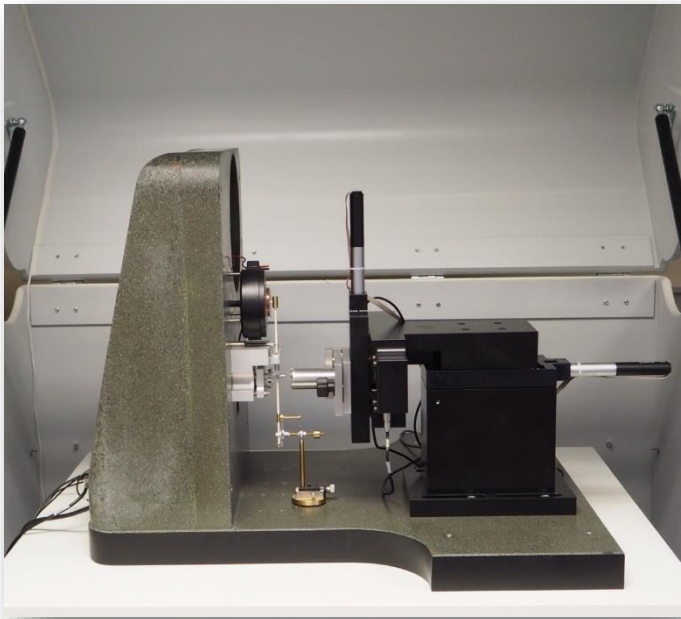




NanoTest

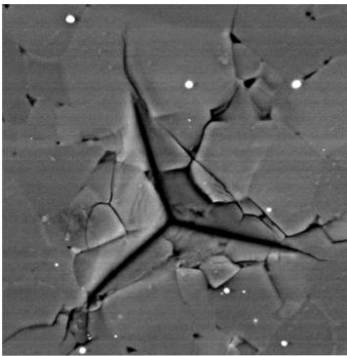
ALPHA



Alpha Advantages

- ▶ **Unrivalled technique versatility**
Nanoindentation, nano-scratch & friction, nano-impact, nano-fretting, nano-wear, nanopositioning
- ▶ **Choice of force range**
Nano (to 500 mN) or Micro (to 30 N)
- ▶ **Flexible entry level system that can expand into a comprehensive nanomechanical test instrument**
Easy on-site upgradability
- ▶ **True measurement flexibility**
Static, dynamic, liquid, humidity and more

Industry Leading Accuracy from our Entry Level NanoTest



The NanoTest Alpha from Micro Materials cleverly combines multiple nanomechanical and tribological test techniques over multiple force scales and multiple environments in a single, affordable instrument to provide the most cost-effective, reliable solution on the market today. Keeping all of the measurement accuracy and precision of the flagship *Vantage* system, the Alpha allows entry into the range at a lower price point with the option to upgrade in coming years as research needs develop.

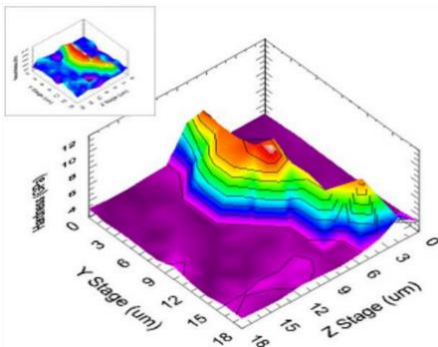
Scientists and engineers at leading universities, research institutions and industrial R&D labs worldwide depend on the unique capabilities of the modular NanoTest range.

Unrivalled Technique Versatility

Every NanoTest Alpha includes advanced data acquisition electronics, intuitive software, a thermally controlled environmental enclosure with an anti-vibration system and a single-objective optical microscope. This remarkably flexible nanomechanical test and characterization solution can be configured to perform nano-indentation, nano-scratch, nano-impact, nano-fretting, and nano-wear techniques. The fully ISO and ASTM-compliant system can even be configured with a nanopositioning stage to provide 3D SPM imaging.

Nanoindentation Module

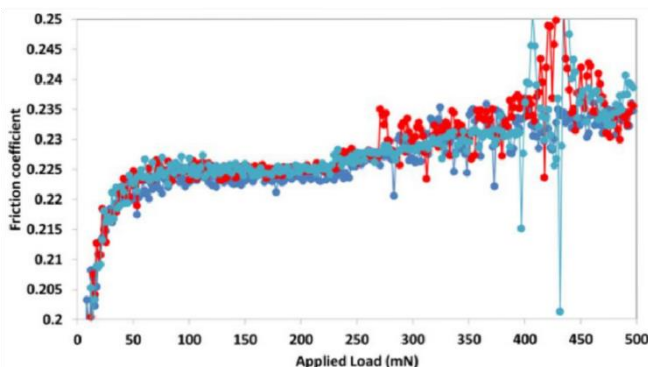
The nanoindentation module has been designed to provide the user with the optimum combination of sensitivity and load range to cover the widest range of applications and sample types. Reliable calibration procedures, experimental protocols and instrument stability ensure that ISO 14577 compliant measurements can easily be performed. High resolution XYZ stages enable precision targeting of test locations, e.g., for indentations into specific phases in multi-phase materials or for micro-pillar compression and micro-cantilever tests. The excellent repositioning accuracy combined with very high thermal stability allows the NanoTest Alpha to target specific features of interest, produce detailed mechanical property maps, evaluate the depth-dependence of hardness and elastic modulus and perform long-duration creep tests.



Mapping the mechanical properties of a hard and stiff intermetallic inclusion (Al7Cu2Fe) in a high-strength Al-Mg-Zn automotive/aerospace alloy.

Nano-scratch module

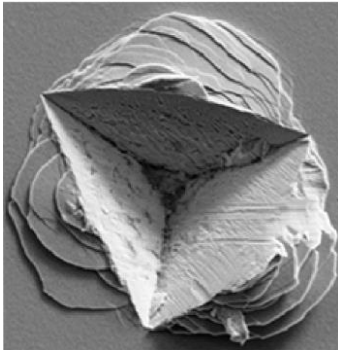
The nano-scratch module has been engineered to provide the optimum combination of (1) wide load range, (2) high lateral rigidity during scratching, and (3) high frictional sensitivity. This module extends the instrument's ability to perform a broad range of nano-tribological tests, including single scratches, multiple-pass scratch and wear tests, surface profilometry, and friction measurements. It is particularly suitable for assessing abrasive wear resistance and critical load for coating failures. The NanoTest Alpha load heads have very high lateral stiffness so the system is very effective for testing hard coatings, even those with very high surface roughness.



Frictional sensitivity and reproducibility in repeat nano-scratch tests on a hard nanocomposite coating. Friction coefficient at failure = 0.223 ± 0.002 .

Nano-impact and fatigue module

Nano-impact works by accelerating the indenter towards the sample surface under controlled conditions. This high-energy impact results in a very high strain rate contact (typical strain rate: $\sim 10^3 - 10^4 \text{ s}^{-1}$) that is orders of magnitude higher than the strain rates in conventional nanoindentation.



Single impacts and repetitive impact tests are possible with this patented technique; each provides different data. Single impacts are used to study rate sensitivity and dynamic hardness in metallic materials as well as energy damping in polymers and biomaterials. Repetitive impact tests are used for assessing fatigue resistance, most commonly on coatings.

Nano-impact complements nanoindentation techniques, especially for applications where toughness is important and hardness alone is insufficient. Impact with the NanoTest has been shown to be an effective accelerated wear test, capable of accurately simulating interrupted contacts (e.g., in metal cutting, in erosive wear, or in auto/aero-engines).

Nano-fretting / nano-wear module

The nano-fretting/nano-wear module can be used for reciprocating wear and fretting testing. By changing the wear track length, both reciprocating nano-wear and true nanoscale fretting tests can be performed with the same module. This technique is important for studying the onset of wear in coatings and metallic materials.

Liquid cell / humidity cell

The NanoTest Alpha can be configured with a liquid cell to perform indentation, scratch, wear and impact tests with the indenter and sample fully immersed in a fluid. The horizontal loading configuration of the NanoTest provides constant buoyancy force and constant surface tension on the loading column, ensuring accurate data. In addition, a fully programmable humidity cell that allows rapid, stable humidity changes from 10% to 90% RH can be included, perfect for studying moisture sensitivity in polymers, biomaterials, and nanocomposites.

Choice of force range

The NanoTest Alpha can be configured with one of two loading heads. Typically most NanoTest Alpha systems are supplied with the low load ('nano') head, which can apply forces up to 500 mN for indentation, scratch, wear and fretting tests, and 100 mN for impact tests. The SPM nanopositioning stage, liquid cell and humidity cell operate in conjunction with this load head.

Alternatively, if micro-scale mechanical measurements are of greater interest, the system can be supplied with the high load ('micro') head. This load head provides true depth-sensing microindentation and micro-scratch up to 30 N, and micro-impact up to 5 N.

Upgradable to a Full Nano/Micro-Mechanical Testing Platform

The NanoTest Alpha can be upgraded to a full NanoTest Vantage system, opening up more test techniques and environmental control capabilities. So as your research expands so does the system, ensuring your investment is protected. Additional options available for the NanoTest Vantage include:

- High temperature stage to 850 °C
- Purge chamber (for purged argon, nitrogen environments)
- Dual load head capability
- Integrated AFM
- Electrical contact resistance (ECR)
- Electrochemical cell
- Acoustic Emission
- Low temperature stage to -20 °C
- Multi-objective optical microscope

Load frame	granite composite material designed specifically for metrology applications
Load application	electromagnetic
Maximum load with standard head	500 mN indentation & scratch/wear, 100 mN impact
Displacement sensor	linear capacitive
Load resolution	3 nN
Displacement resolution	0.002 nm
Repositioning accuracy	< 0.4 µm
Testable surface area	50 mm x 50 mm
Sample manipulation	manual control and point and click from microscope image
Thermal drift	<0.005 nm/s
Contact force	<1 µN
Microscope	5X and 20X as standard
On screen magnification	410X, 1650X
Vibration isolation	Minus K, mechanical passive
Indenter exchange time	<1 min
Compliance with standards	fully compliant with ISO 14577 and ASTM 2546
Scratch module	
Maximum friction force	>250 mN
Friction load resolution	0.03 µN
Maximum scratch distance	> 10 mm
Scratch speed	100 nm/s to 0.1 mm/s
Impact module	
Acceleration distance	Up to 20 µm
Strain rate at contact	Up to 10 ⁴ s ⁻¹
Fretting module	
Track length	≤20 µm
Frequency	≤20 Hz
Maximum number of wear cycles	>10 ⁶
SPM nan positioning stage	
XY scan range	100 µm x 100 µm
Positioning accuracy	≤2 nm
Closed loop linearity	99.97%
Compatibility	Works with all environmental control options
Environmental cell	
Humidity cell	10% to 90% RH
Liquid cell	Sample and indenter fully immersed in fluid
Rapid mapping	
Ability to capture full load/depth curve	Yes
Speed of collection	One indent every 6 seconds (with nan positioning stage)
Statistical analysis	Yes – including distribution analysis
High-load head option	
Maximum load	30 N indentation & scratch, 5 N impact

Applications

The NanoTest Alpha is the perfect instrument for studying a wide range of materials systems for both fundamental research and industrial applications, including:

- ▶ Metals
- ▶ Hard coatings
- ▶ Ceramics
- ▶ Composite materials
- ▶ MEMS
- ▶ Thin films
- ▶ Polymers

The tougher the application, the more likely it requires the NanoTest Alpha!

Micro Materials Ltd

We've been at the forefront of nano-mechanics innovation since 1988 with:

- ▶ The first commercial high- temperature nanoindentation stage
- ▶ The first commercial nano-impact tester
- ▶ The first commercial liquid cell
- ▶ The first commercial instrument for high-vacuum, high-temperature nanomechanics

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NanoTest

ALPHA