Rtec instruments

Surface Materials Tester

SMT-5000

Hardness, Elastic Modulus, Scratch Resistance,
Coating Adhesion, Friction Coefficient , Wear,
Film Thickness, Roughness, 3D Topography

ACCREDITED
MSCB-132
Certified ISO 9001:2015

Rtec-Instruments

New evolutions in surface materials testing

As surfaces become more complex in different applications and products, investigating their mechanical properties requires a new generation of instruments.

The SMT-5000 instrument answers the needs of both researchers and quality control engineers. The wide testing range allows the SMT instruments to test coatings, bulk materials, and fundamental components across several industries and applications.

The Source of Our Leadership

The SMT instruments are the first answer to the increasingly complex testing requirements for surfaces across many industries– from liquid to ultra-hard solid materials. Rtec-Instruments' SMT combines multiple investigative techniques to measure surfaces on one platform. For example, with one run, coating adhesion, hardness, thickness, surface roughness, and 3D image data come together for a conclusive comprehensive analysis. In addition, each instrument's modularity provides access to diverse testing techniques and load ranges on the same platform.

Precision Manufacturing

All critical parts of Rtec-Instruments products are manufactured in our in-house machine shop using high-precision CNC machines. This complete control over manufacturing guarantees that all critical mechanical components are designed and manufactured to the highest accuracy and reliability following our high internal quality standards.

Constant Innovations

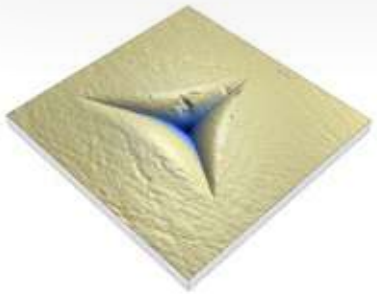
Our highly experienced scientists and application engineers constantly innovate with new products and applications to successfully answer the ever-evolving testing needs. In addition, we regularly partner with industries and universities using our global chain of direct offices.

Robust and Reliable

With design and manufacturing in-house, Rtec-Instruments provides unequaled robust platforms with a high measuring accuracy. Born from industry requirements, Rtec-Instruments also provides "turn-key" testing solutions for many industry-specific international standards.

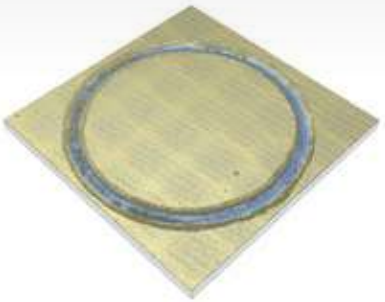
Complete Solution For Surface Characterization

All in one easy-to-use platform



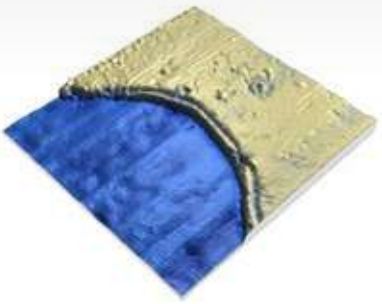
Instrumented Indentation

- Hardness
- Elastic modulus
- Storage/loss modulus
- Creep
- Stress-strain curves
- Fracture toughness



Tribology

- Friction coefficient
- Wear rate
- Lifetime studies
- Tribological behavior

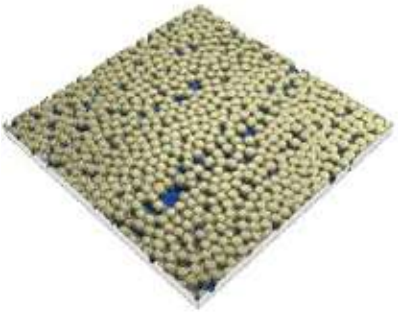


Spectral Reflectance

- Non-destructive and fast coating thickness
- Optical constants

Scratch Testing

- Coating adhesion
- Scratch resistance
- Mar resistance
- Scratch hardness



3D Profilometry

- Surface topography
- Failure analysis
- Morphology
- Defect analysis

Rtec-Instruments Key Features

High accuracy sensor

Our patented capacitive technology provides unequaled accuracy, stability, and resolution for force measurements on single or multiple axes. (Patent US 10,775,247 B1)

Combination of Indentation and Scratch Module (IST)

The IST module provides both indentation and scratch testing in one single module.

Both normal and lateral forces are measured in the head for more accurate force sensing.

True Modularity

The SMT-5000 platform can receive multiple inter-changeable measurement modules, covering Instrumented Indentation, Scratch, Tribology, 3D Profilometry, and Coating Thickness.

Module changes take less than 2 min.

Large Load Range

In addition to multiple techniques, the SMT measurement modules are offered in many different force ranges, yielding a single instrument capable of covering from mN to 200 N.*

In-line 3D Profilometry

The 3D profilometer provides Confocal, White Light Interferometry, Bright & Dark fields, and Versatile Focus imaging in one module.

All techniques are available in-line with testing modules to provide an unequaled imaging capability. (Patent US 10,024,776 B2)

Non-destructive Film Thickness

Based on spectroscopic reflectance, the film thickness measurement (FT-100) module provides a super fast and direct non-contact film measurement.

* For forces above 200 N, please inquire about our MFT-5000 instrument

SMT-5000

Combination Scratch, Indentation, and In-line 3D Profilometry

Indentation, scratch heads

Automatic XY stage

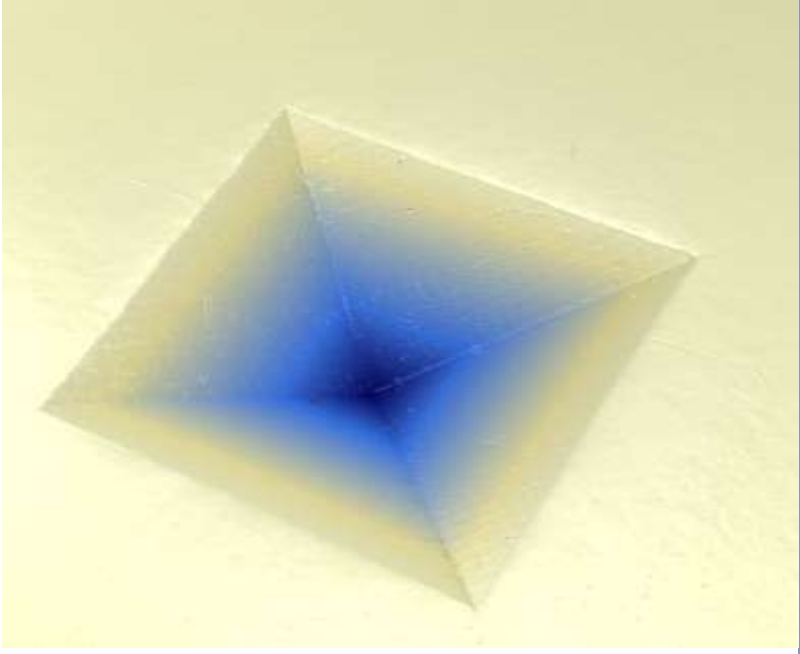
3D profilometer

Film thickness probe

Automatic Z stage

Instrumented Indentation (IIT)

Hardness and Elastic Modulus



Our Instrumented Indenter Testers are high-precision instruments measuring the mechanical properties of thin films, coatings, or any bulk materials.

Hardness, elastic modulus, creep, and fatigue can be determined on almost any material, from soft to hard and fragile to brittle. Using the latest actuation (piezo) and sensing technologies (capacitive sensors), the SMT quantifies the properties of surfaces from nano to micro ranges.

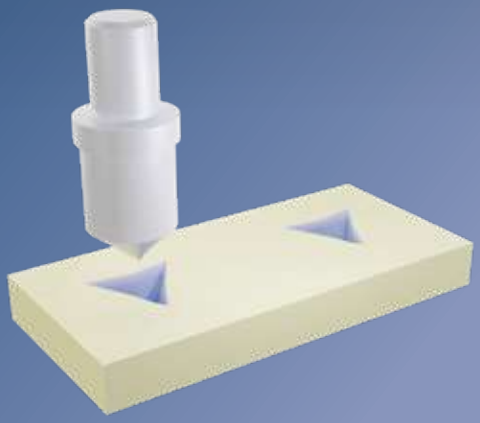
Instrumented Indentation Testing (IIT) involves pressing an indenter of known geometry into a surface while controlling and measuring the force and displacement.

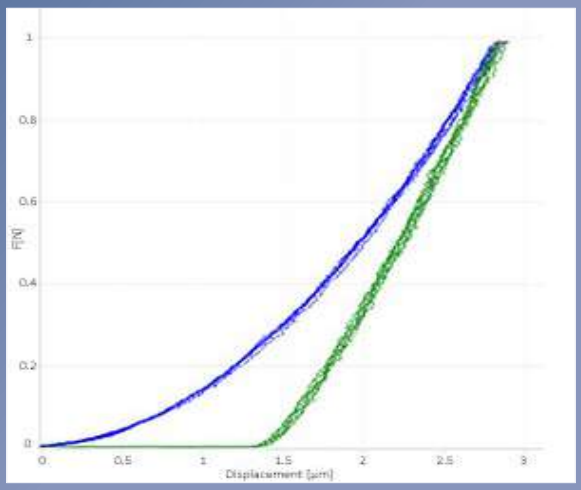
The resulting load-displacement curves are used to calculate hardness and elastic modulus, among other things.

Although traditional hardness measures remain available (Knoop, Rockwell, Vickers); the IIT technique adds the ability to measure the elastic modulus of the material tested.

Key Features of Indentation Testers

- Exchangeable modules to cover multiple load ranges from mN to 200 N
- Unmatched performance with patented capacitive sensor technology
- Berkovich, Vickers, Spherical, Cube Corner, Knoop, ... indenter tip
- Handling large and heavy loads and samples (50 cm; 10 kg)
- Motorized stage 150 mm x 200 mm for automatic mapping
- Automated 3D microscopy inspection





Scratch Testing

Coating adhesion and scratch resistance

A scratch is created by dragging a tip of known geometry to the surface of a sample of interest. As the tip moves along the surface, the normal load applied to the tip is kept constant or increased linearly.

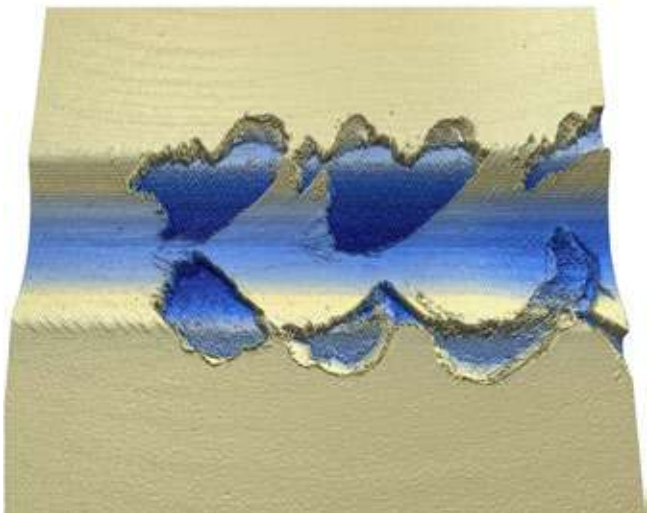
In the case of coatings, the linear increase of the normal force increases the severity of contact, providing the ability to observe critical failures of the coating, the interface, and possible coating removal from the substrate.

The combination of data and 3D imaging provides a complete picture of the effects of forces on the deformation and failures of the surfaces.

Two types of scratch results can be evaluated on the SMT instruments:

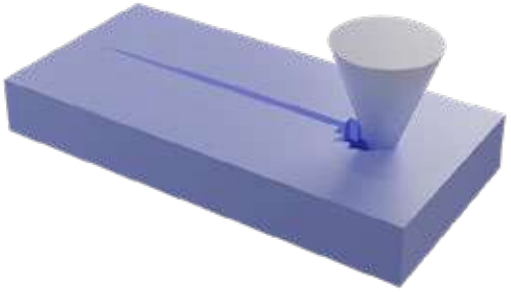
- The scratch resistance: what is the permanent deformation left in the surface for a given load?
- The scratch adhesion: what normal force is required to break the bond between substrate and coating?

Following the scratch, images of the entire scratch are taken to provide the user with complete information on wear track, scratch width and depth, crack propagation, failure mode, roughness, volume lost, and more.



Key Features of Scratch Testers

- Interchangeable scratch head to accommodate multiple testing ranges from nano to macro
- A combination of high-accuracy scratch tester and 3D optical profilometer (US 10,024,776 B2)
- The best sensitivity friction force thanks to combined tangential force sensors in the head and not beneath the sample
- Tests with temperature, humidity, and/or tribo-corrosion cell
- Measurement on flat or curved surfaces



Tribology

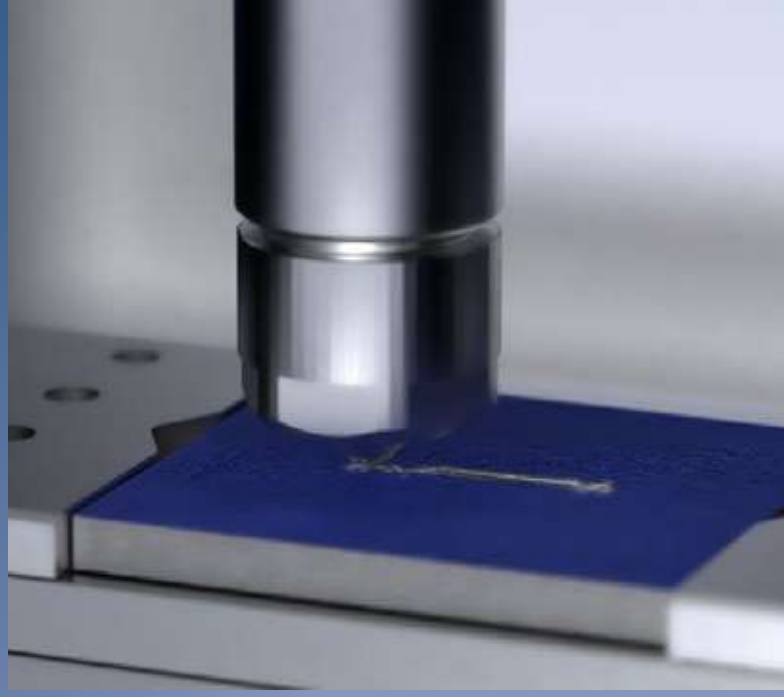
Wear and coefficient of friction

Wear and coefficient of friction studies can efficiently be conducted on the SMT instruments to measure the life and durability of surfaces.

By combining the high-resolution profilometer with the tribometer setup (a sliding contact under known normal force), the wear of the surface can be easily measured as a function of time and forces.

The real-time downforce and speed control allow the creation of a material's fingerprint across a wide range of test parameters such as wear rate, static friction, and dynamic friction.

Since SMT sensors measure both normal and tangential forces, the evolution of the coefficient of friction can be easily monitored with

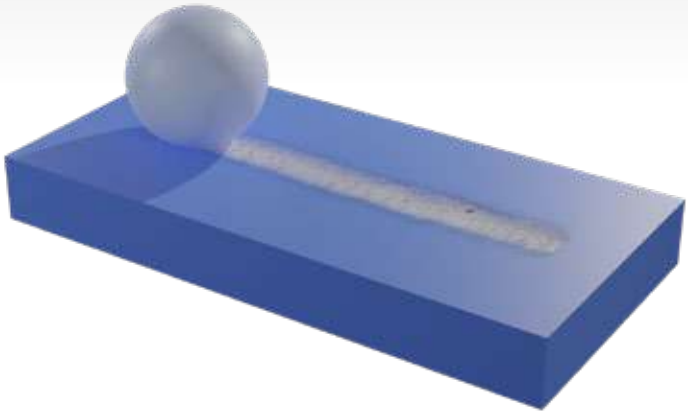


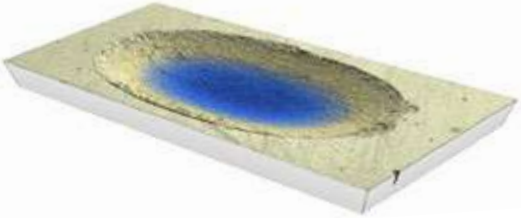
different loading, speed, and contact geometry configurations.

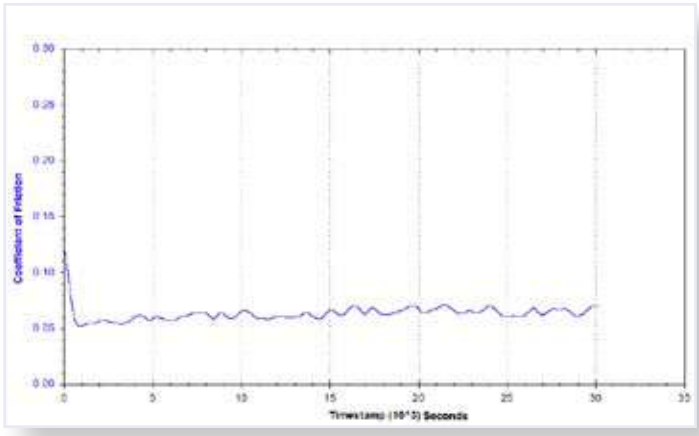
The combination with our patented in-line 3D profilometry provides a unique and automated comprehensive characterization of surface changes vs. time.

Features of the Tribometers

- Nano to macro tribology with fast exchangeable load cells
- Tribo-corrosion capability
- Linear and rotating sample displacement
- Testing conditions with heating, cooling, liquid or humidity
- Automatic program of test-stop on friction, penetration, ECR, ...
- Patented in-line profilometer with automatic stitching technology (US 10,024,776 B2)







Film Thickness

Ultra-fast coating thickness determination

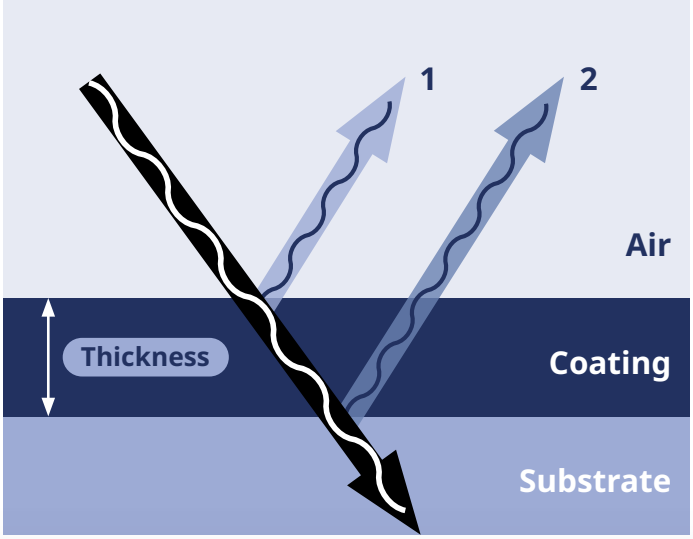
The film thickness measurement module uses spectral reflectance to obtain the thickness of coated surfaces.

Spectral reflectance relies on the interaction of the coating surface with light to calculate the thickness. The comparison of incident light to reflected light from the different interfaces below the sample's surface allows the measurement of optical constants, thickness, and surface roughness.

Interpretation of the reflection data is fairly intuitive and easy to understand, especially in the case of relatively thick films.

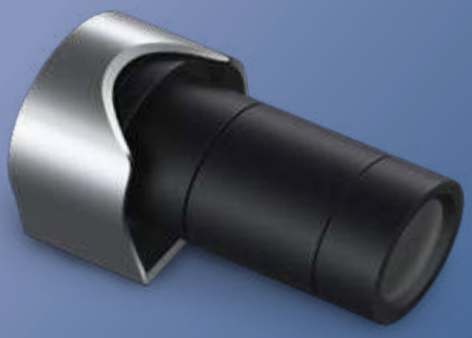
Thickness information is primarily contained in the frequency of reflectance spectrum oscillations, while optical constants (more precisely – optical contrast, i.e., the difference between optical constants at the interface) information is contained in the amplitude of the oscillations.

Our full package includes easy-to-use software to record all measurements and produce statistics.



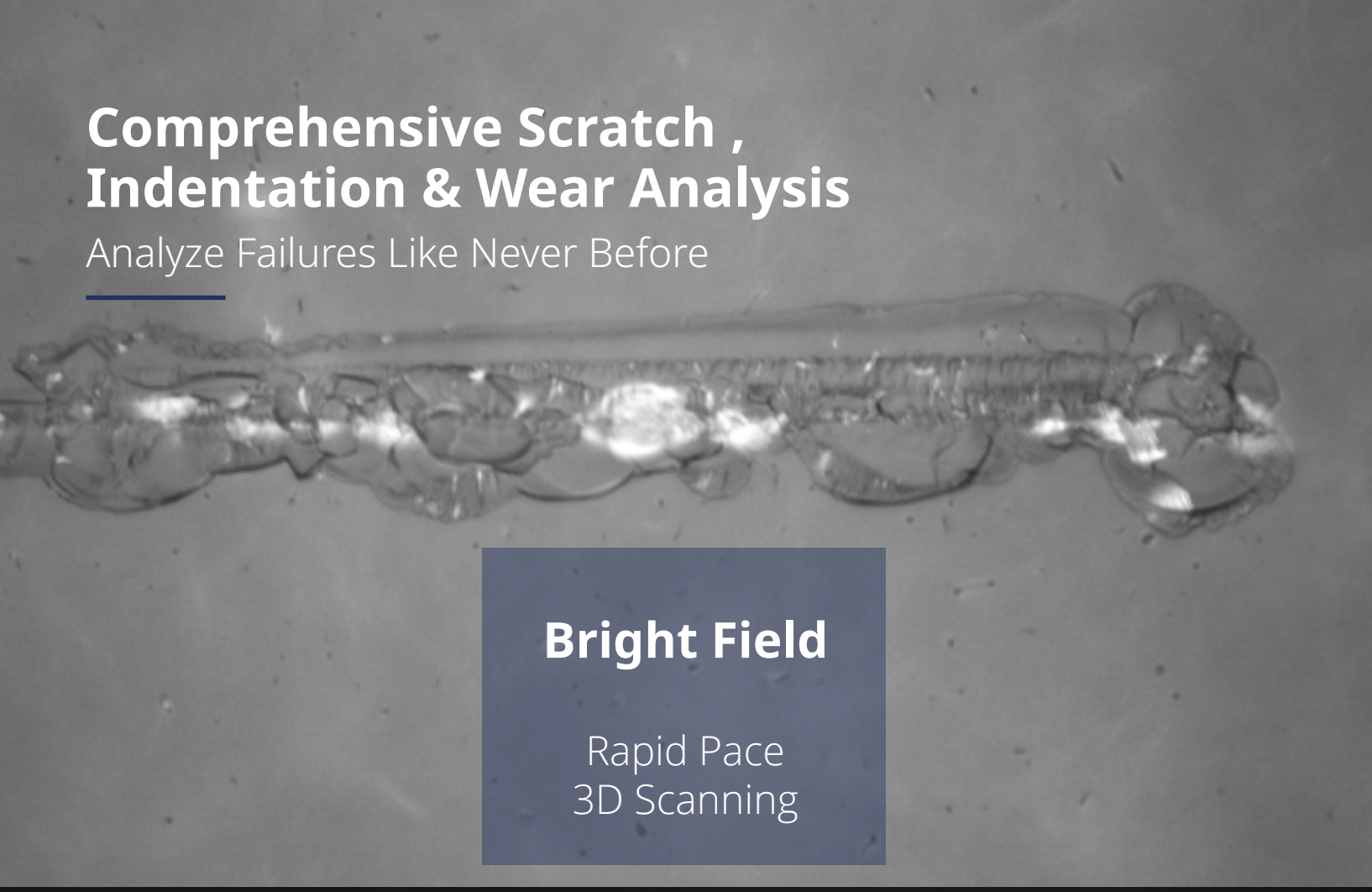
Key features of film thickness

- Extensive materials library (500+)
- Real-time, one-click measurement and analysis of thickness, n&k, and roughness measurement
- Ease of use, no expert knowledge required
- Powerful analysis package scaling correction, multi-sample measurement, and dynamic measurement.
- History of analysis: recall/display measurement results and statistics



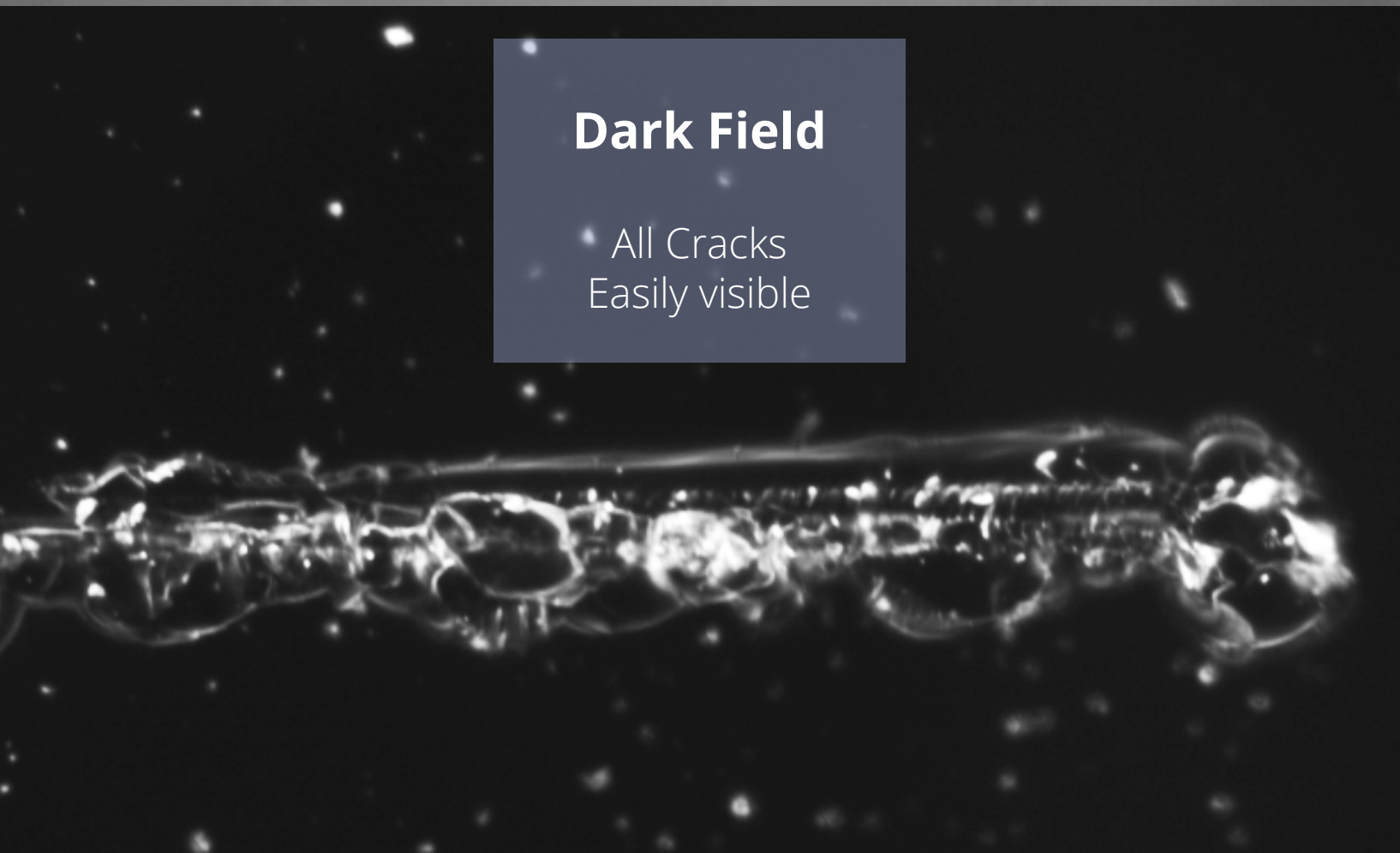
Comprehensive Scratch , Indentation & Wear Analysis

Analyze Failures Like Never Before



Bright Field

Rapid Pace
3D Scanning



Dark Field

All Cracks
Easily visible

3D Universal Profilometer

Rtec-Instruments holds the patent for in-line profilometry (US 10,024,776 B2). This capability allows the sample's surface to be imaged automatically using 3D profilometry at any point during the test.

Different imaging techniques are available for the users:

Spinning Disc Confocal

Optimized to look at steep slopes, transparent, translucent surfaces. Provides fast, highest XY resolution 3D imaging and topography

White Light Interferometry

Optimized to look at smooth, flat surfaces. Provides fast, highest Z resolution 3D imaging and topography of the surface.

Bright and Dark Fields

Imaging provides two different ways to look at the surface with additional illumination. Dark field identifies small cracks by showing them brightly on a dark background.

Variable Focus Imaging

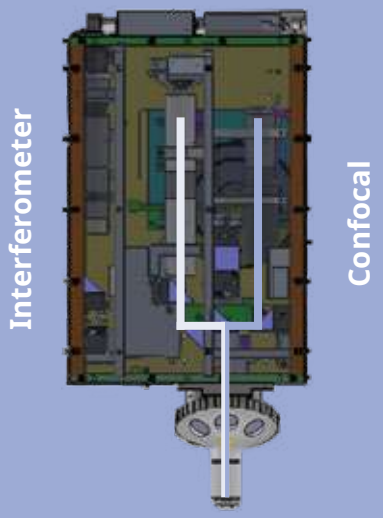
In Variable Focus Imaging, a series of photographs are taken on different focal planes and analyzed to create an entirely in-focus final image.

Stitching

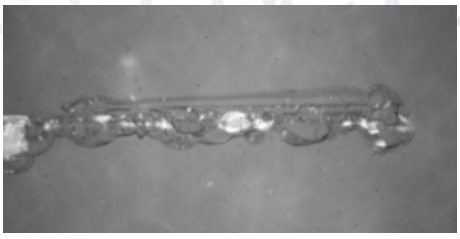
This mode offers the automatic imaging of large surfaces at high magnifications.

Imaging Mode

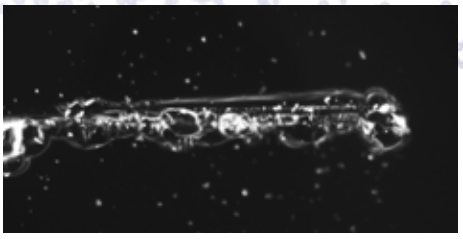
Sub nm automated
3D images of surfaces
2 paths with 2 cameras



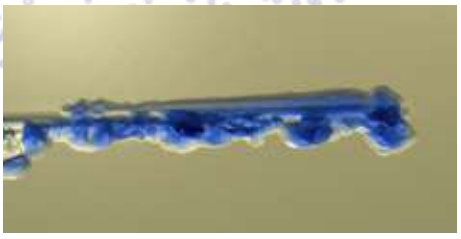
- Surface roughness
- Film thickness
- Wear track
- Volume wear
- Step height
- Add-on - Confocal Raman



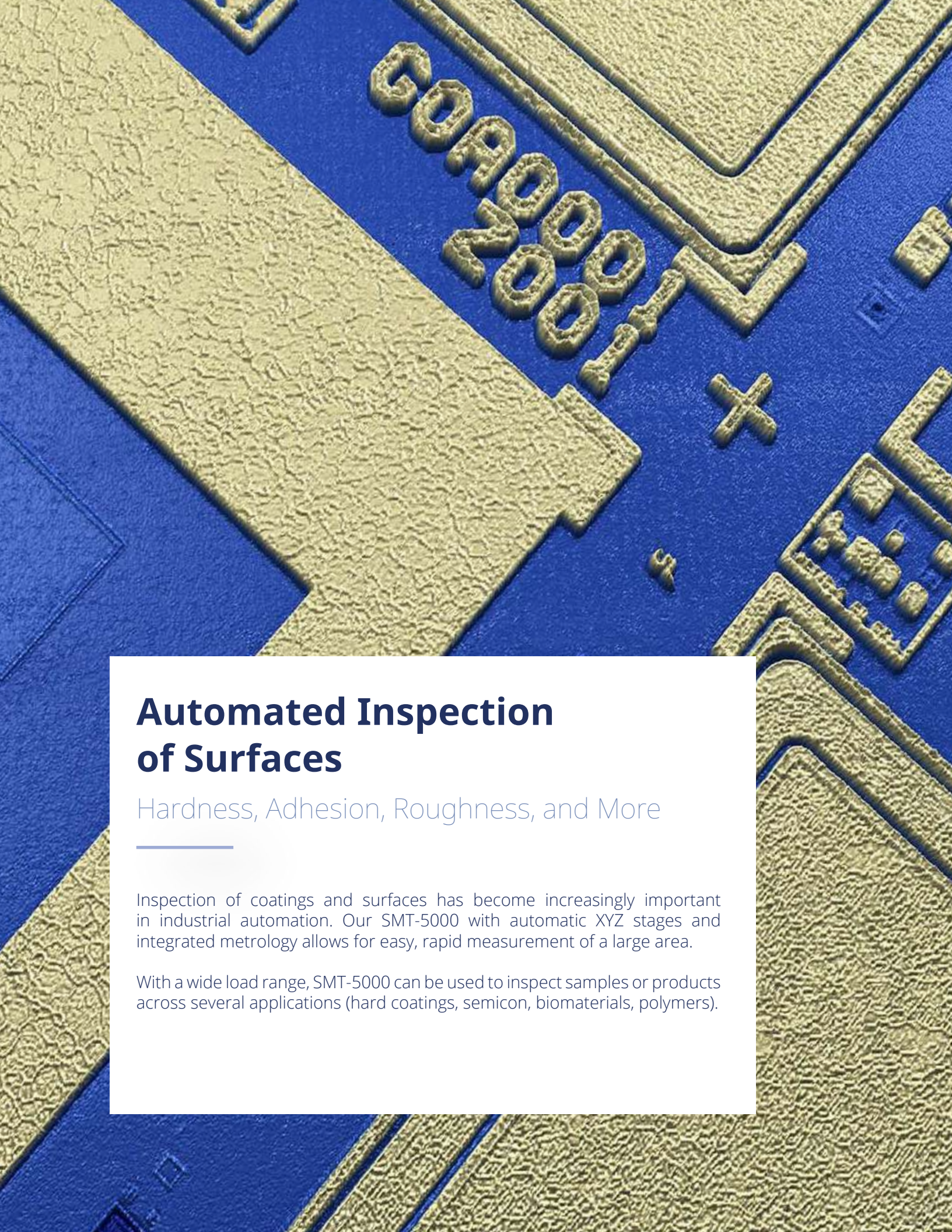
Bright Field



Dark Field



3D Topography



Automated Inspection of Surfaces

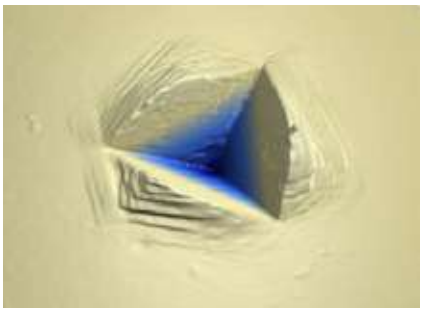
Hardness, Adhesion, Roughness, and More

Inspection of coatings and surfaces has become increasingly important in industrial automation. Our SMT-5000 with automatic XYZ stages and integrated metrology allows for easy, rapid measurement of a large area.

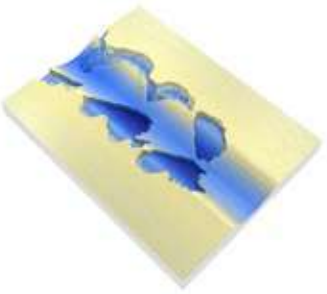
With a wide load range, SMT-5000 can be used to inspect samples or products across several applications (hard coatings, semicon, biomaterials, polymers).

3D Microscope With Multiple Applications

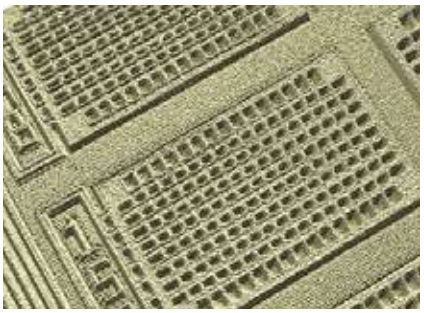
The Most Powerful Package of Analysis On The Market



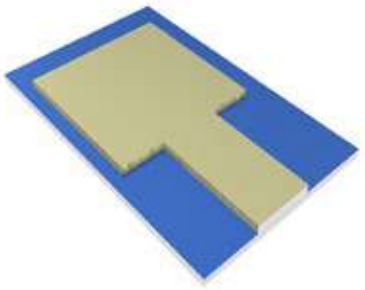
Berkovich indentation



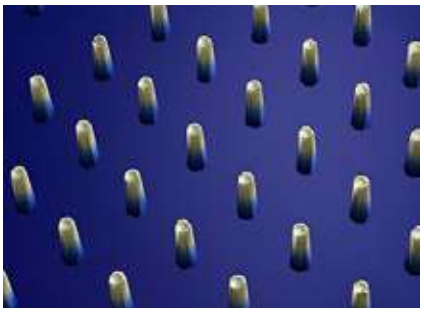
Scratch adhesive delamination



Wafer topography



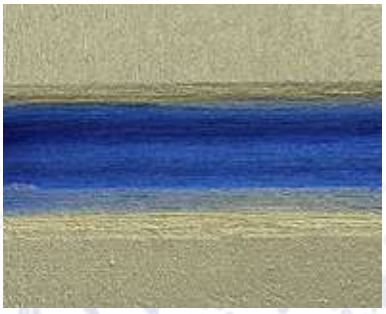
Z calibration sample



Wafer bumps

Micro fluid chip

Ink on paper



Tribology wear

Controlled Environment

Liquid Chamber

Liquid containers are available to test under liquid for both indentation and scratch modules.

The baths ensure constant wetting of the contact during the test.

Some recirculation and heating options can also be added to the fluid.

Humidity Chamber

A humid environment can have tremendous effects on the properties of surfaces and coatings.

A special humidity enclosure is available to study the effect of humidity on the tribological and mechanical properties of surfaces and coatings.

Corrosion

The corrosion cell option makes studies of surfaces under corrosion environments possible. A robust three-electrode measurement system has a corrosion cell typically made from peek material or potentiostat. This allows quantification of the synergistic effect of corrosive media on surface mechanical properties.

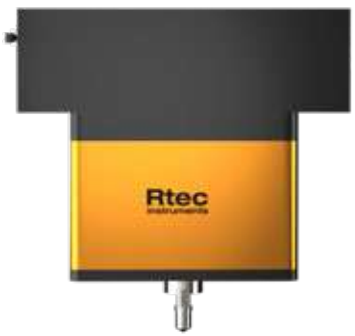
The setup simultaneously measures current, voltage, downforce, friction force, temperature, and acoustic emissions during the test.

Hot and Cold Temperature

A heating/cooling module provides sample temperature control during the surface testing to study the effect of temperature on surface properties.

The temperature control is fully automated and synchronized with the software.

Testing Modules

	Description	Measurement heads
IST Indentation Scratch Tester	This module provides both indentation and scratch capabilities. It is available in different load ranges and measures normal and tangential forces, along with vertical displacement. Both normal and tangential forces are measured on the indenter tip.	
IIT Instrumented Indentation Tester	This module provides indentation capability. It is available in different load ranges and measurements normal and tangential forces, along with vertical displacement. This module can be used or instrumented indentation and traditional hardness tests.	
UST Universal Scratch Tester	This module provides scratch capability. It is available in different load ranges (from mN to 200 N) and measurements normal and tangential forces, along the scratch path. Normal and tangential forces are measured on the scratch tip, offering a higher measurement sensitivity and accuracy.	

Software

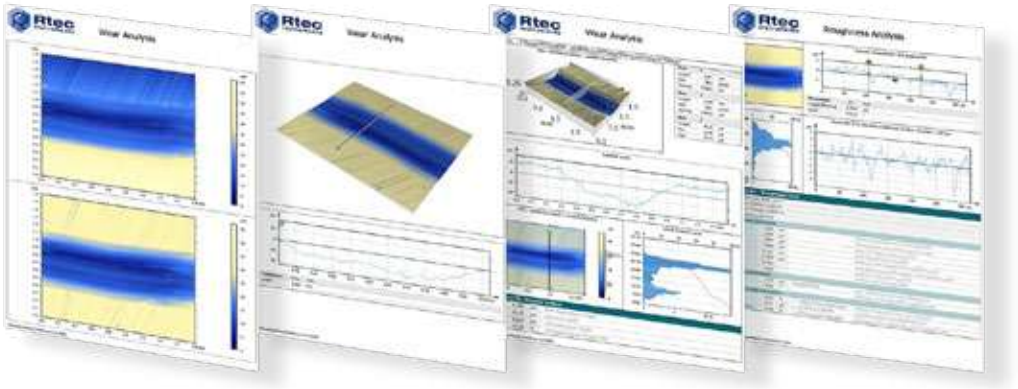
The SMT instruments come standard with control and data analysis software.
This software allows the user to continue to run the instrument while analyzing data from previous tests.

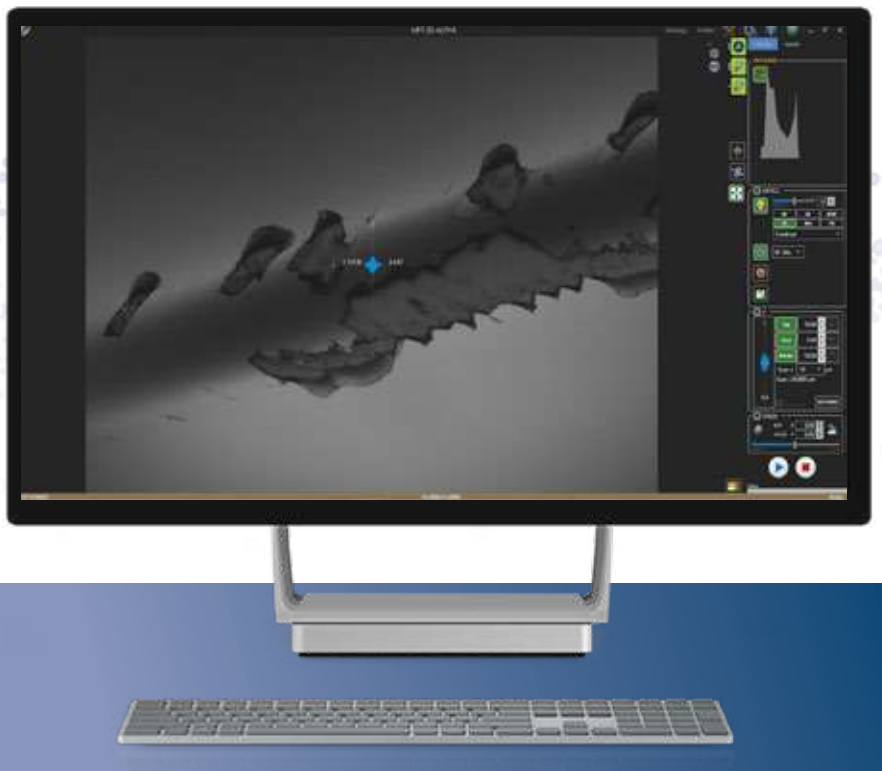
MFT Software

This software controls the instrument and is used to set up the test parameters.
The tests can be as simple as loading a test recipe and clicking start or as advanced as programming each instrument's motion while recording different data.

Insight Software

The insight software allows for the complete data analysis of indentation, scratch, tribology, and other tests.
The software allows for combined analysis of 3D profilometer images and data acquired during the tests.





Standardized Testing

The SMT-5000 comes with several test-specific standards for data traceability and quick platform checkup. The instruments also come with standard test recipes to ensure normalized testing.

Instrumented Indentation	Fused Silica, BK7, tungsten and hardness blocks
Scratch	DLC coating - BCR 692
3D profilometer	Standard step heights and roughness standards (100 nm and 1 micron)
Wear	E52100 standard test sample
Film thickness	10 nm coated sample

The SMT instruments comply with many different testing standards.
The table below presents a non-exhaustive list of possible standards:

Indentation	ASTM E2546, ASTM B933, ASTM D785, ASTM E140	ISO 14577, ISO 6508, ISO 6507, ISO 4516	DIN 50359, DIN 55676 JIS B7734
Scratch	ASTM C1624, ASTM G171, ASTM D7027, ASTM D7187	ISO 20502, ISO 19252, ISO 1518	DIN EN 1071-3
Tribology	ASTM G99, ASTM G132, ASTM G133, ASTM F732	ISO 20808, ISO 7148, ISO 18535	DIN EN , EN 1071-13, DIN 50324, DIN 51834
3D profilometry	ASTM D4172	ISO 25178	

Applications & Industries

Hard Coating

- TiN, WC, DLC, WC
- Cutting tools, drill
- PVD, CVD coatings
- Forming tool
- Thermal, plasma spray

Bio-Materials

- Implants, stents
- Bone tissue
- Tablets, pill
- Drug delivery
- Artificial joints

Materials

- Ceramics
- Polymers
- Metals
- Rubber
- Composite

Optical

- Eye glass, lens
- AR coatings
- Mirror
- Touch screen
- Display panels, LED

Decorative Coatings

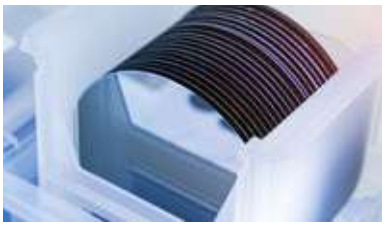
- Jewelry
- Watches
- Evaporated metal
- Cases
- Anti-corrosion coating

Miscellaneous

- Consumer goods
- IoT devices
- Connectors
- 2D materials
- Flexible electronics

Automobile

- Paint, varnish
- Polymer
- Engine, piston
- Thermal spray
- Window



Semiconductor

- Thin films
- Low-K films
- Passivation layers
- MEMS, NEMS
- Hard disks

Aerospace

- Composite material
- Polymeric coating
- Paint
- Thermal spray coatings
- Heat resistance coatings

Specifications

Scratch

UST	1	40	200
Maximum load [N]	1	40	200
Load resolution [µN]	0.01	6	100
Friction force [N]	1	40	200
Friction resolution [µN]	0.01	6	100
Maximum displacement [µm]	1000	1000	1000
Displacement resolution [nm]	0.01	0.03	1.5

* More displacement and force ranges available

SMT Platform

	SMT-5000
XY axis [mm]	150 x 200
XY speed [mm/s]	up to 50
Z [mm]	100
Position Resolution	0.25 µm

*Larger XY Ranges Available

Instrumented Indentation

IIT	1	40
Maximum load [N]	1	40
Load resolution [µN]	0.01	6
Maximum displacement [µm]	1000	1000
Displacement resolution [nm]	0.01	0.03

* More displacement and force ranges available

Coating thickness

	FT-100
Light source	Halogen
Wavelength [nm]	400 - 1100
Thickness range [µm]	0.01 to 75
Precision [nm]	<0.01
Accuracy [nm]	1

Instrumented Indentation and Scratch

IST	1	40
Maximum load [N]	1	40
Load resolution [µN]	0.01	6
Friction force [N]	1	40
Friction resolution [µN]	0.01	6
Maximum displacement [µm]	1000	1000
Displacement resolution [nm]	0.01	0.03

* More displacement and force ranges available

3D Universal Profilometer

See our Universal Profilometer catalog for specifications

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