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Test equipment MTR3: microindentation and scratch tester



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Instruments and equipment for material testing
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Introducing test equipment MT3

The MTR3 is an equipment designed for characterizing the surface mechanical properties of thin films, substrate influence, and coatings and so on.

Specifically, this characterization is carried out by means of two families of already popular tests in scientific world. They are: **micro indentación** test (ISO 14577:2005 "Metallic materials. Instrumented indentation test for hardness and materials parameters"), and **scratch** test (ISO 1071-3:2005 "Advanced technical ceramics. Methods of test for ceramic coatings. Determination of adhesion and other mechanical failure modes by a scratch test", ASTM G171 "Scratch hardness of materials using a diamond stylus").

At MICROTEST we consider both tests as complementary. As a result, our test system MTR3 integrates, in the same equipment, both micro indentator and scratch testers. That characteristic normally is resolved by means of two test machines.

At micro indentation test, the test equipment applies a progressive force in a specific point, relieving that after a while. At scratch test, that force, is produced together with a horizontal displacement before discharging any force.

Indentation's result is a P - h diagram which means and strain - stress curve, from there, it is possible to obtain important parameters such as: indentation modulus, indentation hardness or toughen coefficient



Scratch test will be able to push the cover to the limit into a progressive load test, or submit it to successive scratch cycles simulating a fatigue test or, on the other hand, characterize its scratch hardness measuring with the optical microscope the resultant groove's width.

Adding to Young modulus and indentation hardness, critical force measure, acoustic emission¹ signal maximums, drag coefficient (analogous to friction one) and penetration's depth, we will obtain a wide characterization of coatings and surfaces.

General features test equipment MT3

- Dual possibility micro indentator – scratch tester
- Double axis force transducer (30N, 50N or 200N range)
- Different indentator's shape: Berkovich, Vickers, Rockwell, etc
- High variety of specimen's shape and dimensions susceptibly to be tested
- Valid for different materials (plastics, metals, ceramics, etc)
- High accurate point selection and post view inspection, thanks to optical microscope



¹ Optional equipment



- ➔ ISO, UNE and ASTM standardized
- ➔ Acoustic emission, depth measure, drag force, pictures catching
- ➔ Versatile and powerful test sequence configurator. Automate your own sequences!

Test equipment MT3 servocontrol

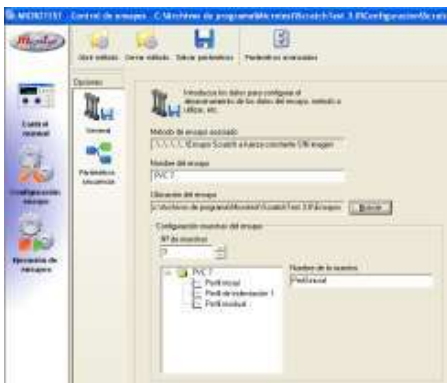
Both micro indentations and scratch tests, MTR3 test equipment has the chance of controlling under different target's variables (vertical force, displacement) by means of a servo controlled PID (proportional - integral - derivative)

ScratchTest software

Specific software ScratchTest includes a complet set of features for setting up properly test equipment MTR3 before and after performing the tests.

- Real time adquisition of vertical and horizontal force, friction coefficient, depth, acoustic emission (by means of acoustic emission option), displacements.
- Accurate selection on each indentation (by means image option)
- Speed control either microindentation or scratch test.
- Pre-installed sequences either micro indentation (simple, multiple) or scratch (constant, progresive, multiple)
- Pictures easy catch. Subsequent measure thought it
- Direct link with Microsoft Excel for further test analysis

The software, integrates all device management (loading system, motion, camera, optical microscope, sensors, ...) in the same environment.



Optional elements

Test equipment MTR3 could be completed with some optional elements such as image system, acoustic emission measurement or different force transducer capacities, as well as any indenter tip shape; either standard² or not.



• **Image option**

Set of elements for test equipment MTR3. This option mainly consists of three differentiated elements: optical microscope image system, digital camera, light source.

Total magnification catches up with standard configuration camera and microscope enables to reach resolutions up to 0.063 μm/pixel.

There several functions associated to the Image Option which can be controlled through the ScratchTest software. This allows the user the pre & post test surface visualization, related to the obtained P-h curves, as well as the indentation and starting scratch points selection.

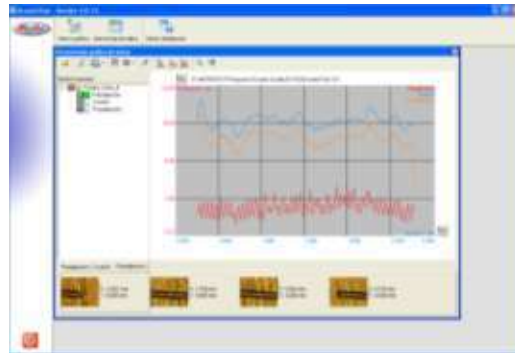


² Knoop, Vickers, Rockwell, Berkovich, etc.

• **Acoustic emission option**

Acoustic emissions are the stress waves generated by the sudden internal stress redistribution in material or structures when changes in the internal structure are produced. Possible sources that justify those internal adjustments are: crack initiation and growth, crack opening and closure, deformation, dislocation movement, void formation, interfacial failure, etc. These waves propagate through the material and reach the surface.

The Acoustic Emission (AE) option the user to measure and register the phenomena described. This option includes a piezoelectric AE sensor for low amplitude and high frequency acoustic signals and conditioning electronics that filters and amplifies acoustic signal with two different outputs: ASL (Average Signal Level) o PL (Peak Level).



Possible applications

- Semiconductor technology
 - Passivation layers
 - Metallization
 - Bond pads
- Wear resistant coatings
 - TiN, TiC, DLC
 - Cutting tools
- Automotive
 - Paints and polymers
 - Varnishes and finishes
 - Windows
 - Brake pads
- Optical components
 - Eye glass lenses
 - Optical scratch-resistant coatings
 - Contact lenses
- General engineering
 - Rubber resistance
 - Sliding bearings
 - Self lubricant systems
- Data storage
 - Magnetic disks
 - Protective coatings on CDs y DVDs

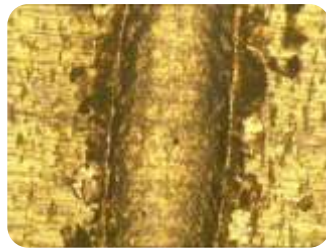
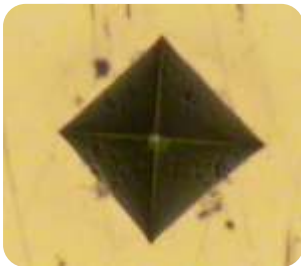
Applicable standards

- ASTM B578
- ASTM D7027
- ASTM C1624
- ASTM G171
- ASTM F2496
- ISO 20502
- ISO 1518
- ASTM E384
- ASTM E2546
- ISO 14577
- ISO 2039
- ISO 4516
- ISO 28079

Technical features

	MTR3
Normal force range	30N, 50 N, 200N
Normal force resolution	0.3mN-0.5mN-2mN
Friction force range	30N, 50 N, 200N
Friction force resolution	0.3mN - 0,5mN-2mN
Maximum scratch (axis X) and amplitude (axis Y)	120 mm or more
Axis X and Y max. speed	150 -600 mm/min
Maximum vertical displacement (axis Z)	150 mm or more
Axis Z speed	20-50 mm/min
Capacite sensor range (typ.)	1000 µm / 200µm
Capacitive sensor resolution	From 20nm to ³ 0.15nm
Optical microscope magnification ⁴	5x...100x
Digital camera	4Mpx or better
Total magnification displayed ⁵	< 0.063 µm/pixel
Software	Tribotester / ScratchTest

Specifications by default may be subject to changes caused by the normal test equipment evolution.



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³ Depending on the specific measuring range .

⁴ Just referred to optical lens magnification. It does not take into account relation between CCD camera resolution and pixels displayed on the screen.

⁵ According to the combination of optical device – digital camera.