UNAT-S

The beginners device for measurements of hardness and Young's modulus on surfaces and thin films according to DIN EN ISO 14577

FAST MEASUREMENTS
AFFORDABLE
UPGRADEABLE
MOBILE MEASURING HEAD
Instrument Features

- combination of a basic, affordable Nanoindenter and a mobile measuring head
- Mobile measuring head with a passive vibration damping system for measurements on large surfaces and work pieces (e.g. lacquers on metal sheets)
- Modular and very robust construction
- Very fast and reproducible measurements
- Different predefined measuring methods (applications)
- Depth resolved measurements of hardness and Young’s modulus via QCSM module
- Diversity of indenter types and test tips
- Unique analysis routines by using new findings in the field of contact mechanics
- Upgradeable to fully automatic device with optics and automated stage system

Concept

The UNAT-S is a basic Nanoindenter for measurements of hardness and Young’s modulus on surfaces and thin films according to DIN EN ISO 14577. Our device ensures the affordable access to these kinds of measurements without the need of a precise sample positioning. Thanks to the very robust construction UNAT-S is particularly suited for training purposes.

Within the product development we attached great importance to high resolution, fast and secure surface detection (approach) and protection of the sensitive measuring tips. This beginners device dispenses with an optics for imaging the sample surface and precise sample stages. The samples will be fixed by a magnetic mounting and can be shifted manually. The device is upgradeable. Optics and sample stages can be retrofitted. The Software and all features for the evaluation of measurement data are equivalent to the other instruments of ASMEC. All analysis methods are equally available.

Measuring Head

- Easy mobility in normal direction and high stiffness in lateral direction by a double leaf spring system
- No force signal before surface contact; decoupling of force generation (by a piezo) and force measurement (by spring deflection)
- Robust construction
- No “dead stop” for the inductive sensors during overload and therefore no damage possible
- Protection tool for the diamond tips
- Height adjustment via micrometer screws
- The shaft can carry substantial weights without leaving the measuring range; this allows the use of any type of customer-specific measuring tips

Scope of delivery

The mobile measuring head is delivered together with one base plate with feet for the horizontal adjustment; a magnetic mounting; a set of different sample holders; two levers for adjustment of the sample; appropriate electronics consisting of controller, computer, monitor, keyboard and mouse, a Ber-
kovich-Indenter and 3 pieces of calibration material, (sapphire single crystal, fused silica and polycarbonate). Obtainable are also other indenter types such as Vickers; Knoop; Cube Corner or spherical indenter. The accuracy of the measurements can be improved by installing the base plate on a vibration damping table or by using an active anti-vibration system.

For the mobile use an equipment trolley is available.

**User Interface**

**Definition of the measuring procedure (application)**

A large number of predefined applications that may be selected by a simple mouse click are available. Each test cycle can be programmed very flexibly with any number of load-unload segments. In the “open loop” mode the user can define force or displacement, the measuring time and data rate of a segment whereas in the “closed loop” mode the user can additionally set the number of data points and the dwell time per point. When using the QCSM module, it is possible to additionally define the amplitude and the frequency of a superimposed oscillation.

**Evaluation of measurement data**

Measurement data can be graphically presented, compared, averaged or exported in different formats (ASCII, EXCEL, BMP etc.). Comprehensive and flexible correction routines are available for the data evaluation. Ones defined, parameters for the analysis and the presentation of results can be stored in configuration files. The correction of data (zero point correction, thermal drift correction) as well as the averaging of measuring curves with equal load can be carried out manually or automatically, so that the results are eventually presented to the user in a table. Almost any number of data files can be read and analyzed simultaneously. Averaged and corrected curves can be stored automatically in separate files.

**Applications**

**Measurement of hardness and Young’s modulus according to DIN EN ISO 14577**

The measurements are usually carried out with a Berkovich indenter under force control. Very fast measurements are possible, for instance with a loading time of 5 s, a hold period of 3 s and an unloading time of 2.5 s.

**Measurable parameters:**
- Indentation hardness $H_I$ (convertible to $H_V$)
- Martens hardness $H_M$ or $H_{Ms}$
- Indentation modulus $E_I$ (Young’s modulus)
- Creep $C_r$ or relaxation $R_{IT}$
- Relation between elastic deformation component and total mechanical work $\eta_{IT}$

Altogether, more than 60 parameters can be measured and displayed.
Vickers Hardness

The Vickers hardness can be calculated by using the indentation hardness. A comprehensive comparison between conventional Vickers hardness and indentation hardness for 20 different materials, carried out by the Federal Institute of Materials Research and Testing, has shown that the mean difference between HIT and HV is below 10 % when using InspectorX algorithms, compared to 25 - 30 % with other software packages.


Spezifikation

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum normal force</td>
<td>1500 mN</td>
</tr>
<tr>
<td>Digital force resolution</td>
<td>&lt; 200 nN</td>
</tr>
<tr>
<td>Noise level force measure</td>
<td>≤ 10 μN</td>
</tr>
<tr>
<td>Maximum normal displacement</td>
<td>150 μm</td>
</tr>
<tr>
<td>Digital displacement resolution</td>
<td>&lt; 0,05 nm</td>
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<tr>
<td>Noise level displacement measurement</td>
<td>≤ 1 nm</td>
</tr>
<tr>
<td>Maximum sample size (X x Y x Z)</td>
<td>100 mm x 100 mm x 11 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>11 kg</td>
</tr>
</tbody>
</table>

The specifications may change. Please get in touch with us for current data.

Depth-Dependent results with QCSM module

The Quasi Continuous Stiffness Measurement method is a new module developed by ASMEC, that allows the measurement of the contact stiffness of the sample not only by means of an unload curve for one depth but for many points during the indentation procedure. Thereby, hardness and Young’s modulus can be determined depth-dependently at one and the same sample position. In addition, the sensitivity of the measurements will be raised in the small force range so that stiffness values can already be determined for very small forces and indentation depths. Regarding the QCSM module, loading is stopped for a short period of time (1 - 4 s) and a sinusoidal oscillation is superimposed on the voltage of the piezoelectric element. Unlike other methods, the amplitude of the voltage of the piezoelectric element is given and not the amplitude for force or displacement. Amplitude and phase of the oscillations are determined with a lock-in filter.

Kontakt

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