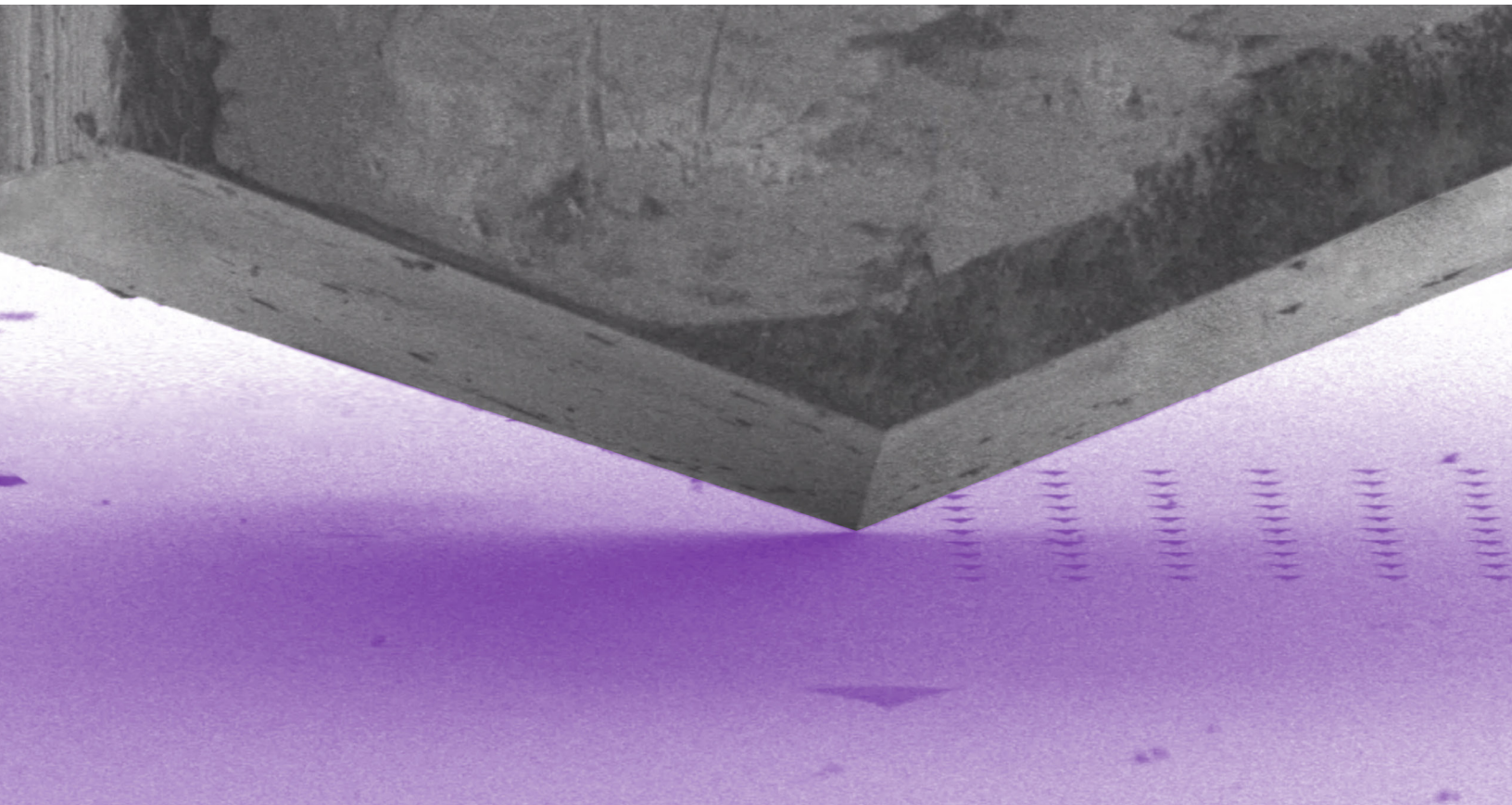


# NanoFlip

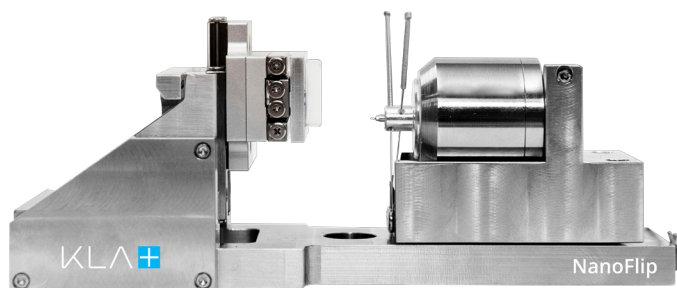
Nanomechanical Tester



## Features

- Upgradeable, extendible platform for automated nanoindentation testing, complete with statistical data analysis package
- Large suite of pre-programmed nanomechanical test methods for improved ease-of-use
- Proprietary online nanoindentation courses taught by nanoindenter experts, and mobile apps for live updates to test methods
- Standard InForce 50 actuator for measurement of capacitance displacement and electromagnetic force actuation up to 50mN, with interchangeable tips. Also available is a two-axis force actuator for tribology and lateral force measurement.
- Revolutionary FIB-to-test technology for seamless transition from FIB to indentation by tilting the sample 90°
- High-speed controller electronics with 100kHz data acquisition rate and 20μs time constant for capture of nanoscale changes in mechanical properties during contact
- SEM video capture provides synchronized SEM images with test data

## NanoFlip

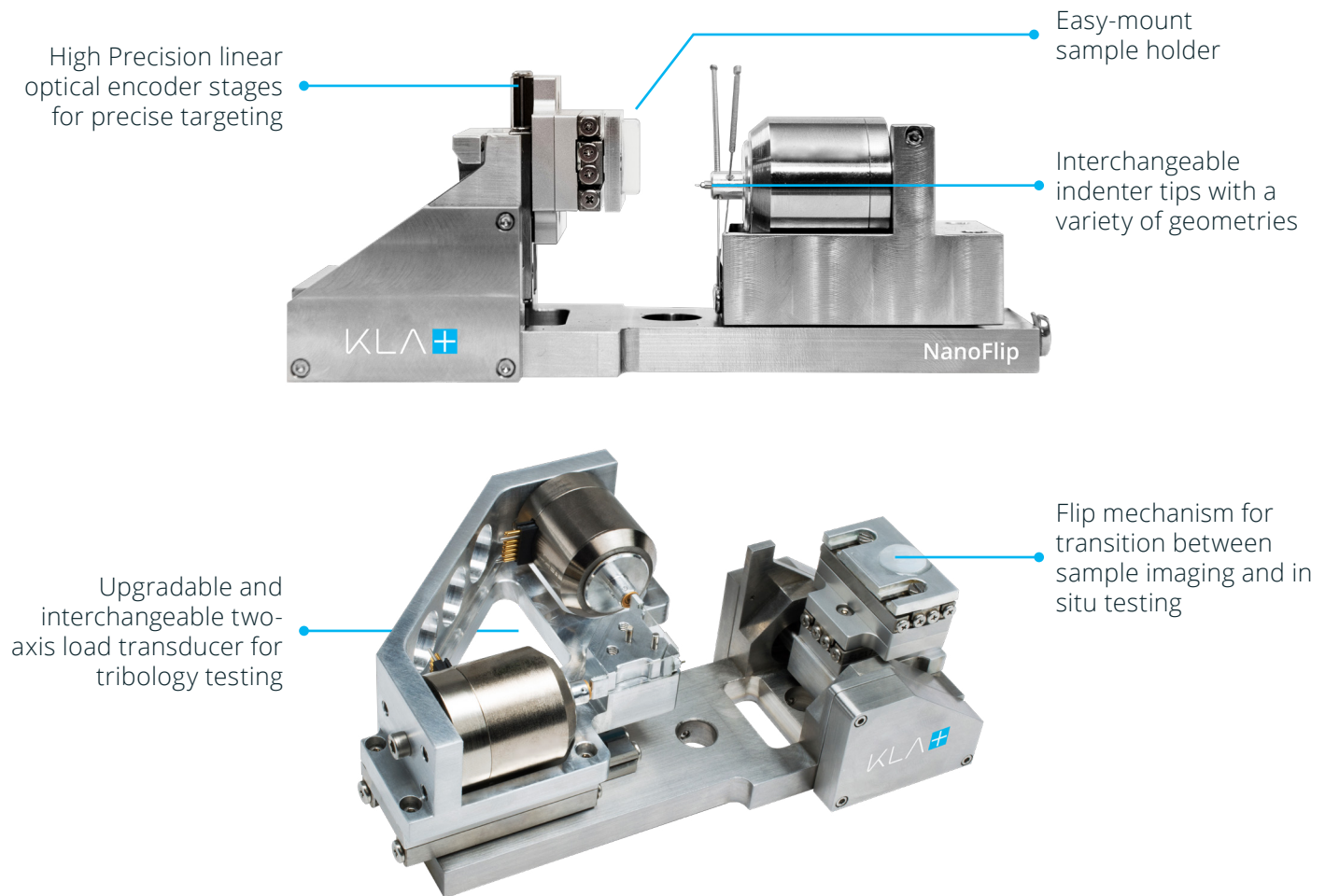


### Universal nanomechanical tester with flip mechanism that transitions between imaging and testing

The NanoFlip nanoindenter measures hardness, modulus, yield strength, stiffness and other nanomechanical properties with high accuracy and precision under both ambient and vacuum conditions. In both scanning electron microscopes (SEM) and focused ion beam (FIB) systems, the NanoFlip provides rapid results by synchronizing SEM images with mechanical test data. Modular options can accommodate a variety of applications, such as mechanical property maps, frequency-specific dynamic tests, and scratch and wear.

Apart from its capability to advance research in universities, labs and institutes, the NanoFlip can perform nanoindentation measurements for the following materials and industries:

- MEMS / nanoscale devices / micropillars
- Metals and alloys
- Batteries and energy storage
- Semiconductor packaging
- Polymer and plastics



### Compatible with a variety of imaging systems and environments:

- **Optical profilers** such as the KLA MicroXAM-800 and Zeta-20 can be used along with NanoFlip for measurement of pre- and post-test deformation
- **Scanning electron microscopy and Focused ion beam** techniques can be combined with nanomechanical testing for seamless in situ testing
- All types of **optical microscopes** may be used along with the NanoFlip to locate and target specific sample features
- **Glove boxes** are compatible with the NanoFlip for inert environment applications such as battery testing
- **Beam line** placement of the NanoFlip can be used for measurement of x-ray diffraction and x-ray scattering during sample indentation
- **Raman spectroscopy** may be combined with the NanoFlip for simultaneous collection of Raman and indentation data from the same sample

## KLA Core Technology

The NanoFlip system is powered by electromagnetic transducers to deliver precise measurements and avoid artifacts in the x and y axes. The system is designed for in situ applications and to provide accurate sample positioning, easy sample viewing, and simple sample height adjustment. In its standard configuration, the NanoFlip utilizes the InForce 50 force actuator, with the modular controller design optimized for upgrades. The system conforms to ISO 14577 to ensure data integrity.

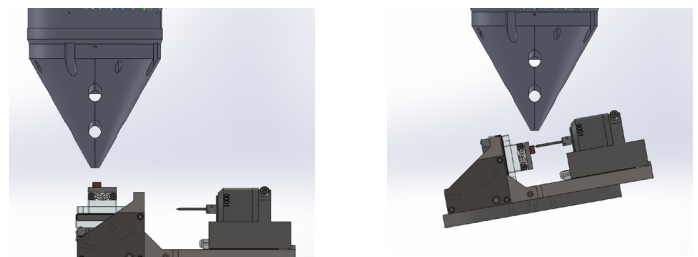
The proprietary InView software suite for the NanoFlip includes RunTest with on-screen controls for simplified test setup, ReviewData for data analysis during or after testing, and InFocus for generating presentation-quality graphs and reports.

## Maximum Versatility for Indentation, Compression, Tensile and Universal Testing

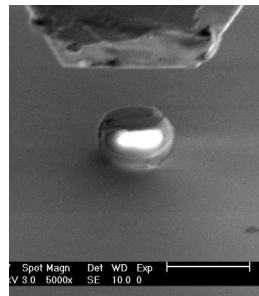
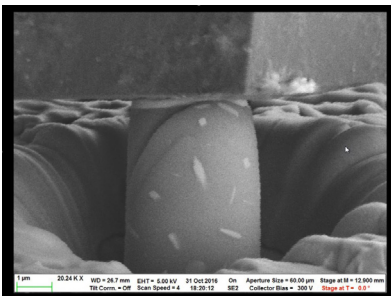
The NanoFlip includes sample flip mechanism, high precision XYZ stages and the 50µm, 50mN InForce 50 actuator for maximum positioning versatility. The NanoFlip can run automated tests at length scales from nanometers to millimeters while recording video and/or images from the experiment.

The flipped Up operation can combine material property maps with Energy Dispersive Spectroscopy (EDS) or other data inside a SEM. The automated testing performs indents in < 1s to create a material property map of hardness or modulus.

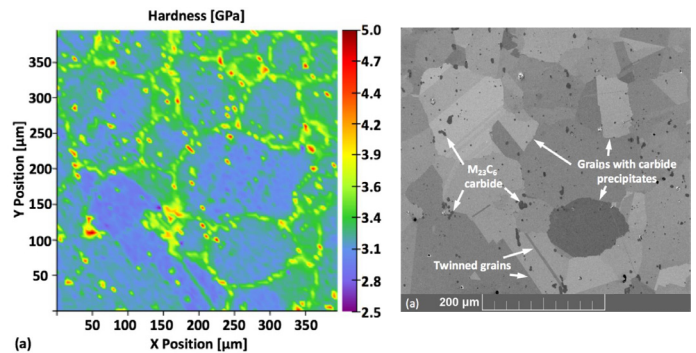
The flipped Down operation can be used for targeted characterization of spheres and pillars.



In the Up position, the NanoFlip presents the sample for imaging and targeting. In the Down position, the NanoFlip allows in situ targeting and real time video recording of the mechanical test



Spheres and pillar compression testing with flipped down operation



Property mapping vs EDS mapping

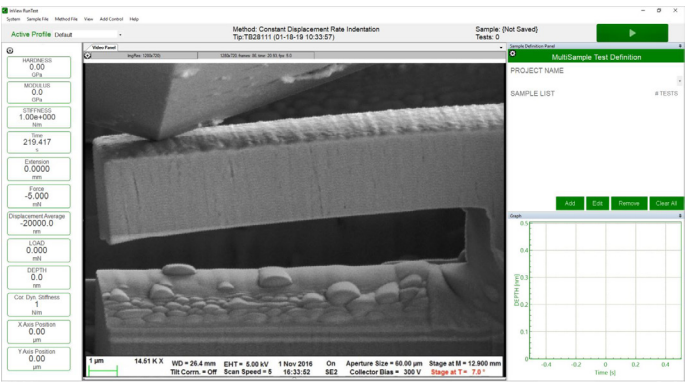


## Integrated Live Video for Precise Targeting

The InView software enables simultaneous use of live SEM or other imaging techniques for easy sample targeting and test setup.

## Data Analysis with Synchronized Video

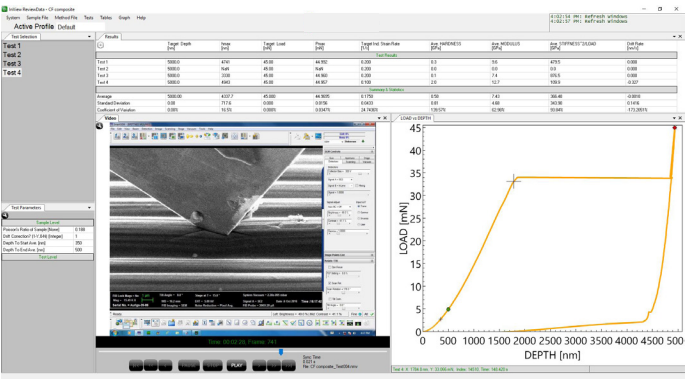
The InView software synchronizes video with test data linking SEM-recorded video to nanoscale changes in mechanical properties.



Simplified setup in RunTest software for pillar compression testing

## Internationally Standardized Nanoindentation Testing

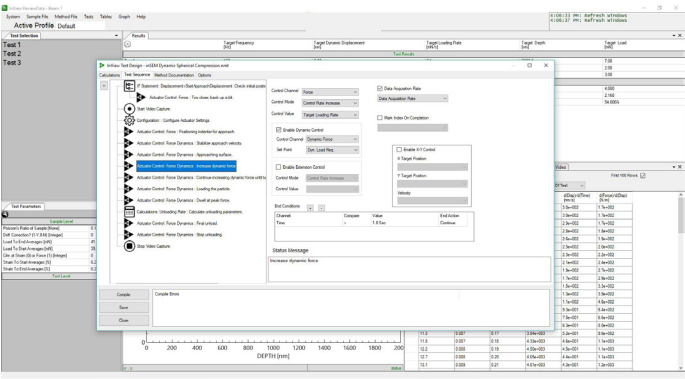
The NanoFlip is compliant with internationally recognized mechanical testing ISO 14577 standards for nanoindentation.



Synchronized video records real-time cracking along with load depth data

## Custom-Designed Testing Protocol

The KLA Method Editor software option provides an open platform that allows custom design of test protocols. The capability to add custom formulas and test sequences helps the user achieve universal nanomechanical testing.

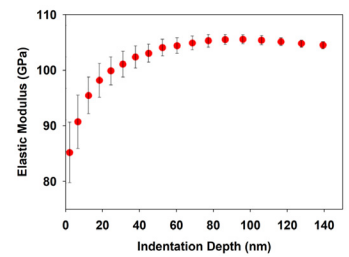


Simplified design of custom test protocols

## Continuous Stiffness Measurement (CSM)

- Measures stiffness and other material properties during the loading cycle

The CSM option involves oscillating the probe during indentation to measure properties as a function of depth, force, time, or frequency. The option comes with a constant strain rate experiment that measures hardness and modulus as a function of depth or load, which is the most common test method used across academia and industry.



Measurement of elastic modulus as a function of indentation depth using the CSM option

Additional NanoFlip options	
Gemini 2D Multi-Axis Transducer	The Gemini transducer operates the CSM module along two axes simultaneously, allowing lateral force and tribology measurements, including Poisson's ratio, coefficient of friction, scratch, wear, shear and topology.
NanoBlitz 3D Rapid Mechanical Property Mapping	The NanoBlitz 3D option measures elastic modulus and hardness as a function of x-y position, generating thousands of data points in a short period of time. The quantitative data is combined with powerful visualization techniques to assess differences in microstructure and gradients in mechanical properties.
Scratch and Wear Test Method	The Scratch and Wear test applies a constant or ramped load to an indenter while moving across the sample surface. It can be used for thin films, brittle ceramics and polymers.
ProbeDMA™	ProbeDMA enables dynamic mechanical analyses (DMA) on soft polymers and other materials with sample geometries and/or material volumes that are not suitable for standard DMA tests.
NanoBlitz 4D Mechanical Property Tomography	To assess elastic modulus and hardness as a function of lateral position and depth, NanoBlitz 4D rapidly creates a user-defined array of constant strain rate indents using the CSM module. Because each indent is performed in about 7 seconds, the system can generate a statistically significant amount of data to accurately characterize complex microstructures and components.
DataBurst Mode	DataBurst mode enables systems to record displacement data at rates > 1kHz for measuring high strain step loads, pop-in and other high-speed events.
InView Experiment Scripting	InView, a powerful and intuitive experiment-scripting platform, enables design of novel and complex experiments.
True Test I-V Measurements	The True Test I-V Option allows the user to apply specific voltages to a sample and measure the current at the tip, to characterize local changes in electrical properties during nanomechanical measurement.
Indenter Tips and Calibration Samples	Interchangeable tips are available for the InForce 50, InForce 1000, and Gemini actuators. Sharp indenters include Berkovich, cube corner, Vickers, and flat and sphere punches.

## The Nanoindenter Family of Products

KLA offers a full range of ambient and in situ nanoindenter solutions, including iMicro, iNano®, NanoFlip, and InSEM® HT.



iNano®



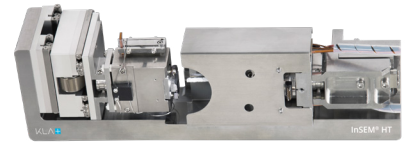
iMicro



Nano Indenter® G200 X



T150 UTM



InSEM® HT

## A Better Level of Understanding

The total customer experience delivered by the NanoFlip is more than a list of specifications. From easy-to-use software and reliable hardware to industry leading customer service and uptime, the NanoFlip offers a powerful, straightforward, worry-free solution.

## Applications Support

KLA application scientists are available to assist with test design and planning. With experience in both materials science and mechanics, our scientists have developed best practice testing techniques and have contributed to many of the key papers in the industry.

## Customer Service

KLA nanoindenters are known for problem-free operation. If you do have a question or need help, our customer service personnel can log in to your equipment to resolve your issue within 24 hours. Most repairs do not require an onsite service visit. The NanoFlip is backed by local service and support around the world, for onsite service or installation.



#### KLA SUPPORT

Maintaining system productivity is an integral part of KLA's yield optimization solution. Efforts in this area include system maintenance, global supply chain management, cost reduction and obsolescence mitigation, system relocation, performance and productivity enhancements, and certified tool resale.

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