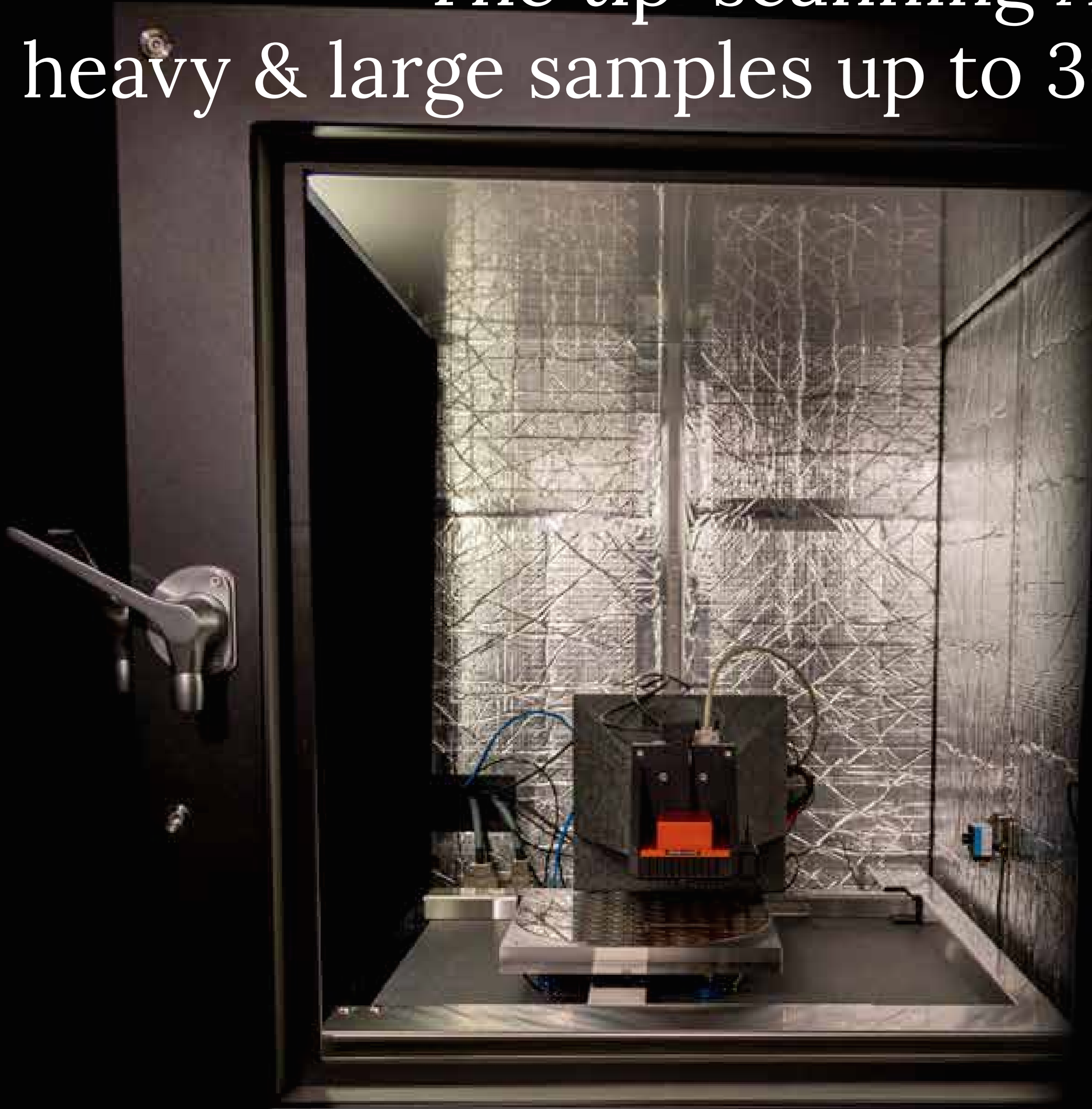
Next-Level Nanotechnology Tools swiss quality

Alphacen 300

The tip-scanning AFM for heavy & large samples up to 300 mm



nanosurf

From the market leader for large stage systems

Nanosurf is the market leader for custom development of systems for large, heavy, and complex-shaped samples. Over the past years our team has built a substantial knowledge base developing such custom stages for various customers in both academia and industry.

Utilizing this vast body of knowledge, we have now developed the Alphacen 300 - Nanosurf's standard product for large samples up to 300 mm x 300 mm or heavy samples up to 45 kg. With the Alphacen 300 Nanosurf reduces price and delivery time compared to a custom system.

From wafers to large and heavy samples

The Alphacen 300 was designed to meet the needs of a large variety of samples. The tip-scanning design of the scan head ensures that imaging performance is not affected by the mass of the sample to be investigated. The mass moved during the scanning process is kept at a minimum and does not depend on the sample.

The large sample platform allows mounting samples up to 300 mm in both width and length and up to 45 mm in height. The virtually frictionless air bearing-based translation mechanism ensures precise positioning of heavy samples up to 45 kg weight within 300 mm x 300 mm in XY. Moreover, the air bearing design ensures decoupling of the translation mechanism from the mechanical loop of the AFM, thus reducing drift and increasing stability of the measurement setup. The large 50 mm z stage ensures that both flat samples like silicon wafers, but also thick samples can be accommodated in the Alphacen 300 system.

The Alphacen 300 provides a number of sample chucks that can be tailored to the customer-needs. Standard sample platforms include vacuum chuck solutions for wafers, flat platforms for large and heavy samples or sample platforms that are also compatible with Nanosurf's sample holder lineup to also allow for measurements that require special sample holders, such as sample heating or low current measurements.

Run automated measurement series

The ability to run a sequence of measurements without user intervention is key to measurement automation. The Alphacen 300 includes powerful automation software that allows collecting images in many locations across a large sample - or several smaller samples.

Measurement locations can be set in different ways. Manually, based on optical inspection of the sample using the top view camera or by simply entering a list of positions of interest that should be addressed during the automatic measurement procedure. Imaing parameters, e.g. scan size or speed, can be separately defined for each location to allow addressing different surface properties or features during a measurement series.

SiC steps

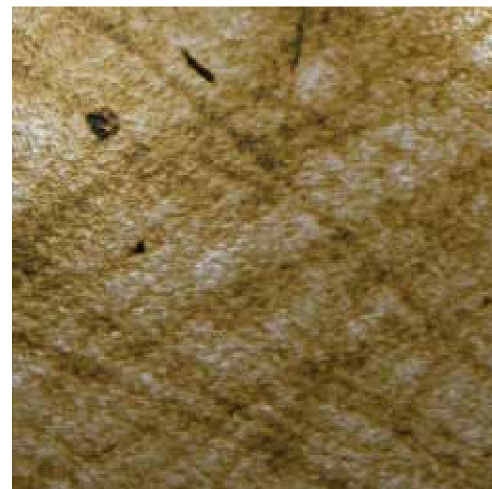
Scan size:
1.5 µm x 1.5 µm

The scan shows step heights of 1.5 nm between the large terraces, and 0.75 nm between the large and small terraces' half-steps.

Complex sample shape?

Quality or process control steps during manufacturing processes of e.g. optical lenses typically require that the product itself can be addressed with the AFM. For such tasks, off the shelf solutions often do not meet the requirements set by the sample.

With its flexible design, the Alphacen 300 serves as a platform for custom systems to accommodate specimens with a complex, non-flat shape. Nanosurf's knowledge in custom stage design allows adapting the Alphacen 300 for even larger samples (xyz) or equipping it with custom sample chucks or rotation axes to probe the required sample locations and safety features to prevent sample damage.



Glass

Scan size:
5 µm x 5 µm

Surface roughness:
0.112 nm RMS
(0.087 nm Ra)

System functionality

Standard imaging modes	Static force, dynamic force, phase contrast, MFM, friction force, force modulation, spreading resistance, EFM
Imaging functions	Up to 8000×8000 data points X/Y sample slope correction
Standard spectroscopy modes	Force–distance, amplitude–distance, phase–distance, tip current–tip voltage
Spectroscopy functions	Setup wizard for each spectroscopy mode XY-position table: point, line, and grid
Standard lithography modes	Free vector objects drawing or real-time drawing by mouse Tip lift or force control during movement from point to point
Sample approach	Fast home, retract, and advance movement Automatic step-by-step approach
Sample observation	2 side view cameras inside acoustic enclosure Top and side view camera for cantilever and sample observation (<2 µm resolution)

CX Controller specifications

High resolution outputs (DAC)	12x 28 bit, 1 MHz/sampling; thereof 4x user DAC
Fast outputs (DAC)	4x 16 bit, 100 MHz/sampling; thereof 1x user DAC
High resolution inputs (ADC)	10x 20 bit, 1 MHz/sampling; thereof 4x user ADC
Fast inputs (ADC)	3x 16 bit, 100 MHz/sampling; thereof 1x user ADC
Signal analyzers	2 signal analyzer function blocks that can be configured as dual channel lock-in
FPGA module and embedded processor	System-on-chip module with low-latency FPGA signal processing at 100MHz and dual-core ARM processor, 2GB RAM, 1.5GHz clock
Scan control	28Bit X/Y/Z-DAC
Detector inputs	Deflection/lateral signals each 16 bit and 28 bit
Digital sync, Spike-Guard	2-bit line/frame sync out 5 V/TTL galvanically isolated, Spike-Guard input
Clock sync	10MHz/3V clock input to synchronize data acquisition and processing
Communication to PC	Gigabit Ethernet, galvanically isolated

Scanner specifications

Scan head type	Tip scanner
Maximum XY scan range	100 µm[(1)]
Maximum Z-range	10 µm[(1)]
XY linearity mean error	< 0.1%
XY flatness at max. scan range	typ. < 5 nm
Z-sensor noise level (RMS)	typ. 150 pm / max. 200 pm
Z-measurement noise level (RMS, static mode in air)	typ. 100 pm / max. 200 pm
Z-measurement noise level (RMS, dynamic mode in air)	typ. 30 pm / max. 40 pm[(2)]
Optical detection light source	850 nm low coherence SLD
DC detector noise	<10 pm RMS (0.1Hz to 1kHz)
AC detector noise	<60 fm $Hz^{-1/2}$ above 100 kHz
Detector bandwidth	DC to 4 MHz

(1) Manufacturing tolerances ±10%

(2) VC-F or better; acoustic noise 60 dB or better

Stage specifications

Top view field of view	5 MP, 1.5 mm x 1.1 mm
Side view field of view	5 MP, 3.2 mm x 3.2 mm
Max. sample size	300 mm x 300 mm x 45 mm
Max. sample weight	45 kg
Vacuum chuck for	4" / 6"/ 8" / 12" wafers
Motorized XY travel range	300 mm x 300 mm
Motorized approach range	50 mm
System dimensions	1008 mm x 1887 mm x 1208 mm (fits through 800 mm door prior to assembling the acoustic enclosure)
System weight	833 kg
Stage XY resolution	< 1 µm
Unilateral repositioning accuracy	< 2 µm
Acoustic isolation	~30 dB above 250 Hz
Vibration isolation	Active vibration isolation

Full Alphacen 300 system in acoustic enclosure. The system features two orthogonal side view cameras to allow easy sample navigation in its closed state.

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