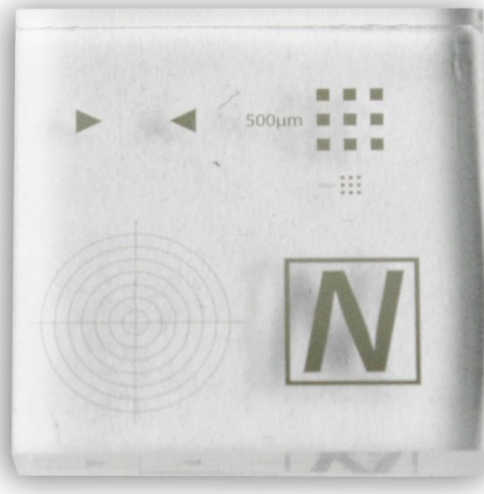
NANOVEA®
A Better Measure.

500nm Glass Step Height:
Extreme Accuracy with Non-Contact Profilometry



SAMPLE: 500nm Step Height Standard with 500um Lateral Matrix

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INTRODUCTION:

Surface characterization are current topics undergoing intense study. The surfaces of materials are important since they are the regions where physical and chemical interactions between the material and environment occur. Thus, being able to image the surface with high resolution has been desirable, since it allows scientists to visually observe the smallest surface details. Common surface imaging data includes topography, roughness, lateral dimensions, and vertical dimensions. Identifying the load bearing surface, spacing and step height of fabricated microstructures, and defects on the surface are some applications that can be obtained from surface imaging. All surface imaging techniques, however, are not created equal.

NANOVEA'S NON-CONTACT PROFILOMETRY COMPARED TO AFM TECHNOLOGY

With the angstrom-level vertical resolution of Atomic Force Microscopy, mapping and characterizing surface details can be done at nearly and atomic level. Nanovea's Profilometers are designed to reach nanometer level resolution, with many significant benefits over AFM. The non-contact optical technology of the Nanovea system does not disturb the surface during its measurements, the ease of use minimizes sample preparation and setup time, scanning times are much shorter, and its ability to measure all types of samples are all factors that makes it superior to AFMs. With the additional of the large XY scan areas, and z-height ranges possible, Nanovea's profilometers provide a system for almost any surface measurement application. With this study, we have investigated the measurement of low feature heights to showcase Nanovea's resolution.

MEASUREMENT OBJECTIVE

Using a NIST traceable quartz step height standard, the step height of 500nm was measured using the PS1 point sensor. The HS2000 model base was used to for its zero-noise properties and air-bearing stage movement.

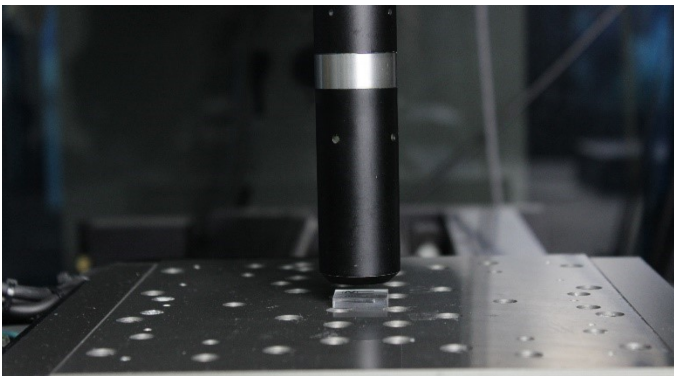
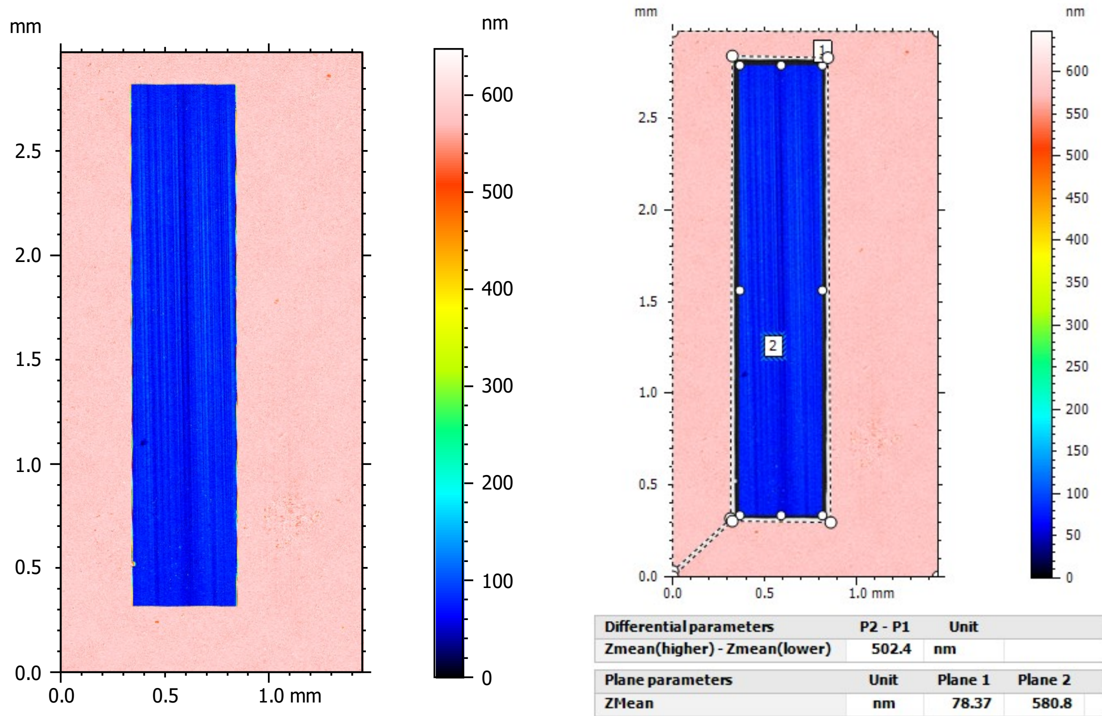


Figure 1: Picture of test setup on the HS2000

Measurement Setup	
Instrument	Nanovea HS2000 – Standard Speed
Optical Sensor	PS1 Lens (110um Z- Range)
Scan Size (mm)	3mm x 1.5mm
Step Size (um)	0.9um x 4um
2D Profile Scan Time (h:m:s)	00:00:04
3D Area Scan Time (h:m:s)	01:03:10

RESULTS: STEP HEIGHT

Below, the height map and a 3D view of the scanned area can be seen. The step height of 500nm, which is not discernable to the eye, is very distinct after being scanned by Nanovea's 3D Non-Contact Profilometer. The step height measurement of 502.4 nm matches almost exactly to 500nm etched step height. A total of 107 profiles were extracted from the area scan conducted and the step height was averaged to 502.5 ± 12.0 nm over the full 3D area scan.



Differential parameters	P2 - P1	Unit
Zmean(higher) - Zmean(lower)	502.4	nm

Plane parameters	Unit	Plane 1	Plane 2
ZMean	nm	78.37	580.8

Figure 2: Height Map (left) and 3D step height analysis (right)

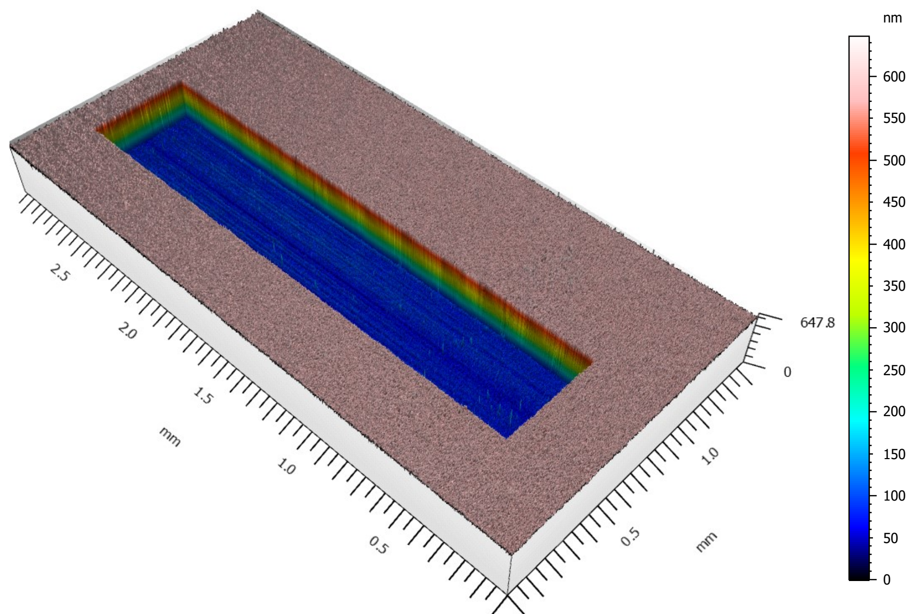
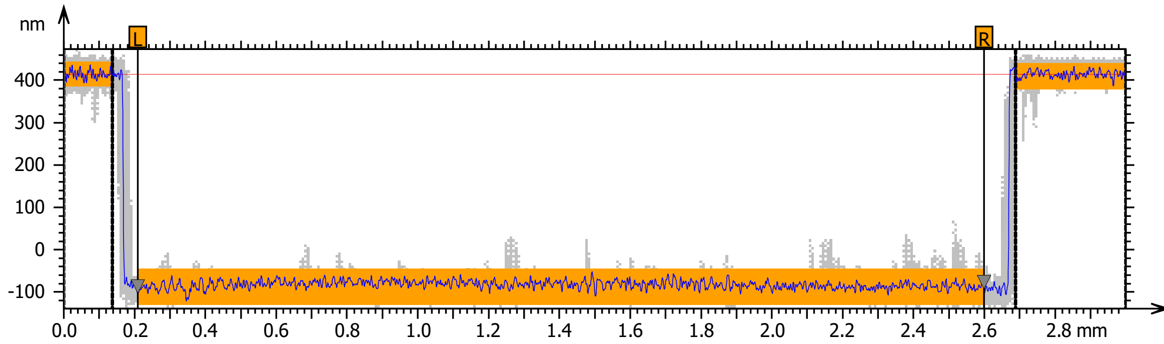


Figure 2: 3D view of step height standard



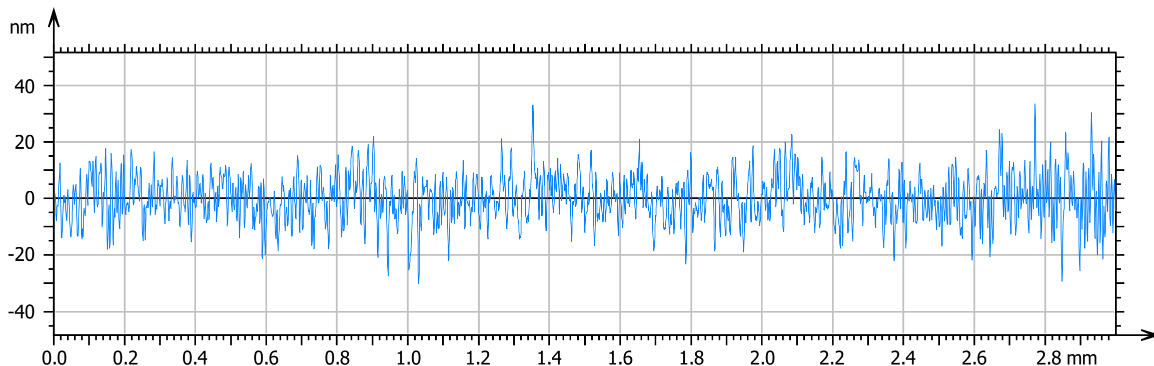
Information	
T-axis	Y-Axis Profile = 107.0
Parameter display mode	Statistical results across the series

Parameters	Stat.	Step 1	Unit
Mean height	Mean	502.5	nm
	Std dev	10.95	nm
	Range	55.48	nm

Figure 3: Step height analysis of 107 profiles

Noise Level

Below is a raw extracted profile from area scans above. This is the amount of noise that is generated when measuring the quartz step height standard. Differences in height can be easily discernible if they are not hidden in the noise. The low noise observed shows that Nanovea's profilometer is not only limited to 500nm of height, but can measure features down to, and below 10nm.



ISO 4287				
Amplitude parameters - Primary profile				
Pa	6.361	nm		*Arithmetic Mean Deviation of the raw profile.*
Pq	8.130	nm		*Root-mean-square (RMS) Deviation of the raw profile.*
Pz	63.63	nm		*Maximum height of the raw profile.*
Pp	33.48	nm		*Maximum peak height of the raw profile.*
Pv	30.15	nm		*Maximum valley depth of the raw profile.*
Pt	63.63	nm		*Total height of raw profile.*
Pc	19.37	nm	*ISO 4287 w/o amendment 2*	*Mean height of the raw profile elements.*

CONCLUSION:

The Nanovea 3D Non-Contact Profilometer showcases its high vertical resolution abilities by scanning a step height standard of 500nm. The step height can be seen very clearly, and the obtained value of 502.5 ± 12.0 nm shows its high accuracy as well. Profile of the scans were taken to display the amount of noise that the instrument generates. Differences in heights above the noise profile are easy to discern. This shows that while a 500nm step height was measured, higher vertical resolutions can be achieved.

Compared to other high-resolution surface metrology instruments, such as AFMs, Nanovea's chromatic confocal technology combined with the HS2000's zero-noise stages, provide a system with nearly angstrom-level resolution, which is superior in all other practical aspects. Therefore, unless angstrom level vertical resolution is required, Nanovea's Profilometers are the ideal instruments for ALL surface imaging due to their ease of use, fast scan times, non-contact technique, and the ability to measure ALL types of materials and surfaces.

Learn more about Nanovea Profilometers or Lab Services