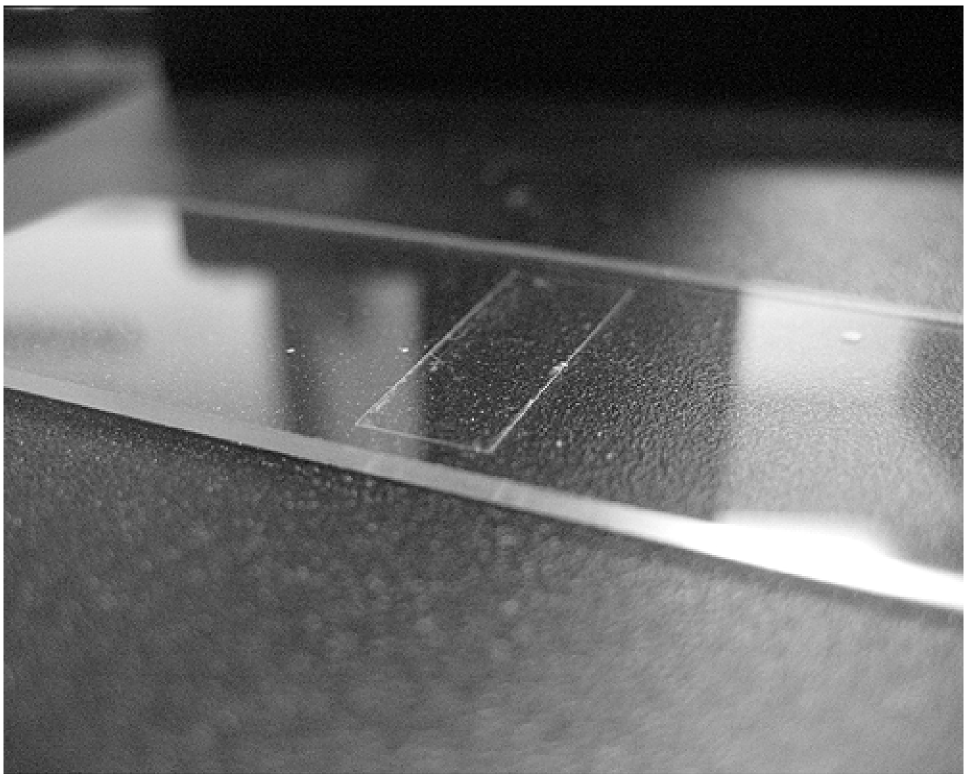
NANOVEA
A Better Measure.

Transparent Film on Transparent Substrate Measurement Using 3D Profilometry



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INTRO:

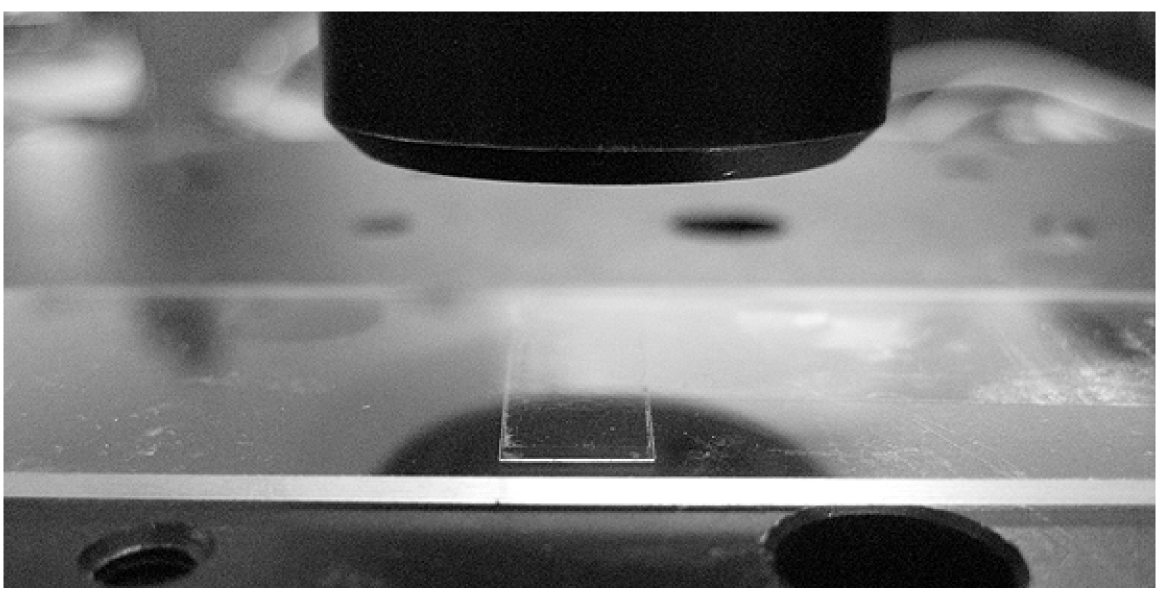
A single instrument that can measure both thickness and roughness of thin transparent material, on a transparent substrate, is crucial both in development and quality control. This can prove to be challenging because traditional stylus based profilometers will have difficulty accurately measuring a soft film; while other optical techniques will have difficulty measuring thin transparent film on a transparent substrate. There are other instruments capable of measuring the thickness of this material combination, but will not have the ability to measure roughness.

IMPORTANCE OF SURFACE METROLOGY INSPECTION FOR QUALITY CONTROL

Thickness and roughness of transparent films of this type are critical as they are typically intended to be optically transparent. If a material is too thick or the surface roughness of the material is too high, the optical properties of this material will vary. To insure the quality control of such parameters will heavily rely upon quantifiable, reproducible and reliable inspection. The Nanovea 3D Non-Contact Profilometers utilize chromatic confocal technology with unmatched capability to measure transparent on transparent applications. Where other techniques fail to provide reliable data, due to probe contact, surface variation, angle, absorption or reflectivity, Nanovea Profilometers succeed.

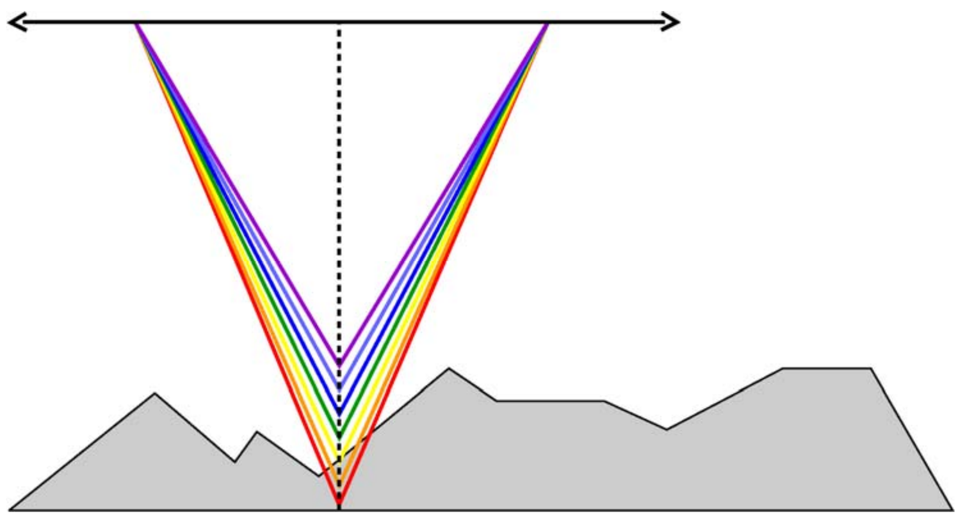
MEASUREMENT OBJECTIVE

The Nanovea PS50 is used to measure step height thickness, optical thickness and roughness of a thin transparent film on a transparent glass substrate. Step height will be obtained by measuring an area of the film and an area where the substrate is exposed for relative height difference, while optical thickness will be measured by using the PS50's capability of measuring through the transparent film and detecting a reflecting both from the top surface of the film and the substrate simultaneously.



MEASUREMENT PRINCIPLE:

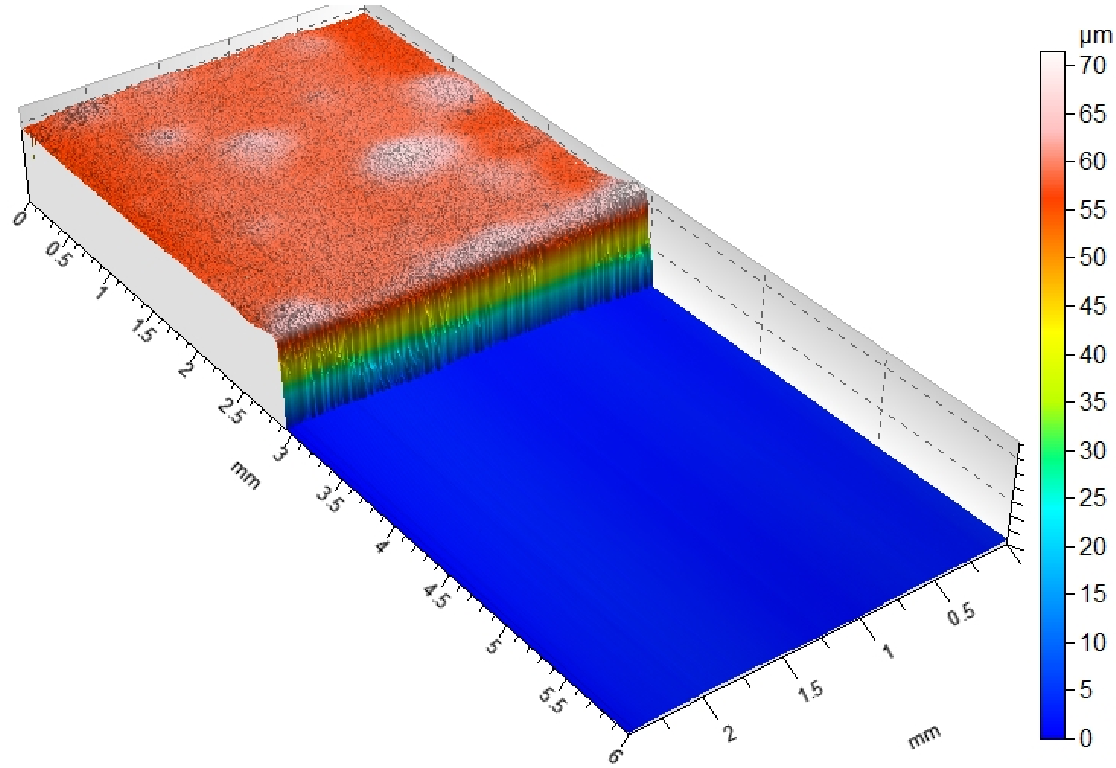
The axial chromatism technique uses a white light source, where light passes through an objective lens with a high degree of chromatic aberration. The refractive index of the objective lens will vary in relation to the wavelength of the light. In effect, each separate wavelength of the incident white light will re-focus at a different distance from the lens (different height). When the measured sample is within the range of possible heights, a single monochromatic point will be focalized to form the image. Due to the confocal configuration of the system, only the focused wavelength will pass through the spatial filter with high efficiency, thus causing all other wavelengths to be out of focus. The spectral analysis is done using a diffraction grating. This technique deviates each wavelength at a different position, intercepting a line of CCD, which in turn indicates the position of the maximum intensity and allows direct correspondence to the Z height position.



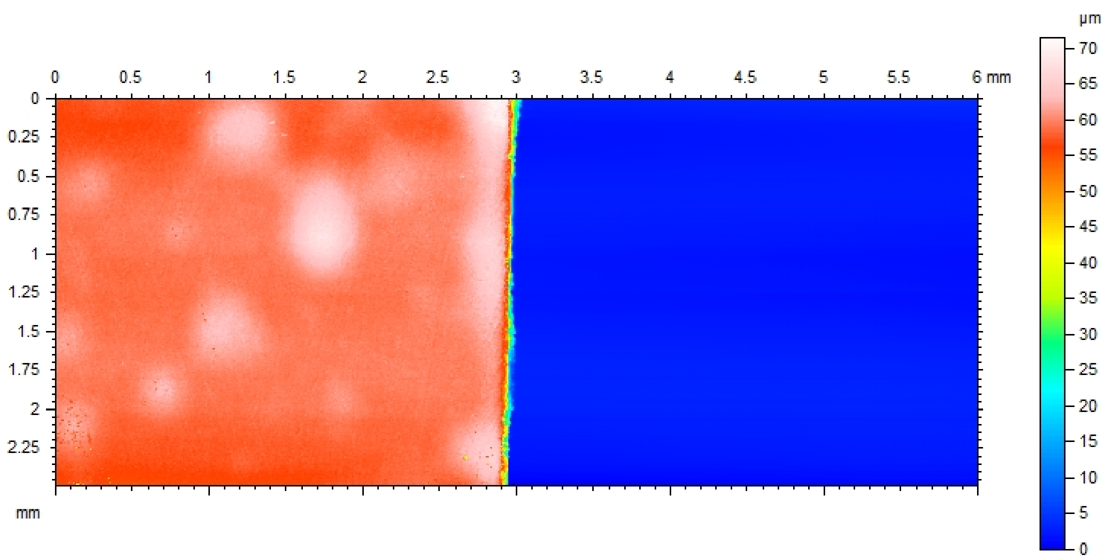
Chromatic Confocal White Light Measurement

Unlike the errors caused by probe contact or the manipulative Interferometry technique, White light Axial Chromatism technology measures height directly from the detection of the wavelength that hits the surface of the sample in focus. It is a direct measurement with no mathematical software manipulation. This provides unmatched accuracy on the surface measured because a data point is either measured accurately without software interpretation or not at all. The software completes the unmeasured point but the user is fully aware of it and can have confidence that there are no hidden artifacts created by software guessing. Nanovea optical pens have zero influence from sample reflectivity or absorption. Variations require no sample preparation and have advanced ability to measure high surface angles. Capable of large Z measurement ranges. Measure any material: transparent or opaque, specular or diffusive, polished or rough.

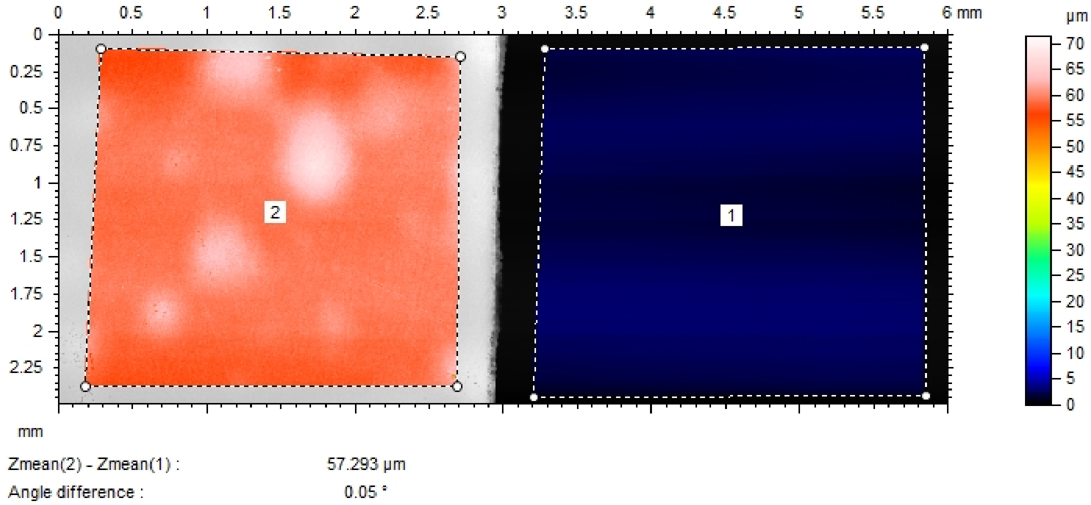
RESULTS:



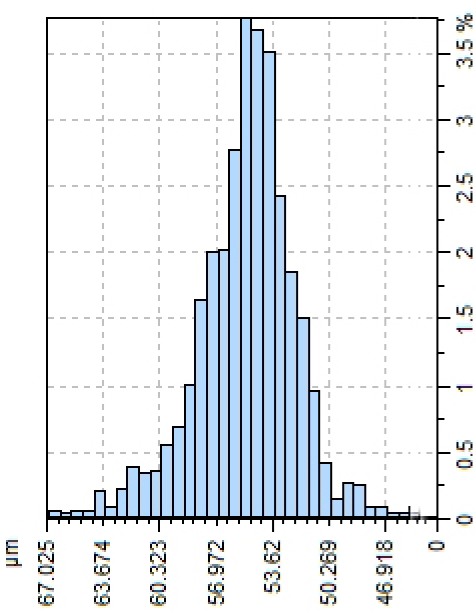
3D Profile



False Color Height



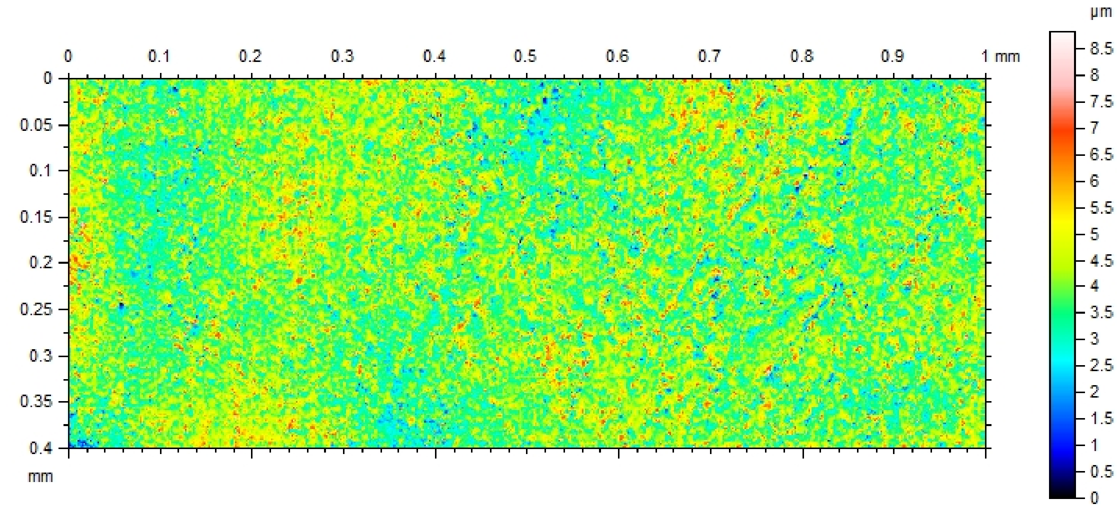
Step Height Software Calculation



Distribution of Thickness
(Direct Measurement)

ISO 25178			
Height Parameters			
Sa	0.691	µm	Arithmetic mean height
Sq	0.894	µm	Root mean square height
Ssk	0.484		Skewness
Sku	4.174		Kurtosis
Sp	4.8	µm	Maximum peak height
Sv	4.024	µm	Maximum pit height
Sz	8.823	µm	Maximum height

Roughness Results



3D Roughness Profile

CONCLUSION:

Both the step height thickness measurement and the direct thickness measurement (measurement through transparent film) show similar thickness calculations of 57µm, confirming the accuracy of both methods of thickness measurement. Step height can be used when an area of the substrate is exposed or direct thickness measurement can be used when there is no area of substrate exposed. (refractive index must be known). These two methods prove useful in both development phases and quality control type applications. The results above clearly illustrate the Nanovea PS50's ability to precisely measure thin transparent films. With the PS5 it is also possible to make these types of measurements on transparent or opaque films on transparent or opaque substrates among many others.
Learn more about the Nanovea Profilometer or Lab Services