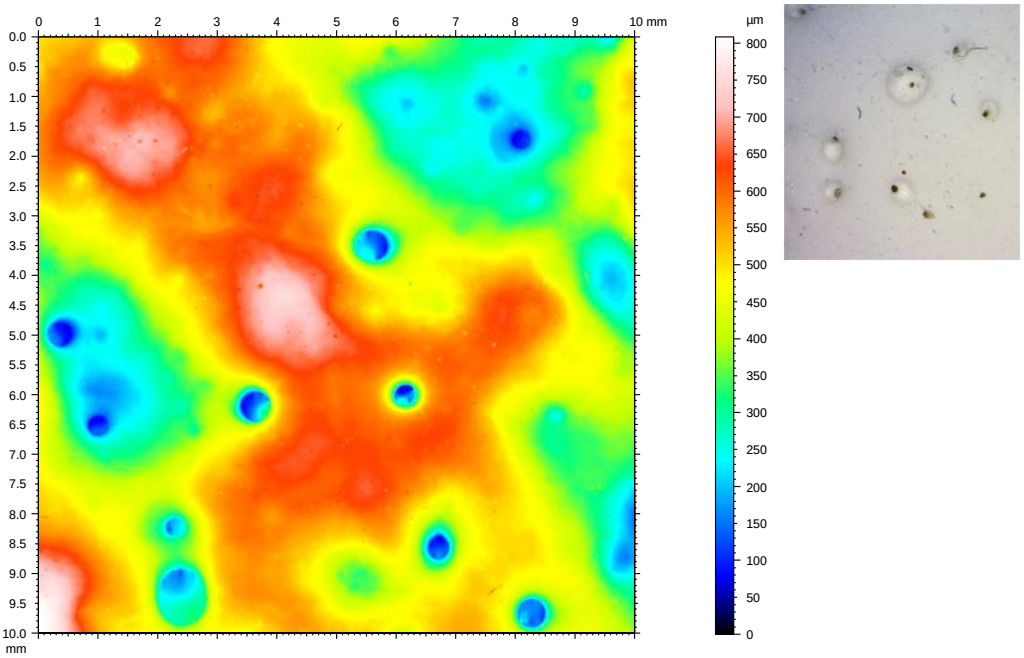
NANOVEA®
A Better Measure.

DRYWALL TEXTURE & PITTING
USING 3D PROFILOMETRY



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INTRODUCTION

Drywall is prevalently used on the construction of interior walls and ceilings in the States. It consists of two layers of paper sandwiching a layer of gypsum plaster in between. The inherent properties of the materials including gypsum, paper, and organic binders make drywall highly susceptible to moisture and water damage. Paper and gypsum get soften upon exposure to moisture, resulting in deterioration of the mechanical properties and exterior appearance. Repairing and replacing the damaged drywall can be very costly and time-consuming. Therefore, primer and coatings are applied on the drywall surface to enhance moisture and wear resistance, as well as to improve cosmetic appearance.

IMPORTANCE OF 3D PROFILOMETRY FOR COATED DRYWALLS

Roughness and texture of the coating is critical in the final product quality and appearance. A better understanding of the effect of surface texture and consistency on the moisture resistance of the coated drywall allows selecting the finest product and optimizing the painting technique to obtain the best result. Quantifiable, fast and reliable surface inspection of the coating surface is in need for quantitative evaluation of the surface quality. The Nanovea 3D Non-Contact Profilometers utilizes chromatic confocal technology with unique capability to precisely measure the sample surface. The line-sensor technique can finish scanning a large drywall surface in minutes.

MEASUREMENT OBJECTIVE

In this study, the Nanovea ST500 non-contact profilometer is used to measure and compare two drywall samples with different surface finish. We showcase the capacity of Nanovea non-contact profilometer in providing precise 3D profile measurement and comprehensive in-depth analysis of the drywall surface.

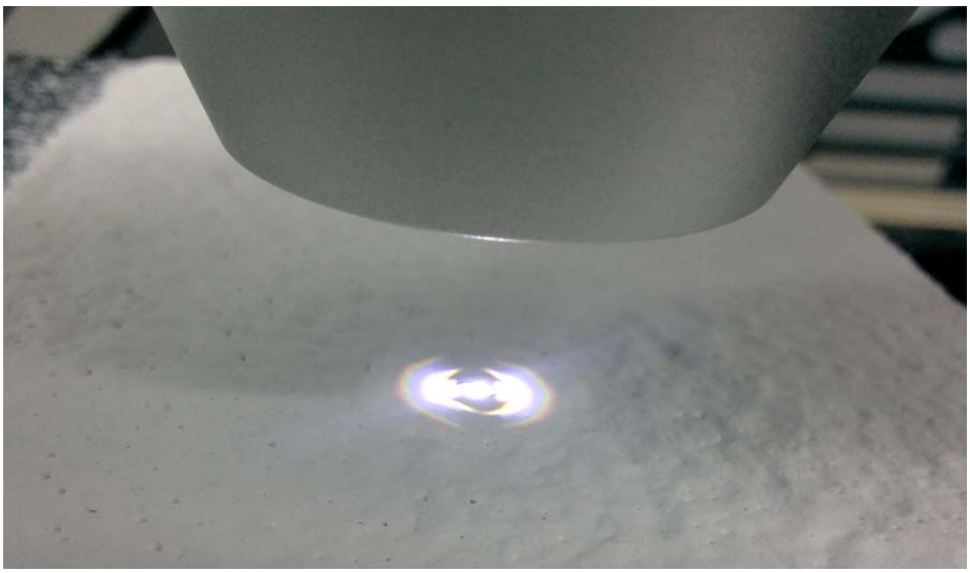


Fig. 1: Optical line-sensor scanning on the surface of the drywall sample.

RESULTS AND DISCUSSION

As shown in Fig. 1, the optical line sensor of ST500 generates a bright line composed of 192 light spots that scan the sample surface at the same time. This significantly increases the scan speed and enables a detailed 3D scan of an 80 mm × 50 mm drywall sample surface in two minutes. Such a fast speed makes it possible to implement the Nanovea 3D profilometer into the production line for quality control of the product in situ. In addition, the portable JR25 model allows users to directly measure the drywall in use.

Two sets of drywall samples with different surface finish are evaluated in this study. Fig. 2 compares these two samples under the microscope at different magnifications. Sample 1 shows a relatively smooth and dense surface texture. In comparison, it is observed that small pits distribute on the surface of Sample 2, making it more vulnerable to mold and moisture.

(a) Sample 1 (Low magnification):

(b) Sample 1 (High magnification):

(c) Sample 2 (Low magnification):

(d) Sample 2 (High magnification):

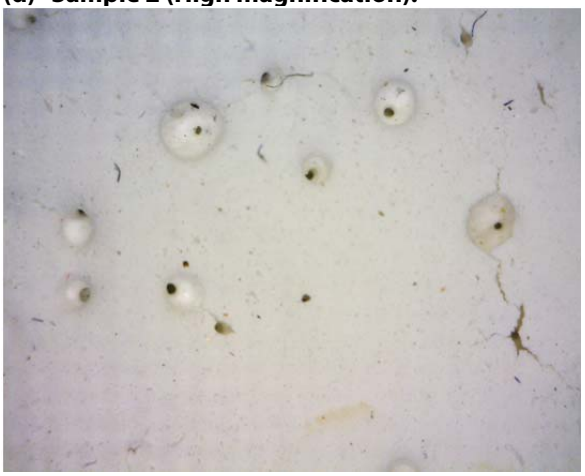
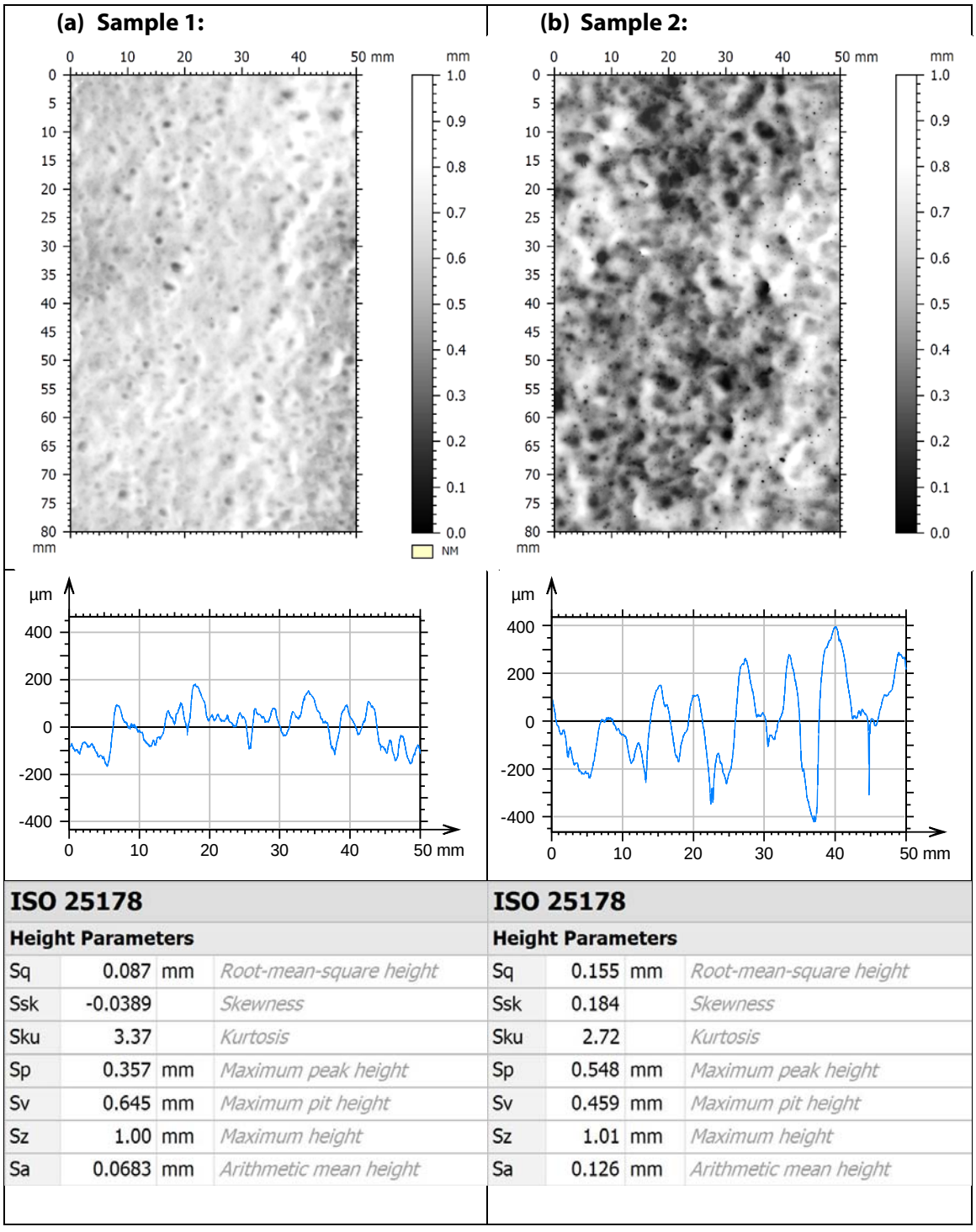


Fig. 2: The surface of Samples 1 and 2 under the optical microscope at different magnifications.

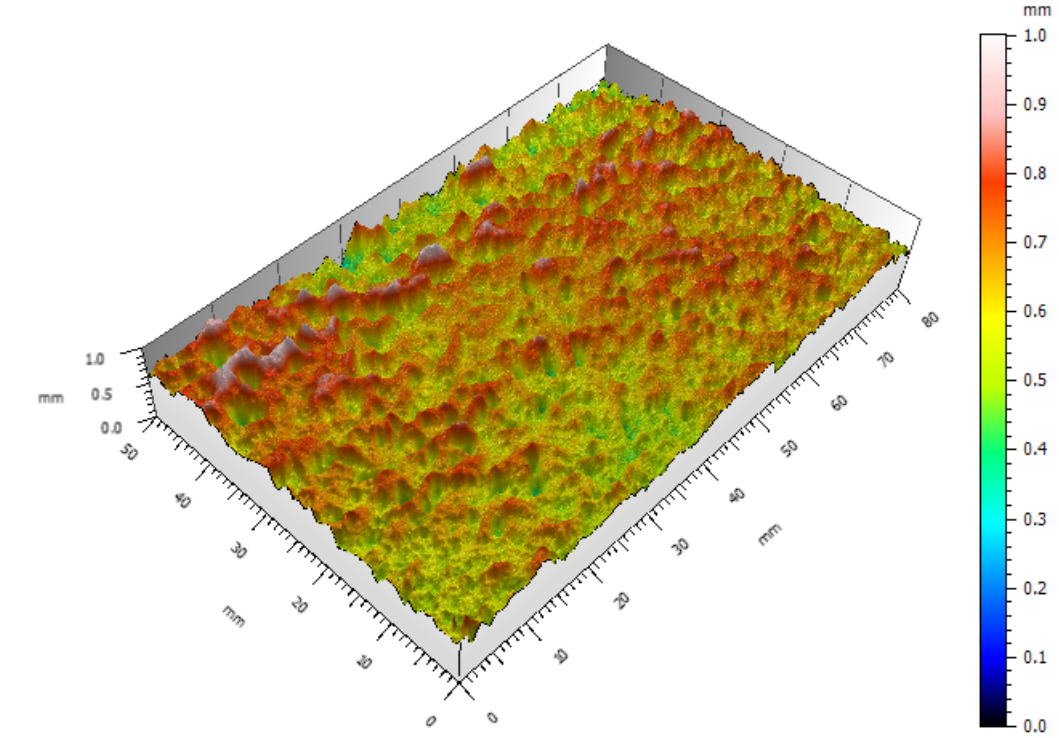
The pseudo-color view, cross section profile and roughness of the two drywall samples are compared in Fig. 3. The 3D view of the drywall samples is compared in Fig. 4. Sample 2 shows a lumpy surface texture with a higher roughness R_a of 0.126 mm, compared to a R_a of 0.0683 mm for Sample 1. Sample 2 also possesses small pits all over the surface represented as small black dots in the pseudo-color image.



ISO 25178				ISO 25178			
Height Parameters				**Height Parameters**			
Sq	0.087	mm	*Root-mean-square height*	Sq	0.155	mm	*Root-mean-square height*
Ssk	-0.0389		*Skewness*	Ssk	0.184		*Skewness*
Sku	3.37		*Kurtosis*	Sku	2.72		*Kurtosis*
Sp	0.357	mm	*Maximum peak height*	Sp	0.548	mm	*Maximum peak height*
Sv	0.645	mm	*Maximum pit height*	Sv	0.459	mm	*Maximum pit height*
Sz	1.00	mm	*Maximum height*	Sz	1.01	mm	*Maximum height*
Sa	0.0683	mm	*Arithmetic mean height*	Sa	0.126	mm	*Arithmetic mean height*

Fig. 3: Pseudo-color view, cross section profile and roughness of the two drywall samples.

(a) Sample 1:



(b) Sample 2:

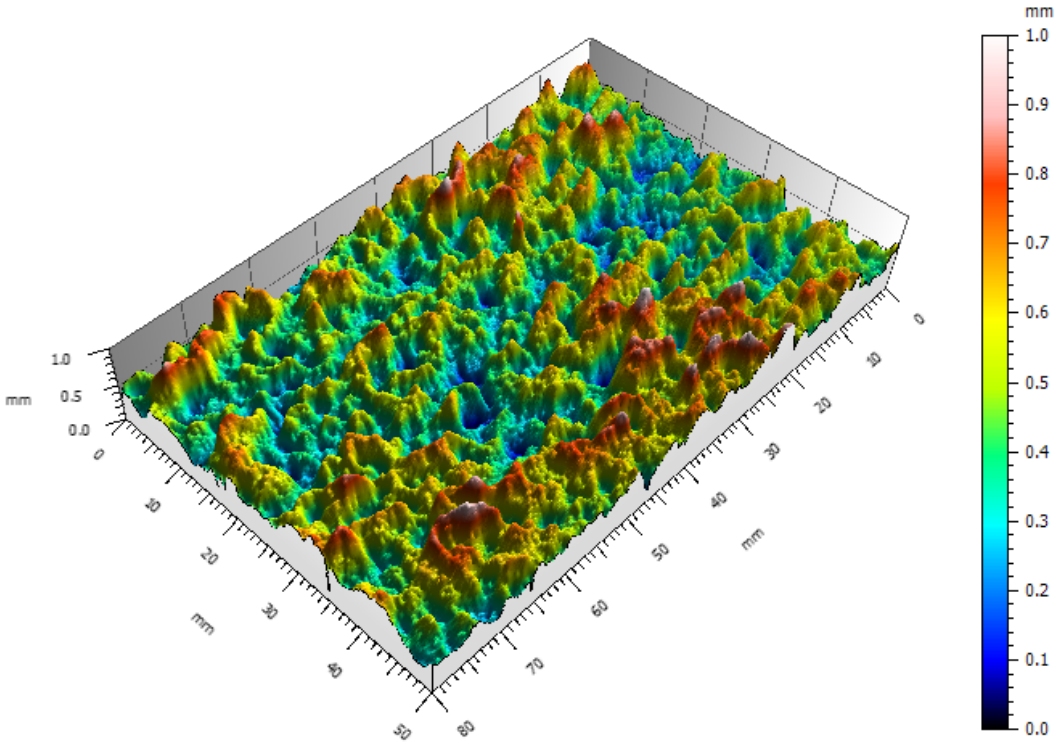


Fig. 4: 3D view of the drywall samples.

In order to further investigate the effect of the pits on the corrosion resistance of the drywall, higher resolution surface scan on Sample 2 is performed and analyzed in the following section.

The false-color view and pitting analysis of Sample 2 at a higher resolution are displayed in Fig. 5. It is clearly seen that Sample 2 shows small circular pits present on the sample surface. The pitting analysis allows us to locate the pits and calculate the statistics of all the pits. The pits, highlighted in blue color on the pitting analysis image, take up 2.26% of the projected area and have a total volume of 0.091 μm^3.

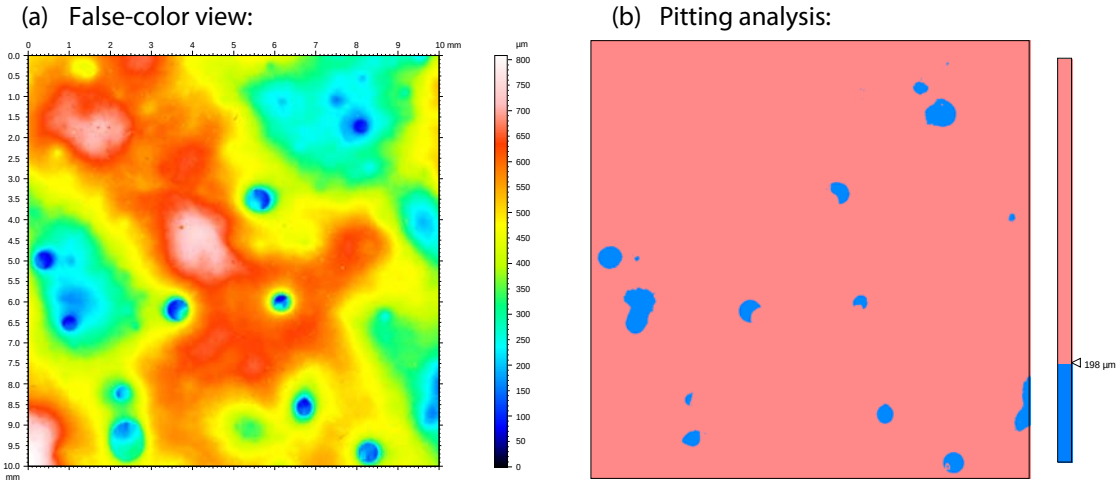
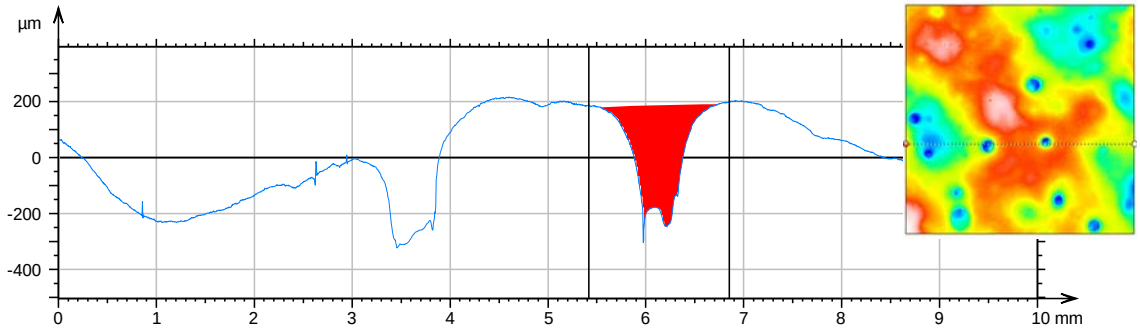


Fig. 5: False-color view and pitting analysis of Sample 2.

Fig. 6 exhibits the 2D profile analysis on one of the pits on Sample 2 as an example. The measured pit has a "cone" shape with a maximum depth of 494 µm and area of 2.2×10^5 μm^2.



Parameters	Value	Unit
Maximum depth	494	µm
Area of the hole	223473	µm²
Maximum height	1.08	µm
Area of the peak	9.51	µm²

Fig. 6: 2D pitting profile analysis for Sample 2.

CONCLUSION

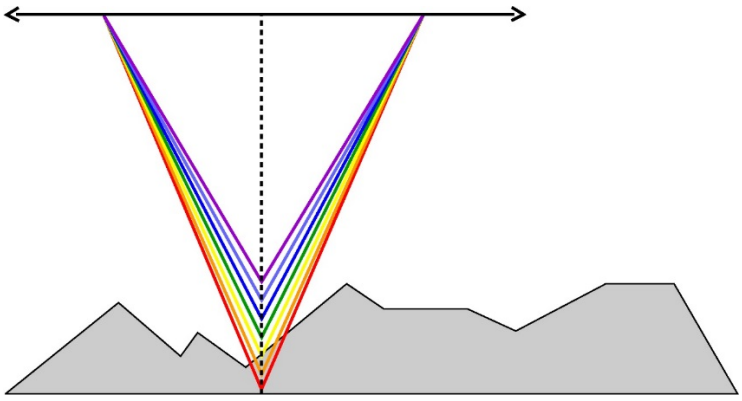
In this application, we have showcased that the Nanovea ST500 3D Non-Contact Profilometer is an ideal tool for analyzing and comparing the surface finish of drywall samples. The small pits on the drywall surface play a critical role in the susceptibility of the drywall to moisture and mold. The high resolution scan and comprehensive analysis tools including 3D and pitting analyses by Nanovea profilometer enable comprehensive and quantitative evaluation of the surface finish, which is critical in assessing and optimizing the product quality.

The data shown here represents only a portion of the calculations available in the analysis software. Nanovea Profilometers measure virtually any surface in fields including Semiconductor, Microelectronics, Solar, Fiber Optics, Automotive, Aerospace, Metallurgy, Machining, Coatings, Pharmaceutical, Biomedical, Environmental and many others.

Learn more about the Nanovea Profilometer or Lab Services

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.



Nanovea optical pens have zero influence from sample reflectivity. Variations require no sample preparation and have advanced ability to measure high surface angles. Measure any material: transparent/opaque, specular/diffusive, and polished/rough.