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A Better Measure.

SOFT & TRANSPARENT SURFACE MEASUREMENT USING 3D PROFILOMETRY

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INTRODUCTION:

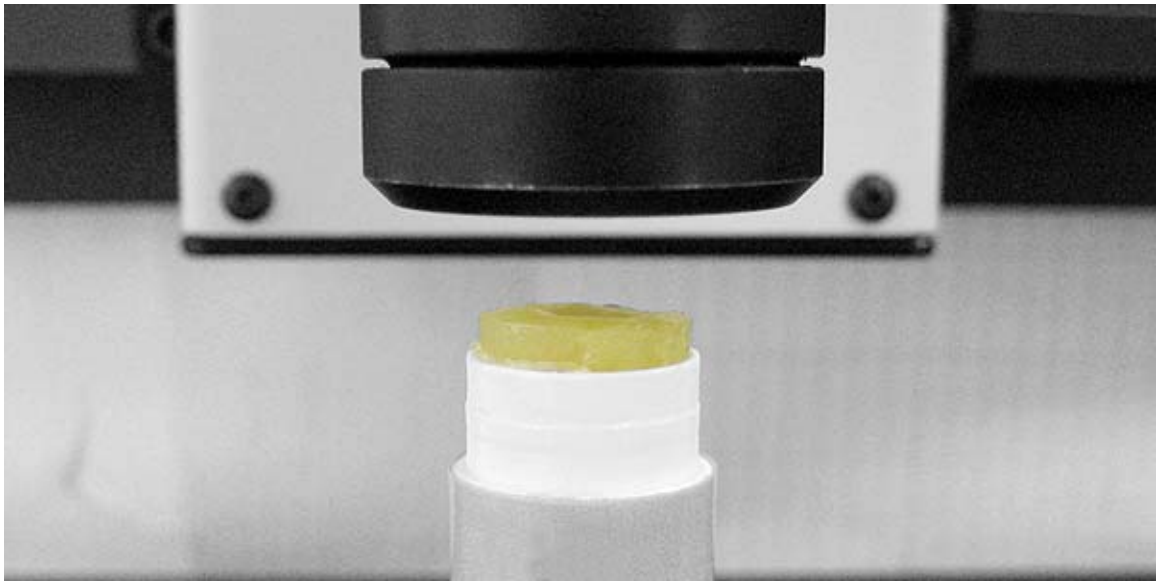
Non-contact surface measurement has the advantage that eliminates the possibility of surface alteration of a given application (deformed, scratched or moved). This may be critical, for example, when measuring soft surfaces of films, gels and many others. Additionally, many of these soft surfaces will have transparent or absorptive surfaces leading to measurement error with some optical techniques.

IMPORTANCE OF 3D NON CONTACT PROFILOMETER FOR WELD INSPECTION

Unlike other techniques such as touch probes or interferometry, the 3D Non Contact Profilometer, using axial chromatism, can measure nearly any surface, sample sizes can vary widely due to open staging and there is no sample preparation needed. Nano through macro range is obtained during surface profile measurement with zero influence from sample reflectivity or absorption, has advanced ability to measure high surface angles and there is no software manipulation of results. Easily measure any material: transparent, opaque, specular, diffusive, polished, rough etc. The technique of the Non Contact Profilometer provides an ideal, broad and user friendly capability to maximize weld surface studies with the benefits of combined 2D & 3D capability and portability for field studies.

MEASUREMENT OBJECTIVE

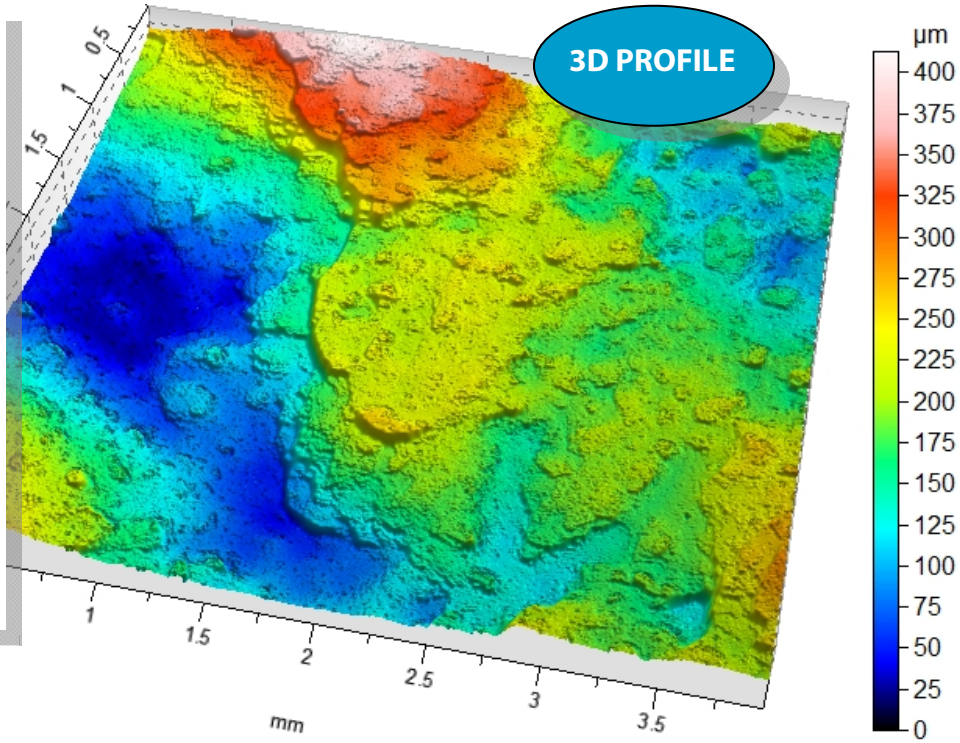
In this application the Nanovea ST400 Profilometer is used to measure the extremely soft and transparent surface of lip balm made of a petroleum jelly.

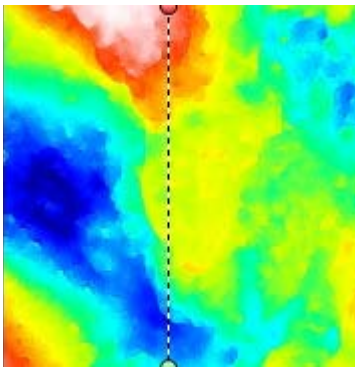


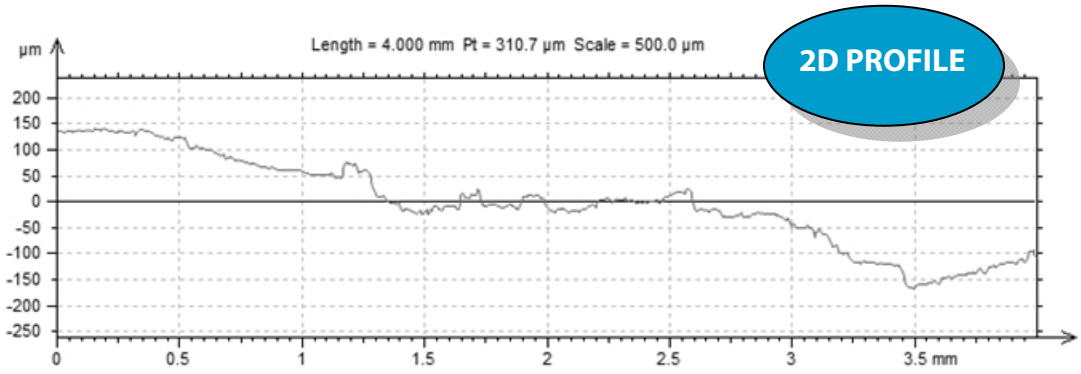
RESULTS:

Image below shows the full 3D view of petroleum jelly surface, along with different surface parameters corresponding to ISO 25178, 3D surface area caluclations and surface flatness corresponding to ISO 12781. A 2D cross-section (below) is shown for more surface detail.

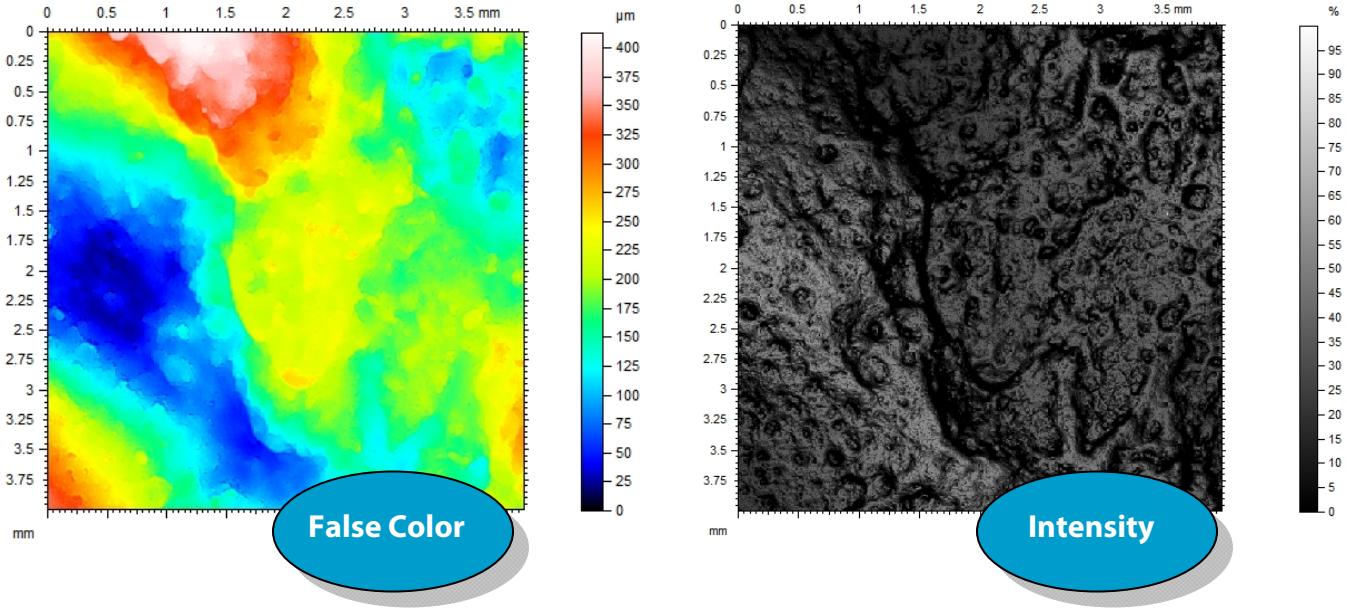
ISO 25178		
Height Parameters		
Sq	76.63	µm
Ssk	0.3746	
Sku	3.144	
Sp	238.5	µm
Sv	174.3	µm
Sz	412.8	µm
Sa	60.00	µm
Other 3D Parameters		
Miscellaneous		
Sdar	20.66	mm²
Spar	16.00	mm²
ISO 12781		
Flatness parameters		
FLTt	326.9	µm







Images below show a 3D surface of the petroleum jelly (left) alongside a contrast image (right), both acquired simultaneously in the measurement.

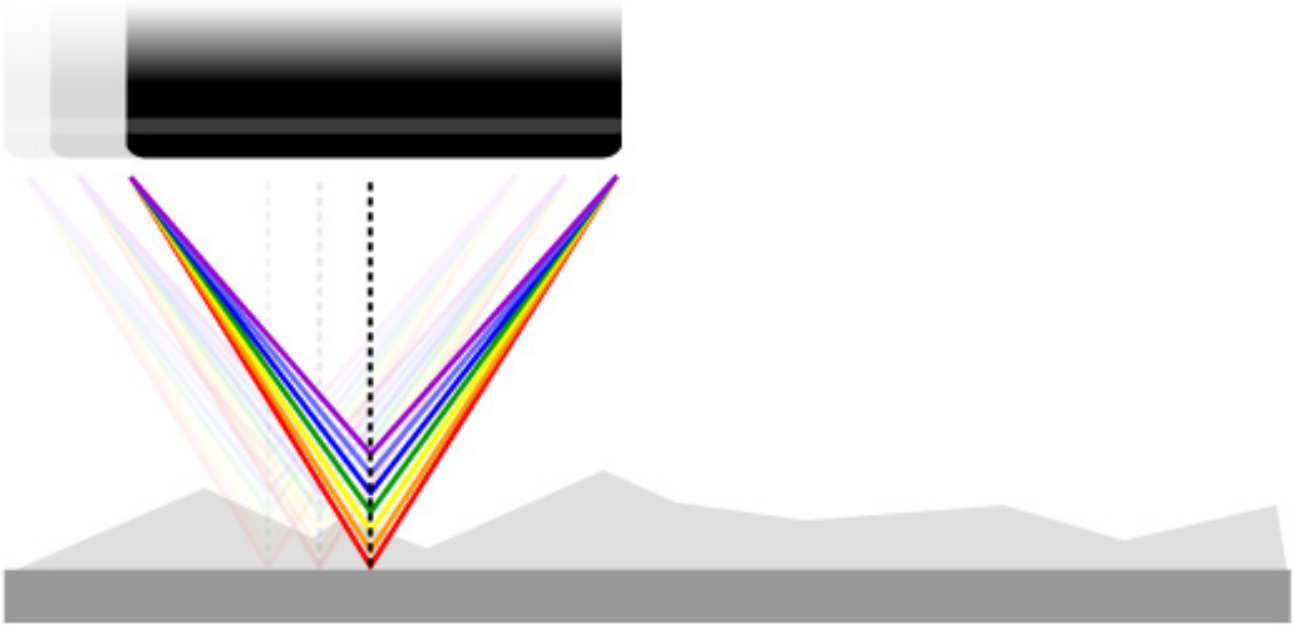


CONCLUSION:

In this application, we have shown how the Nanovea 3D Non Contact Profilometer can precisely characterize a very soft, transparent material that could have the potential for internal reflections. Surface roughness, surface flatness and 3D surface area were used here to characterize the surface. If applicable the 3D data or the Intensity data could be used to determine particle or pit size distributions. Soft materials, such as the petroleum jelly example in this note, can easily be analyzed with the standard table top Nanovea Profilometer or a portable option is available for immovable and or field application study.
Learn more about the: Nanovea Profilometer

MEASUREMENT PRINCIPLE:

The Chromatic Confocal 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.



Unlike the errors caused by probe contact or the manipulative Interferometry technique, Chromatic Confocal 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. Measurement includes: Profile Dimension, Roughness Finish Texture, Shape Form Topography, Flatness Warpage Planarity, Volume Area, Step-Height Depth Thickness and many others.

DEFINITION OF HEIGHT PARAMETERS

	Height Parameter	Definition
Sa	Arithmetical Mean Height	Mean surface roughness. $Sa = \frac{1}{A}\iint_A \lvert z(x,y)\rvert dxdy$
Sq	Root Mean Square Height	Standard deviation of the height distribution, or RMS surface roughness. $Sq = \sqrt{\frac{1}{A}\iint_A z^2(x,y)dxdy}$ Computes the standard deviation for the amplitudes of the surface (RMS).
Sp	Maximum Peak Height	Height between the highest peak and the mean plane.
Sv	Maximum Pit Height	Depth between the mean plane and the deepest valley.
Sz	Maximum Height	Height between the highest peak and the deepest valley.
Ssk	Skewness	Skewness of the height distribution. $Ssk = \frac{1}{Sq^3}\left[\frac{1}{A}\iint_A z^3(x,y)dxdy\right]$ Skewness qualifies the symmetry of the height distribution. A negative Ssk indicates that the surface is composed of mainly one plateau and deep and fine valleys. In this case, the distribution is sloping to the top. A positive Ssk indicates a surface with a lot of peaks on a plane. Therefore, the distribution is sloping to the bottom. Due to the large exponent used, this parameter is very sensitive to the sampling and noise of the measurement.
Sku	Kurtosis	Kurtosis of the height distribution. $Sku = \frac{1}{Sq^4}\left[\frac{1}{A}\iint_A z^4(x,y)dxdy\right]$ Kurtosis qualifies the flatness of the height distribution. Due to the large exponent used, this parameter is very sensitive to the sampling and noise of the measurement.
Spar	Projected Area	Projected surface area.
Sdar	Developed Area	Developed surface area.