NANOVEA®
A Better Measure.

Tissue Surface Topography
Using 3D Metrology

Prepared by
Craig Leising

6 Morgan, Ste156, Irvine CA 92618 · P: 949.461.9292 · F: 949.461.9232 · nanovea.com

INTRO:

Surface area, texture and topography are all crucial measurements required when studying the interaction between tissue and biomaterial surfaces. During the Microfabrication of biomaterials successful development will rely heavily upon precisely controlled surface areas. Changes within surface topography can result in unintended or intended surface interaction. It is for this reason that a reliable method of measurement is critical to assure the intended surface characteristics during development.

IMPORTANCE OF 3D NON CONTACT PROFILOMETER FOR BIOMEDICAL SURFACES

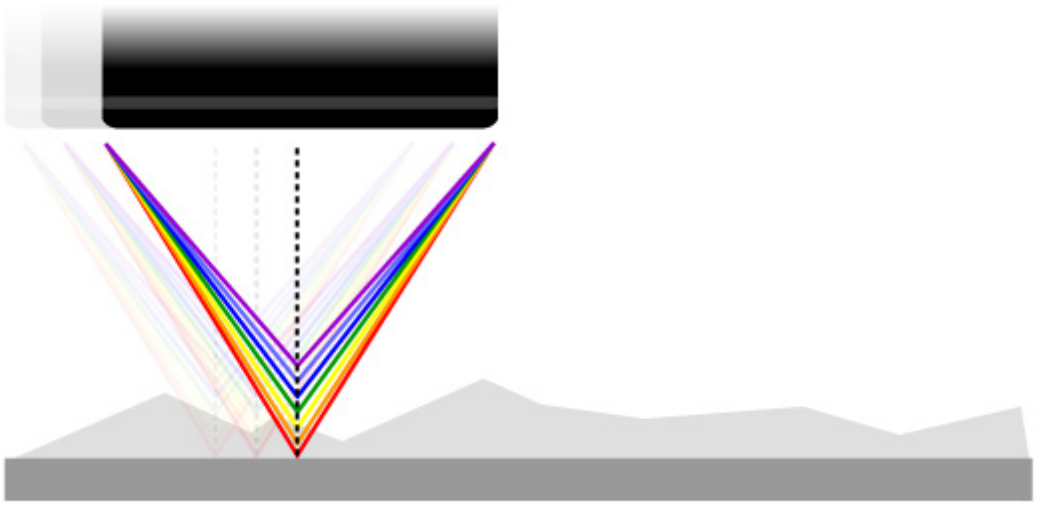
Utilizing chromatic confocal technology, the Nanovea Profilometer has superior capability to measure nearly any material. That includes the unique and steep angles, reflective and absorbing surfaces found within biomedicals broad range of surface characteristics. 3D non contact measurement provides a full 3D image to give a more complete understanding of surface features. Without 3D capabilities, identification of biomedical surfaces would be solely relying on 2D information or microscope imaging, which does not provide sufficient information to properly understand the surface studied. Understanding the full range of the surface characteristics surface area, texture and topography, among many others, will be critical to successful fabrication.

MEASUREMENT OBJECTIVE

In this application, the Nanovea ST400 is used to measure the surface of raw steak. There is an endless list of surface parameters that can be automatically calculated after the 3D surface scan. Here we will review the 3D surface and select areas of interest to further analyze, including quantifying and investigating the surface area, surface texture and topography.

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.



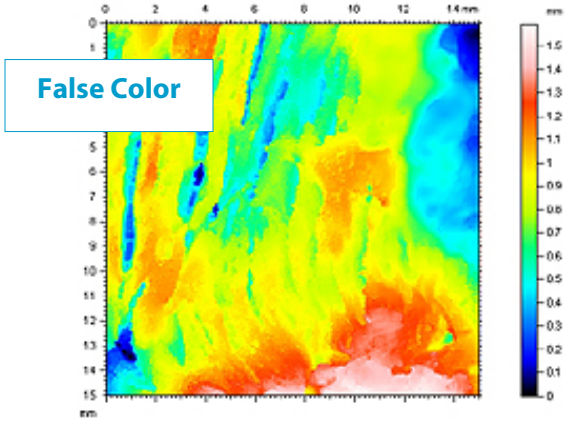
Nanovea optical pens have zero influence from sample reflectivity. Variations require no sample preparation and have advanced ability to measure high surface angles. Capable of large Z measurement ranges. Measure any material: transparent/opaque, specular/diffusive, polished/rough. Measurement includes: Profile Dimension, Roughness Finish Texture, Shape Form Topography, Flatness Warpage Planarity, Volume Area, Step-Height Depth Thickness and many others.

RESULTS:

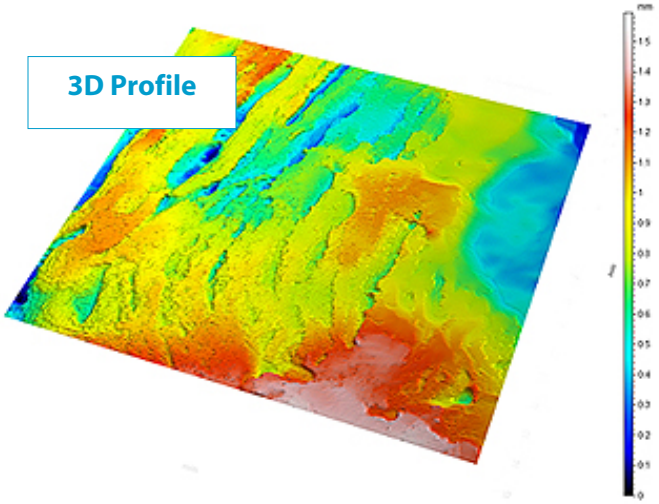
Surface Measurement 1

Scan Length: 15.0mm | Scan Step Size: 50.0µm

False Color

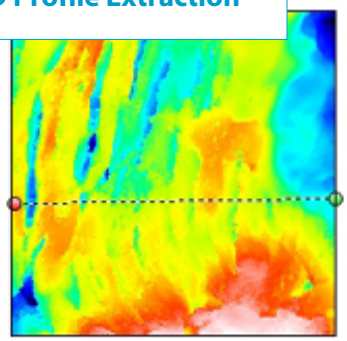


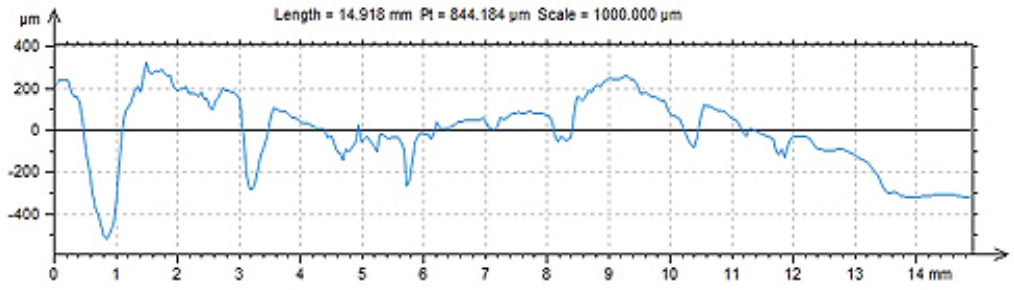
3D Profile



ISO 25178			
Height Parameters			
Sa	0.205933	mm	*Arithmetic mean height*
Sq	0.265343	mm	*Root mean square height*
Sz	1.59481	mm	*Maximum height*
Sp	0.757889	mm	*Maximum peak height*
Sv	0.836916	mm	*Maximum pit height*
Sku	3.01740		*Kurtosis*
Ssk	-0.0660996		*Skewness*
Other 3D Parameters			
Miscellaneous			
Sdar	331.242	mm²	*Developed area*
Spar	225.000	mm²	*Projected area*
EUR 15178N			
Functional Parameters			
Sk	0.0398999	mm	*Core roughness depth*
Spk	0.0514194	mm	*Reduced summit height*
Svk	0.079518	mm	*Reduced valley depth*
Sr1	15.3890	%	*Upper bearing area*
Sr2	81.7890	%	*Lower bearing area*
Sr2	81.7890	%	*Lower bearing area*

2D Profile Extraction

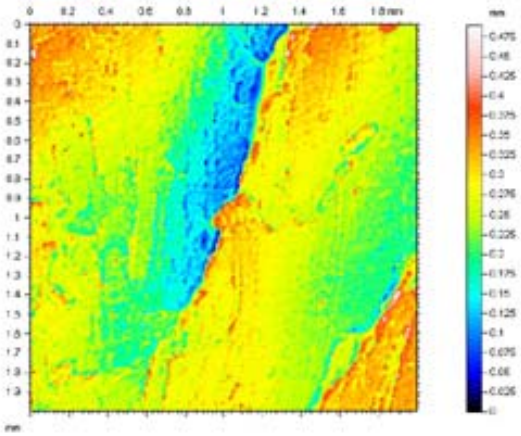


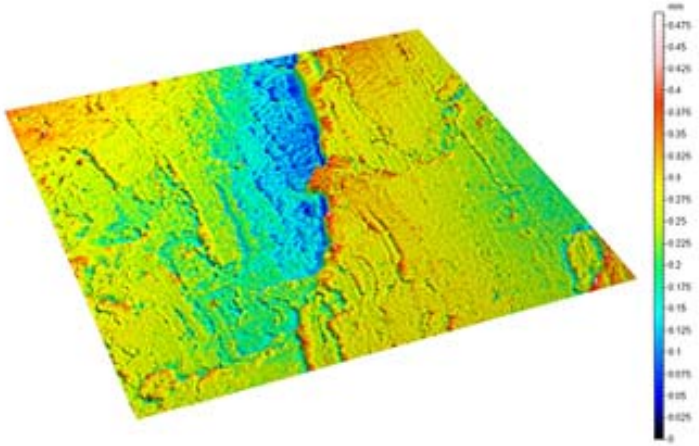


RESULTS:

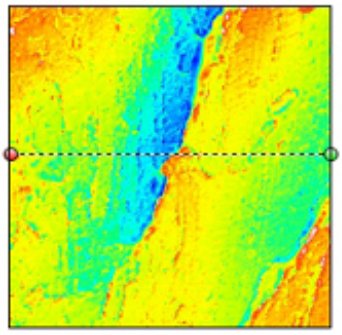
Surface Measurement 2

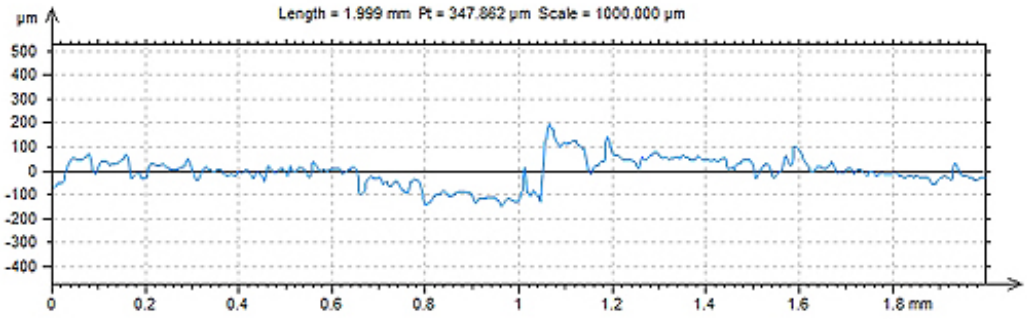
Scan Length: 2.0mm | Scan Step Size: 2.6µm





ISO 25178			
Height Parameters			
Sa	0.0467994	mm	*Arithmetic mean height*
Sq	0.0600867	mm	*Root mean square height*
Sz	0.489343	mm	*Maximum height*
Sp	0.237807	mm	*Maximum peak height*
Sv	0.251536	mm	*Maximum pit height*
Sku	3.39089		*Kurtosis*
Ssk	-0.536478		*Skewness*
Other 3D Parameters			
Miscellaneous			
Sdar	33.5989	mm²	*Developed area*
Spar	3.99760	mm²	*Projected area*
EUR 15178N			
Functional Parameters			
Sk	0.0713327	mm	*Core roughness depth*
Spk	0.0628999	mm	*Reduced summit height*
Svk	0.0648758	mm	*Reduced valley depth*
Sr1	12.0392	%	*Upper bearing area*
Sr2	81.9892	%	*Lower bearing area*
Sr2	81.9892	%	*Lower bearing area*





CONCLUSION:

In this application, we have shown how the Nanovea ST400 3D Non Contact Profilometer can precisely characterize both the topography and the nanometer texture/roughness of a tissue surface. Here we have shown the broad capability to study biomedical surfaces. From these 3D surface measurements, areas of interest can quickly be identified and then analyzed with a list of endless measurements (Dimension, Roughness Finish Texture, Shape Form Topography, Flatness Warpage Planarity, Volume Area, Step-Height and others). A 2D cross section can quickly be chosen to analyze further details. With this information biomedical surfaces can be broadly investigated with a complete set of surface measurement resources. Special areas of interest could have been further analyzed with integrated AFM module on table top models. Nanovea 3D Profilometers speeds range from 20mm/s to 1m/s for laboratory or research to the needs of hi-speed inspection; can be built with custom size, speeds, scanning capabilities, Class 1 Clean Room compliance, with Indexing Conveyor and for Inline or online Integration.