



Witec
focus innovations

TrueSurface® Microscopy

Confocal Microscopy Along with
Large Area Optical Profiling

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alpha500 with sensor
for profilometry

Features & Benefits

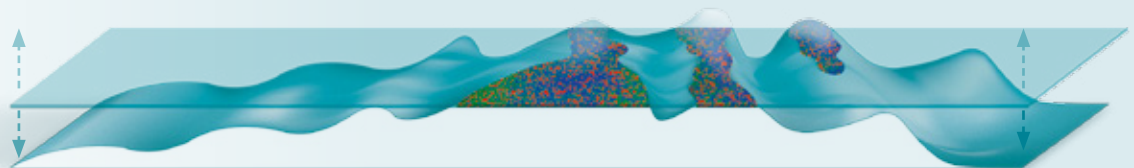
- Extension for the WITec alpha500 series that combines Large Area Surface Topography profiling with Confocal Raman Imaging and/or AFM:
 - Topographic Confocal Raman Imaging
 - Topographic Large Area Surface Imaging
 - Topographic Spectroscopic Imaging
- Unique combination (patent pending) delivers innovative application possibilities for new research techniques
- Ease-of-use through full integration with the alphaControl hardware and WITec Project Software environment
- Scan Speed up to 2000 pixels/s for rapid data acquisition
- Spatial Resolution of 10 - 25 μm laterally and < 100 nm vertically to reveal an expanse of miniscule surface structures
- Light source: High brightness LED for highest throughput and accuracy
- Measuring distance: 10 mm – 16 mm providing wide-ranging sample size flexibility
- Multi-sensors easily configurable to meet virtually any application

TrueSurface[®] Microscopy

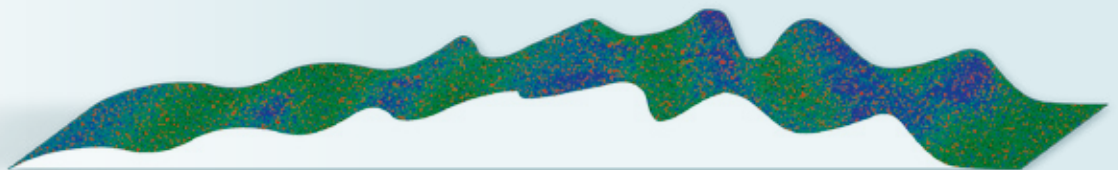
Confocal Microscopy Along with Large Area Optical Profiling

WITec's new TrueSurface[®] Microscopy option (patent pending) allows confocal Raman imaging guided by surface topography. Confocal microscopy is often desirable due to its suppression of out-of-focus light but can be challenging when analyzing large or rough surfaces. In these cases, only those points that are in focus contribute to the image. TrueSurface Microscopy follows the surface topography with high precision, so that even rough or inclined samples always stay in focus. To achieve this unique capability, the WITec alpha500 series can be equipped with a highly precise sensor for optical profilometry. The topographic coordinates from the profilometer measurement are used to perfectly follow the sample surface in confocal Raman imaging mode. The result is an image revealing chemical properties at the surface of the sample, even if this surface is rough or inclined.

Working Principle



Confocal Raman imaging on large samples (mm-size) delivers an optical cross-section through the sample. If the sample is not transparent, only the intersection of focal plane and sample surface will give a Raman signal. Depending on the objective used, the focal plane might have a thickness of less than 1 μm .



The TrueSurface Microscopy option enables the precise tracing of the surface while acquiring Raman imaging data, resulting in a true surface Raman image.

Topographic Confocal Raman Imaging

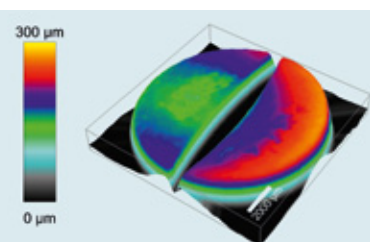
The Topographic Confocal Raman Imaging option revolutionizes imaging possibilities for large samples with extensive topographic variation in a way that allows the collection of confocal Raman images that precisely trace the true 3D surface. Sample preparation is reduced to a minimum without compromising the confocality of the system.

The key element of this novel imaging mode is a topographic sensor that works using the principle of chromatic aberration. A white light point source is focused onto the sample with a hyperchromatic lens assembly, a lens system with a good point mapping capability,

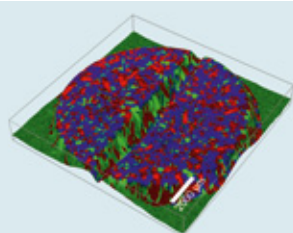
but a strong linear chromatic error. Every color has therefore a different focal distance. The light reflected from the sample is collected with the lens and focused through a pinhole onto a spectrometer. As only one specific color is in focus at the sample surface, only this light can pass through the confocal pinhole. The detected wavelength is therefore related to the surface topography. Scanning the sample in the XY plane (up to 50 x 100 mm) reveals a topographic map of the sample. This map can then be followed in a subsequent Raman image so that the Raman laser is always kept in focus with the sample surface (or at any distance below the surface). Depending on the type of sensor used, a lateral resolution of 10-25 μm and a vertical resolution of 40-120 nm can be achieved at a measurement range of 1-3 mm and a working distance of 10-16 mm (other sensors with different ranges and resolutions are available upon request).

These topographic sensors are an ideal supplement to atomic force microscopy (AFM), which provides topographic information on small sample areas (< 100 μm) with ultra-high precision (< 1 nm).

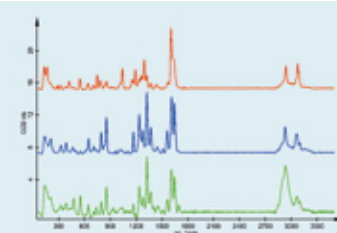
Applications



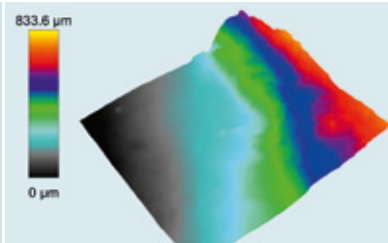
1.1 Height profile of a pharmaceutical tablet. (12 x 12 mm)



1.2 Topographic confocal Raman image along the tablet's TrueSurface.



1.3 Corresponding Raman spectra, Red + Blue: API, Green: Excipient

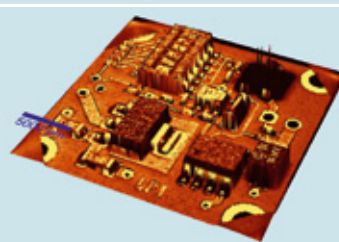


4.1 Height profile measured on a shell. Scan range: 1.3 x 1.7 mm



2.1 Large area topography profilometer measurement of a micromechanical gear (15 x 15 mm).

2.2 Surface topography profile of an electronic circuit board (25 x 25 mm)



Comparison

Topographic Large Area Surface Imaging, Confocal Optical/Raman Imaging and AFM

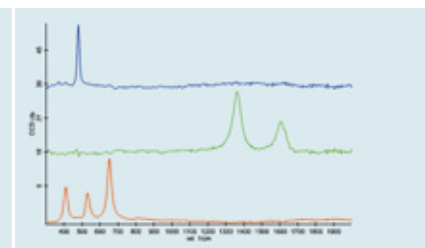
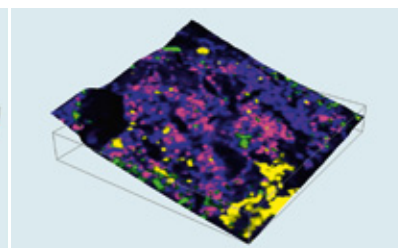
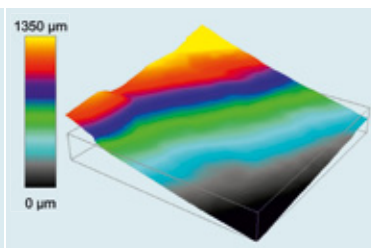
The Topographic Large Area Surface Imaging option extends the previously available imaging modes of the WITec alpha500 series with respect to scan range and resolution to deliver an all-encompassing surface inspection tool.

Scan Range X/Y	
Topographic Large-Area Surface Imaging	50 x 100 mm
Large-Area Confocal Raman Mapping	100 x 100 mm
3D Confocal Raman Imaging	200 x 200 μm
AFM	100 x 100 μm

Scan Range Z	
Topographic Large-Area Surface Imaging	10 mm
Large-Area Confocal Raman Mapping	10 mm
3D Confocal Raman Imaging	10 mm
AFM	20 μm

Spatial Resolution X/Y	
Topographic Large-Area Surface Imaging	10 μm
Large-Area Confocal Raman Mapping	200 nm
3D Confocal Raman Imaging	200 nm
AFM	<10 nm

Spatial Resolution Z	
Topographic Large-Area Surface Imaging	<100 nm
Large-Area Confocal Raman Mapping	500 nm
3D Confocal Raman Imaging	500 nm
AFM	<1 nm

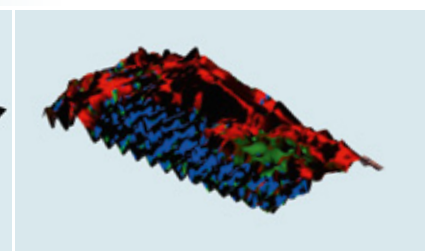
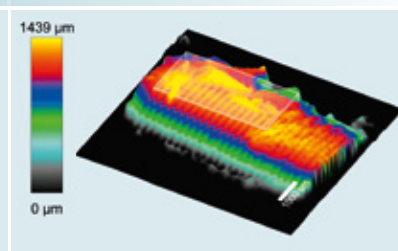
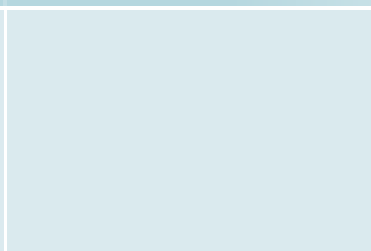
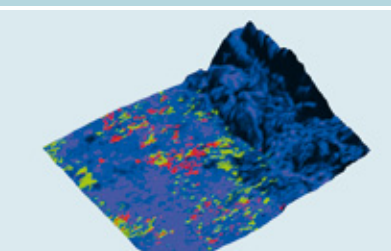


3.1 A 2 x 2 mm area at the indicated position was investigated on this inclined and rough rock sample while the sample was positioned under the microscope exactly as shown in the image.

3.2 Height profile as measured by the integrated optical profilometer.

3.3 TrueSurface Raman image as a result of the height profile to be overlaid with the topography-traced confocal Raman image.

3.4 Corresponding spectra of the mineral phases: Blue: Quartz, Green: Kerogen, Red: Anatase.



4.2 Topographic Raman image of the same area on the shell, revealing that some of the compounds (green, red) are not present in the elevated areas.

5.1 A metal screw (topography, 2 x 4 mm) with contamination covering the threads.

5.2 The TrueSurface confocal Raman image of the marked area in 5.1 makes it possible to chemically identify and locate the contamination on the threads.

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