KEYENCE
VK-9700 Color 3D Laser Scanning Microscope

A Training Guide for Understanding the Basic Principles of Operation

For the **VK Viewer**

Introduction:
What exactly is the VK-9700?

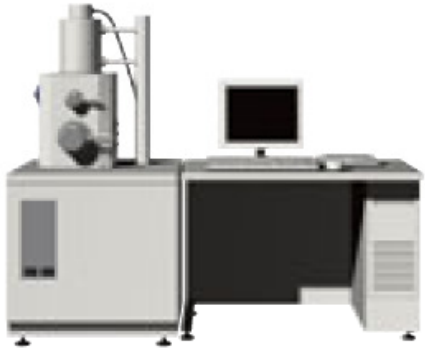
KEYENCE

The VK-9700 combines the convenience of an optical microscope with the analysis functions of an SEM and a roughness gauge

Optical microscope

Convenience

+



SEM

High definition and ultra-depth

+

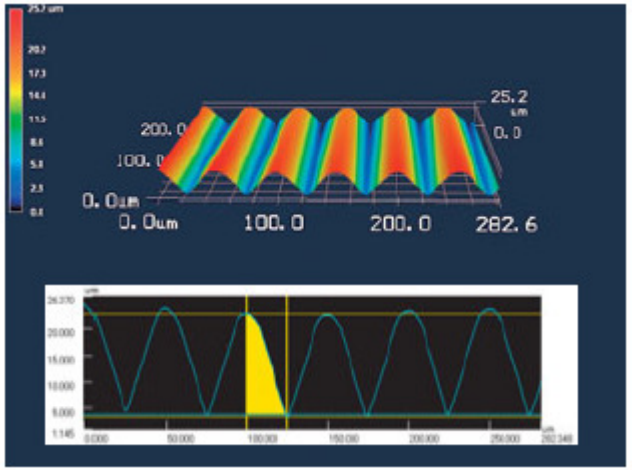
Roughness gauge

Shape measurement

* Non-contact 2D & 3D Measurement
* Zero Sample Preparation Required
* Material Independent

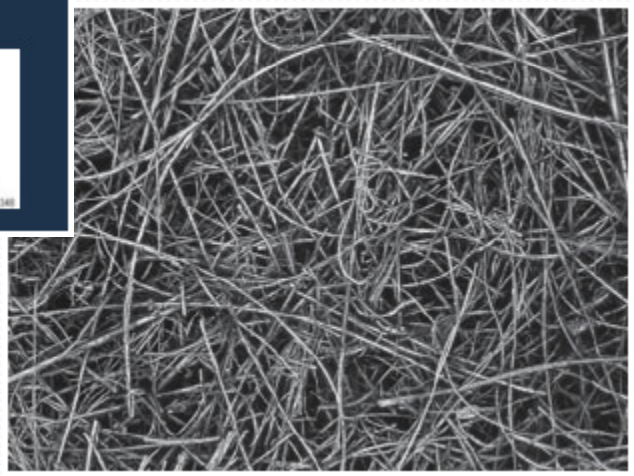
VK-9700 Generation II
Main Features

Non-contact 3D measurement



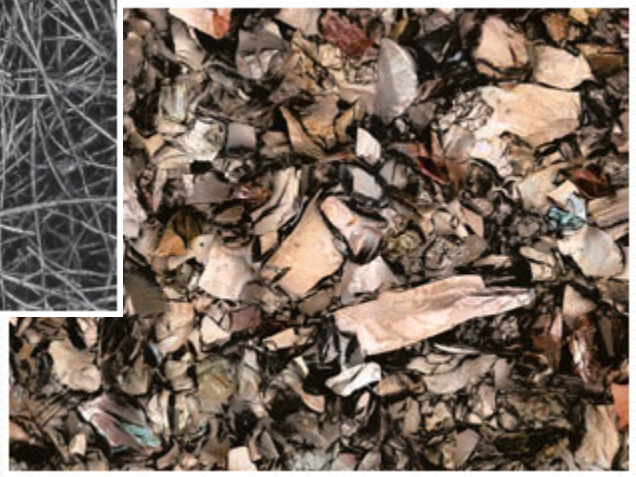
Optical sheet (1000x)

High definition and ultra-depth



HEPA filter (1000x)

HD real-color observation



Sandpaper (400x)

KEYENCE

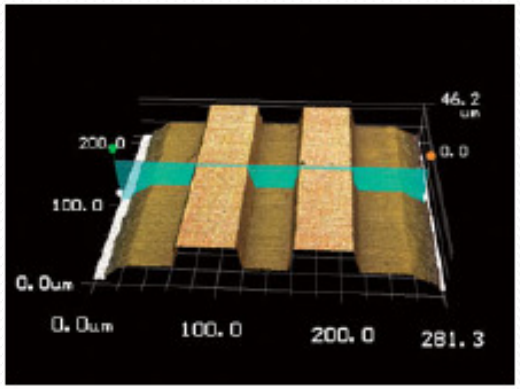
Wide Range of Versatile 3D Measurement Functions

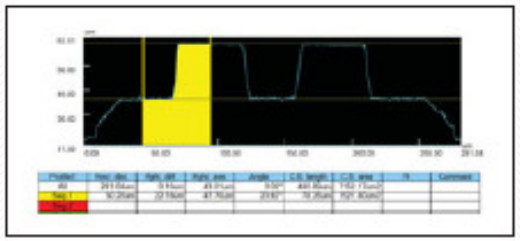
1 & 2

VK-Analyzer

[1] Profile Measurement

- Height
- Width
- Cross-section
- Shape angle
- R measurement

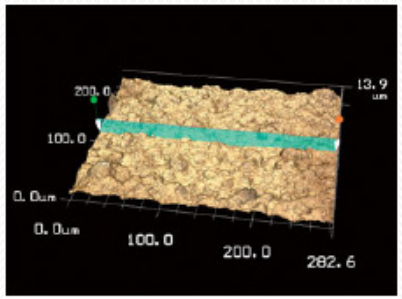


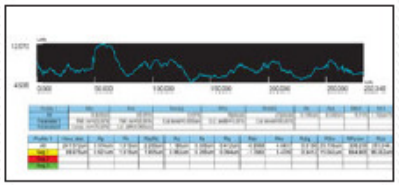


PCB step (1000x)

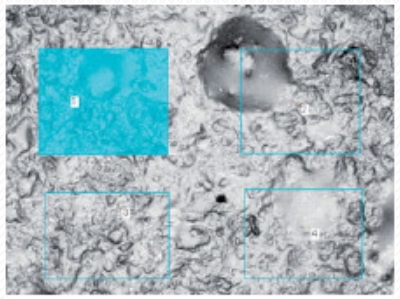
[2] Roughness Measurement

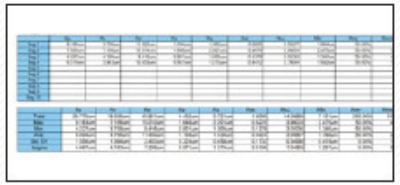
- Line Roughness
- Surface Roughness





Plated surface (1000x)





Building material (1000x)

KEYENCE

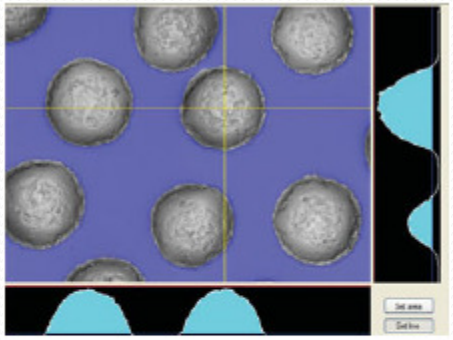
Wide Range of Versatile 3D Measurement Functions

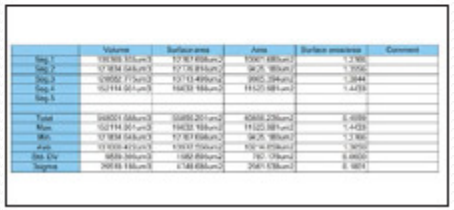
3 & 4

VK-Analyzer

[3] 3D Measurement

- Volume
- Surface
- Ratio of area to surface area

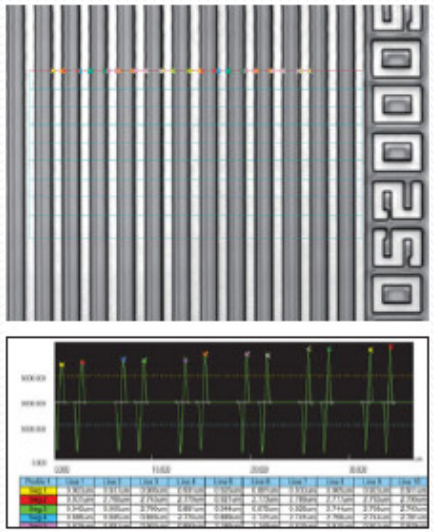




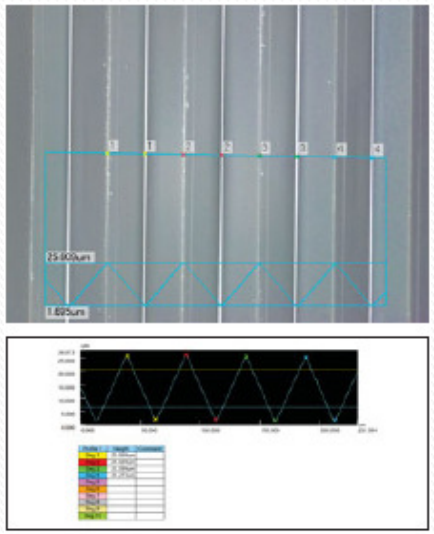
Optical film (1000x)

[4] Automatic Width / Height Measurement

Width **Height**



Resist pattern (6000x)



Optical film (1000x)

KEYENCE

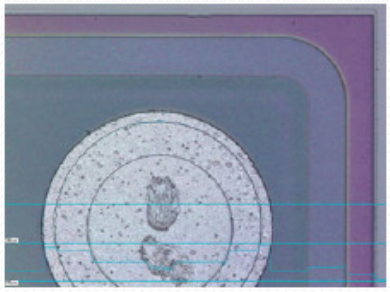
Wide Range of Versatile 3D Measurement Functions

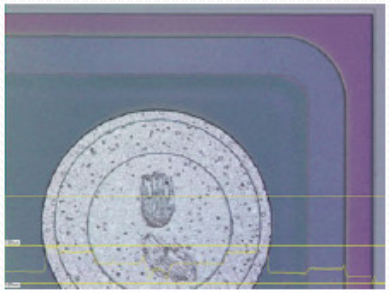
5 & 6

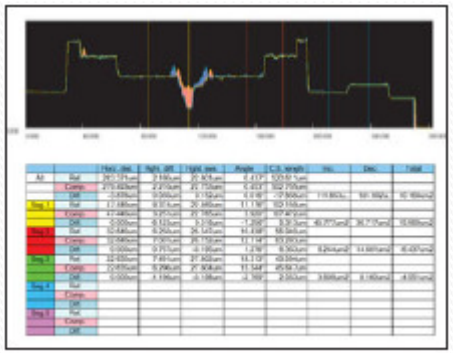
VK-Analyzer

[5] Comparative Measurement

Compare two target objects and measure their differences



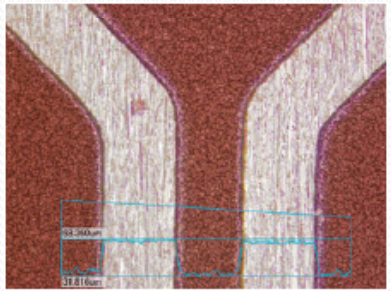




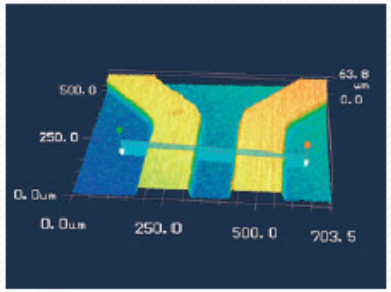
LED pad unit (1000x)

[6] 2D plus 3D Measurement

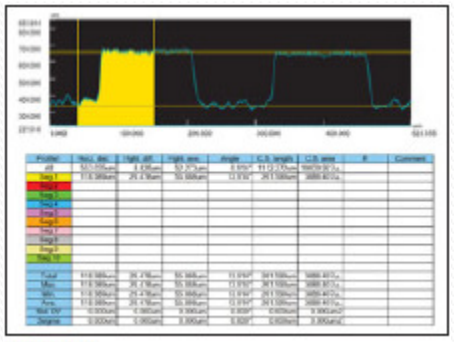
Set measurement locations in 2D and 3D images



2D image



3D image



PCB (400x)

System Configuration

1) Incident laser sent from control tower to the microscope

2) Received laser sent from microscope back to control tower

3) Digital signal sent to computer

KEYENCE

Advantages of LSCMs over other profiling techniques (stylus, interferometers)

1. Steep Angle of Detection - up to 80º
2. Non-contact and requires zero sample preparation
3. Up to 18,000X magnification with 120nm spatial resolution
4. Has an extremely high degree of material independence
5. Ability to be operated without advanced training

Outline: VK Viewer Pre-Processing software

1) Determine mode of operation
    1) Beginner Mode
    2) Expert Mode

2) Set your Upper and Lower limits for scanning in the Z-direction

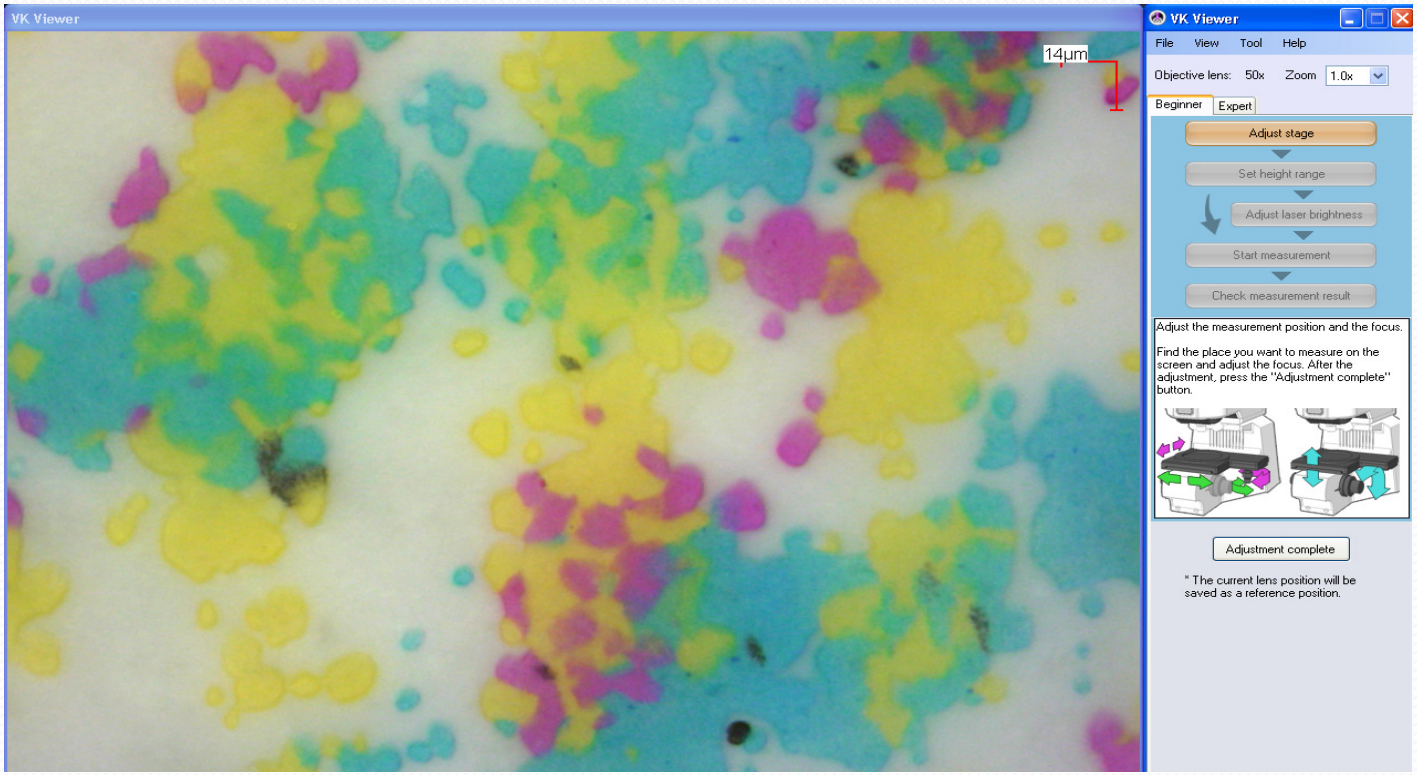
3) Adjust the Intensity of the Laser
    1) Avoiding saturation
    2) Using Auto Gain and Wide-Dynamic Range

4) Measurement Settings (Expert Mode only)
    1) RPD
    2) Mode
    3) Area
    4) Quality

1) Determine Mode of Operation

Beginner Mode

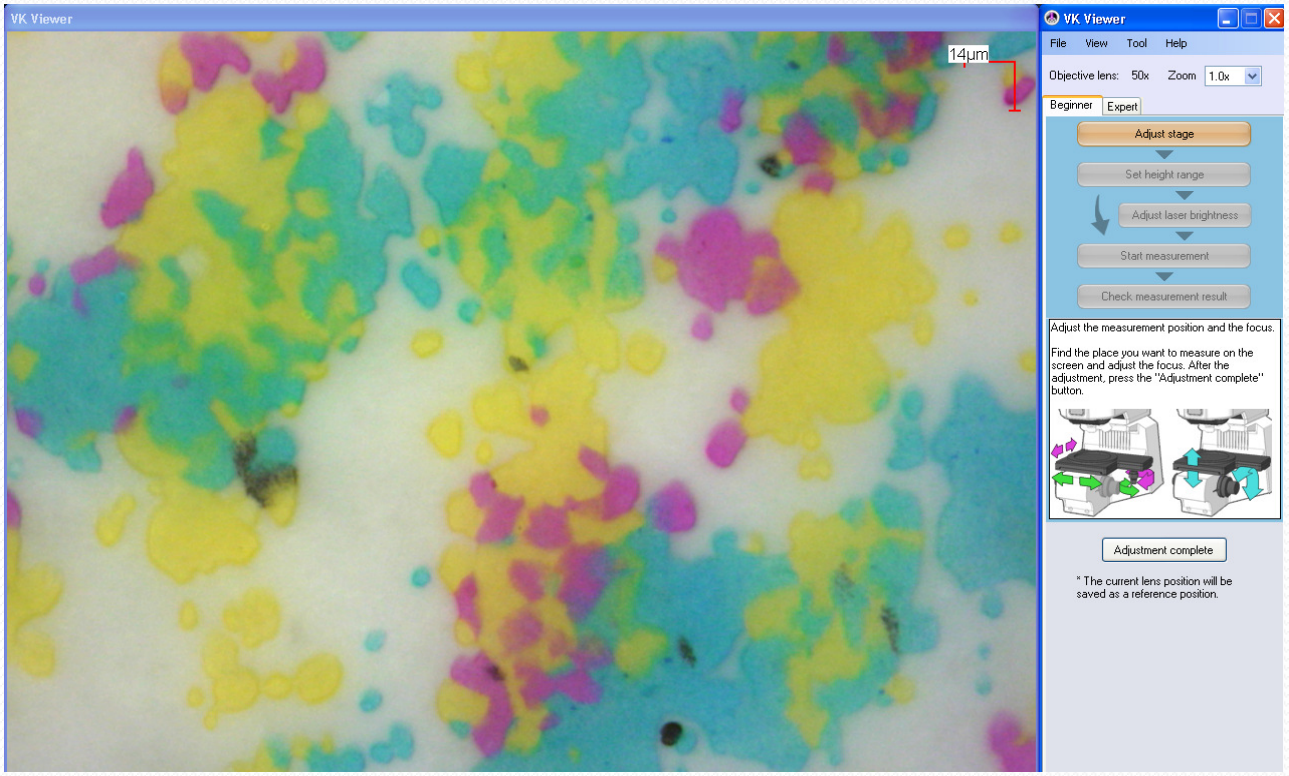
Providing working data in 3 easy steps



Beginner Mode: Step 1

Adjust Stage: Manually adjust the Z-stage until you can see a portion of the sample in focus.

Notice that most of the ink on the paper is in focus. You only need to locate a portion of the sample in focus in order to determine the correct height for the manual Z-stage.

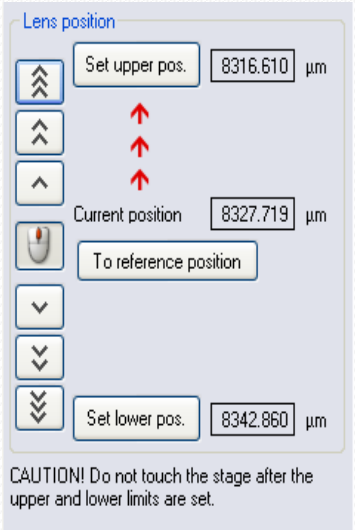


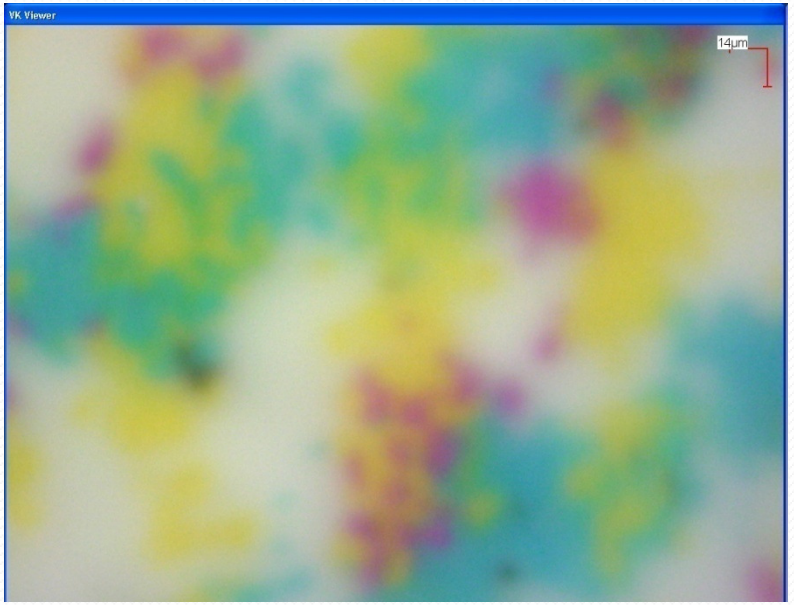
Beginner Mode: Step 2

Set height range: By using focus planes, determine the tallest location of the sample ("Upper") and the lowest location of the sample ("Lower").

Example: Setting Upper plane when out of focus

Either roll the track wheel on the mouse or use the arrow buttons provided to move the lens turret north and south to determine the Z-range.





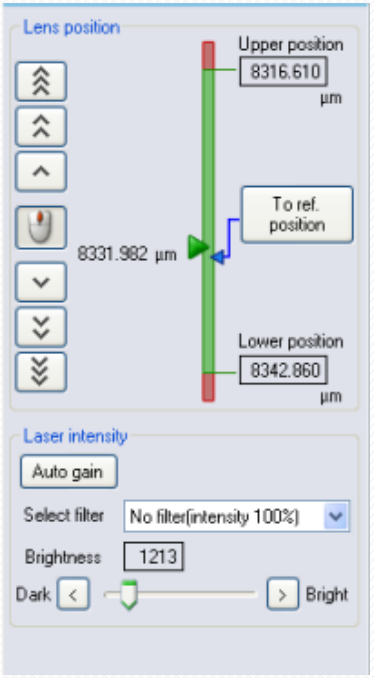
Tip: When using the track wheel , holding down **Crtl** will make the turret go faster; **Shift+Crtl** will go fastest

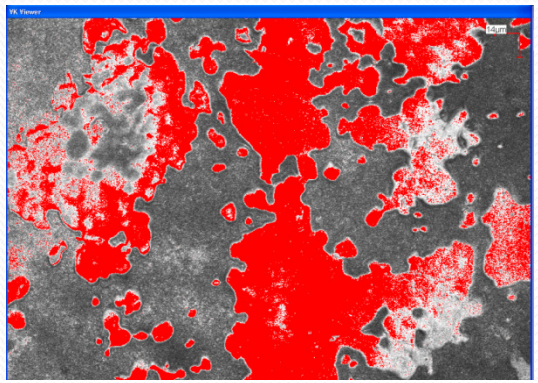
Beginner Mode: Step 3

Adjust laser brightness: Increase the intensity of the laser just below the saturation level throughout the entire Z-range using the slide bar or the Auto Gain tool.

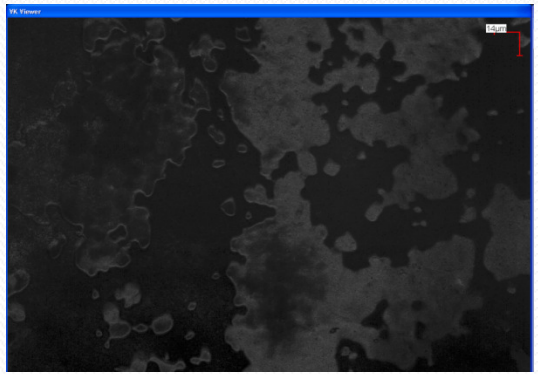
Auto Gain will have the software run through an algorithm to automatically adjust the intensity of the laser for your sample.

Select Filter allows the user to decrease the magnitude of minimum laser intensity for very reflective samples.





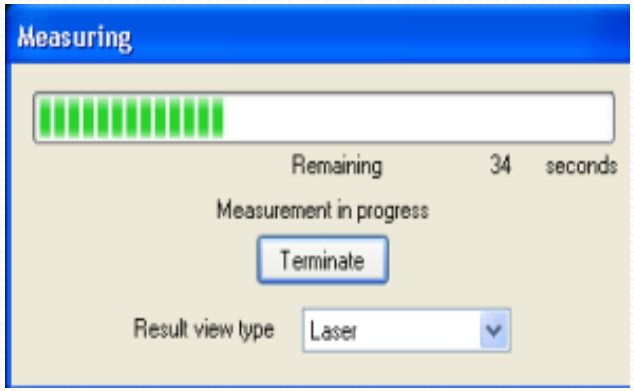
Too Bright: Red Areas represent locations of saturated laser



Too Dark: Not enough laser intensity to provide accurate data

Beginner Mode: Step 4

Start measurement: Once you have set everything up, clicking "start measurement" will move the lens turret to the Upper position and it will begin to scan down through the Z-range at the specified laser intensity.



This dialogue box will pop up as soon as you start the scan and will tell you how much time is remaining.

Clicking **Terminate** will immediately stop the scan and erase all data that was previously obtained.

Result view type allows the user to change the data set that is displayed.

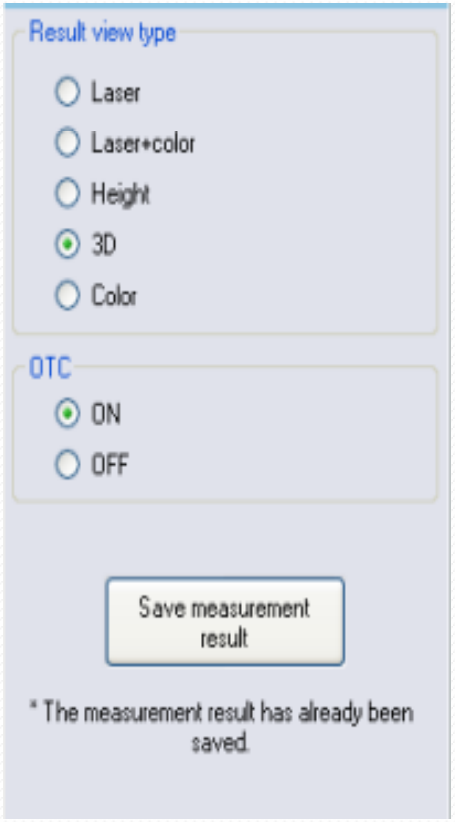
Beginner Mode: Step 5

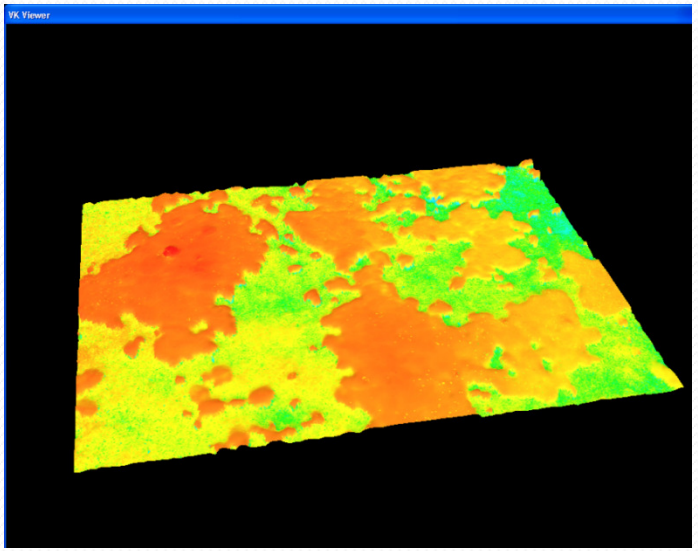
Check measurement result: Allows the user to get a quick look at the 2D photos as well as a quick rendering of the 3D model.

Toggle between the various **result view types** to get a glimpse as to how well the system was able to scan the surface of your sample.

Click **save measurement result** if you are satisfied.

Optimal Texture Contrast (OTC) settings can be defaulted in the VK Analyzer and will emphasize surface characteristics when ON.

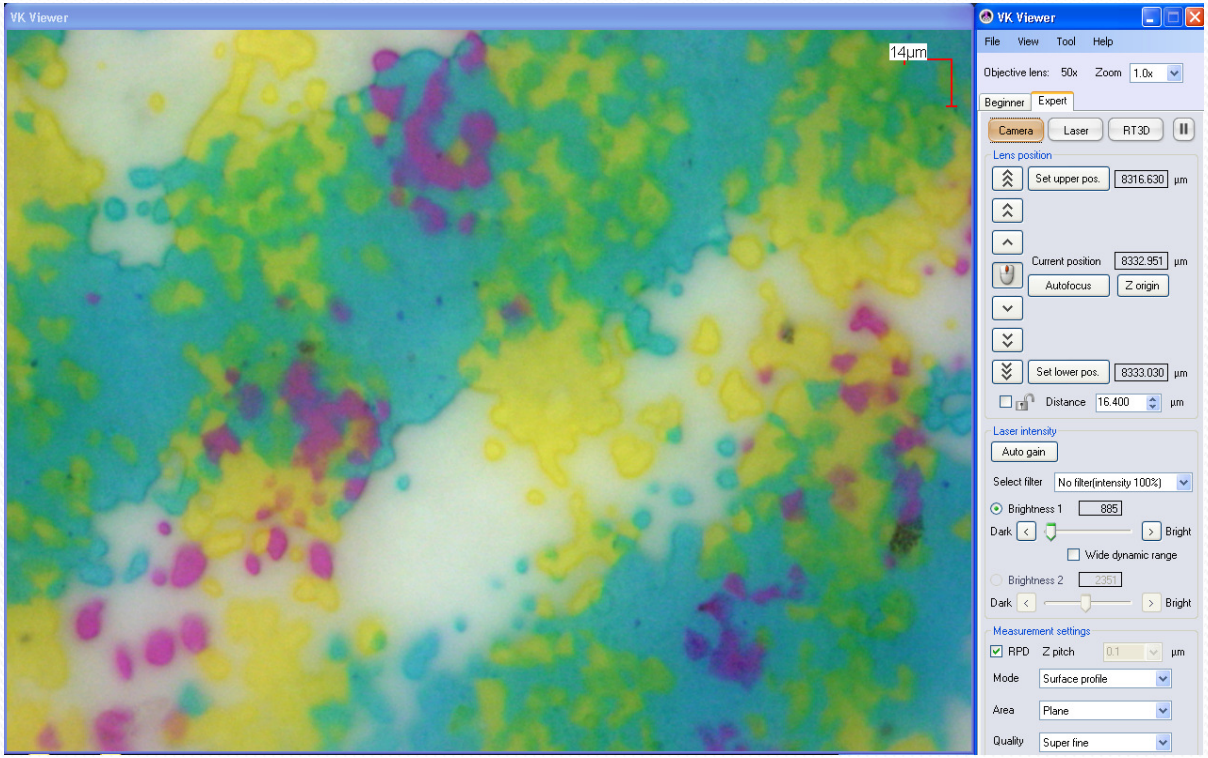




1) Determine Mode of Operation

Expert Mode

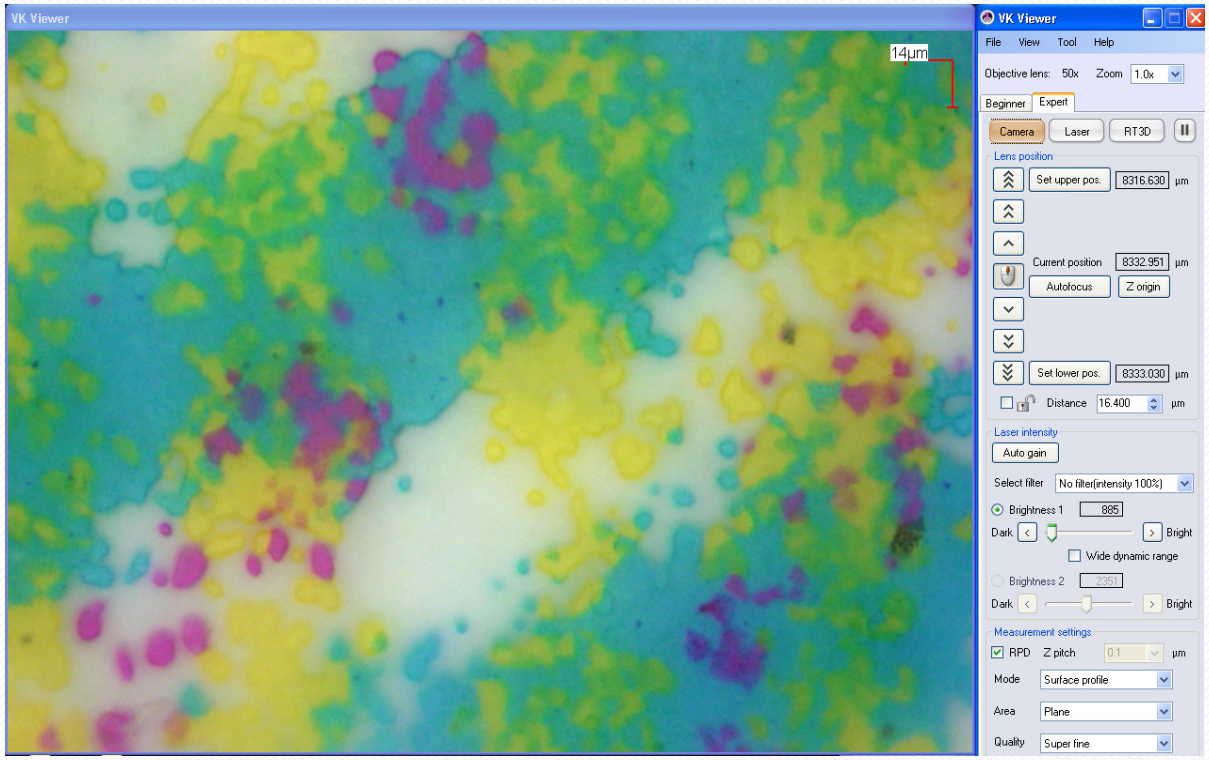
Providing more setup options for users who want to explore the full capability of the VK-9700



Expert Mode: Step 1

Adjust stage: Manually adjust the Z-stage until you can see a portion of the sample in focus.

Notice that most of the ink on the paper is in focus. You only need to locate a portion of the sample in focus in order to determine the correct height for the manual Z-stage.

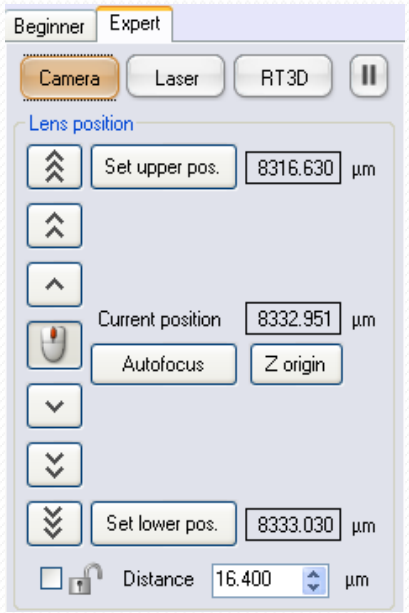


Expert Mode: Step 2

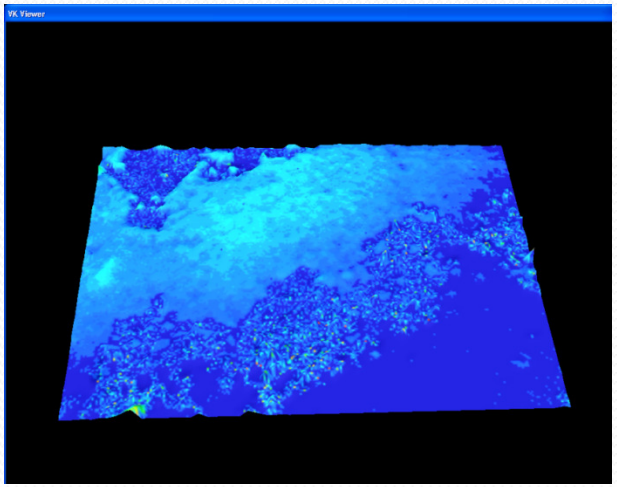
Lens position: By using focus planes of either power source, determine the tallest location of the sample ("Upper") and the lowest location of the sample ("Lower").

You can choose between the white light power source (**Camera**) or the laser power source (**Laser**) to determine the Z-range of your scan.

The laser power source is particularly helpful when looking at low-contrast samples (glass, wafers)



RT3D stands for Real Time 3D and will provide a coarse real-time 3D rendering of the surface after the Z-range is set.

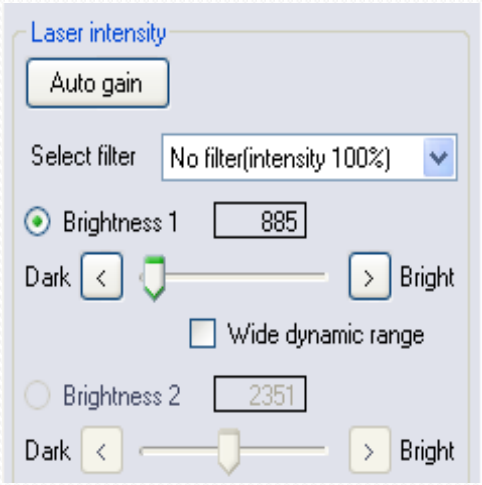


Expert Mode: Step 3

Laser intensity: Increase the intensity of the laser just below the saturation level throughout the entire Z-range using the slide bar or the Auto Gain tool.

Auto Gain and **Select Filter** work just as they did in Beginner Mode.

Wide Dynamic Range allows the user to work with two separate levels of laser intensity. The system will scan two separate times and will take the best data from each scan before creating the measurement file.

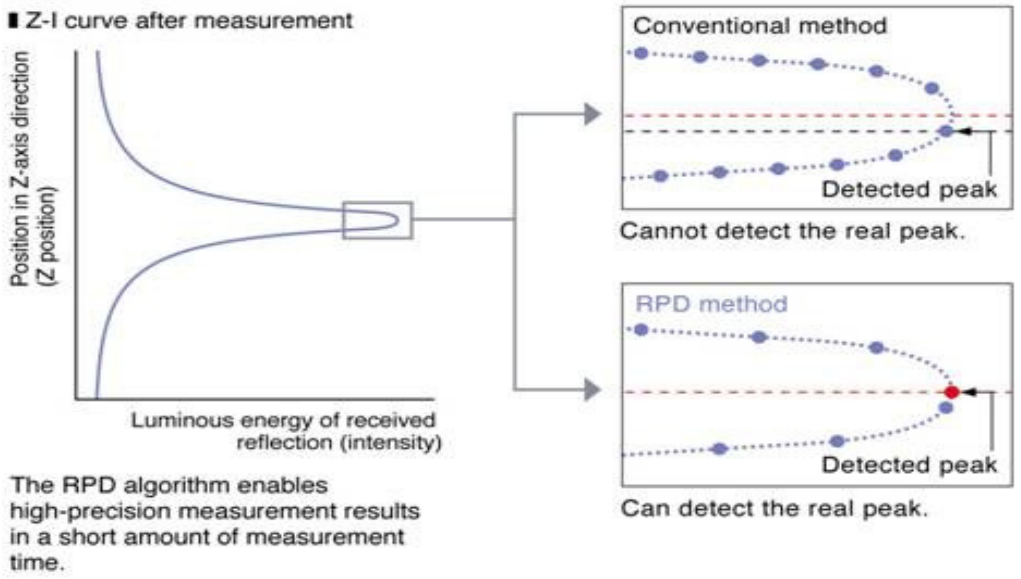


Wide Dynamic Range is particularly useful when you have various materials on the surface or if you have varying levels of geometry.

It is also recommended that you make the intensity of Brightness 2 > Brightness 1

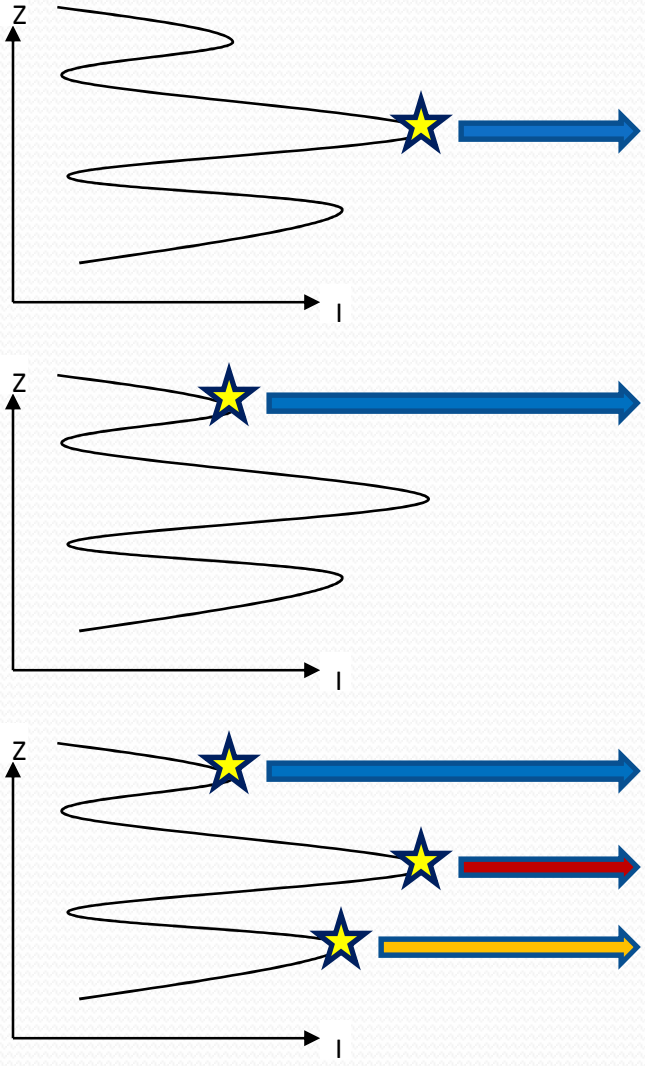
Expert Mode: Step 4 (RPD)

Measurement settings: Determine the parameters for the movement of the lens turret, the speed of the laser raster and the interpretation of the received signal.



Manually adjust the Z pitch(distance between data points) from **10nm** to **50um**

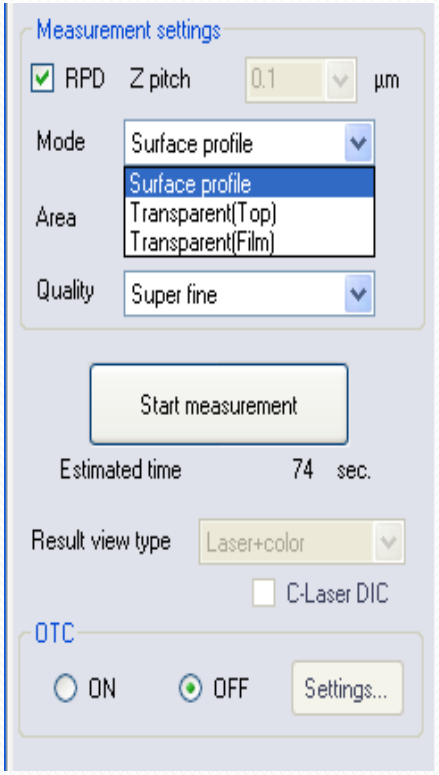
Expert Mode: Step 4 (Mode)



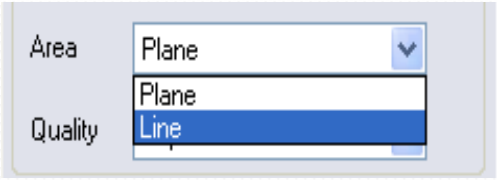
Surface Profile:
Measures one (1) peak that has the highest magnitude of received laser intensity

Transparent (Top):
Measures only the very first peak, despite magnitude or number of subsequent peaks.

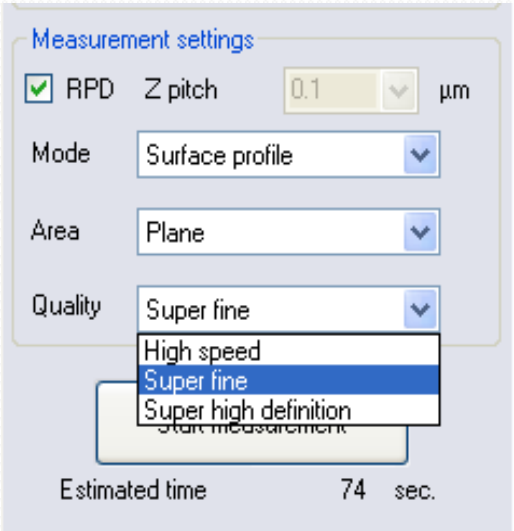
Transparent (Film):
Measures all subsequent peaks in order to quantify thickness of clear materials.



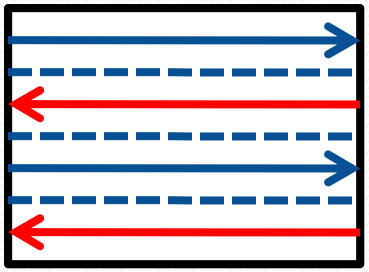
•Expert Mode: Step 4 (Area/Quality)



Determine whether the laser rasters across the entire field-of-view or just one line of pixels



Laser Raster

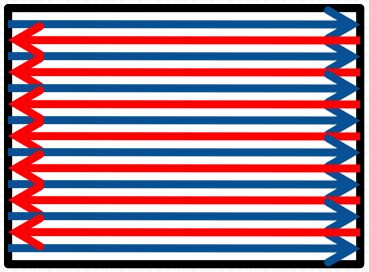


High Speed:
Left-to-Right, skip a line,
Right-to-Left, skip a line
1024 X 768

Laser Raster

Super fine:
Left-to-Right, Left-to-Right
1024 X 768

Laser Raster



Super high definition:
Left-to-Right, Right-to-Left
2048 X 1536