COVALENT METROLOGY



COVALENT ACADEMY Q&A

Episode 3: Optical Profilometry – Surface Roughness Characterization for Smooth Operators

Presented By: ***Matt Wong, PhD***

Director, Optical Imaging,
Covalent Metrology

01 You noted the (x,y) and z resolutions for each of the techniques. what is the difference in the maximum z-range for each?

In the current configuration, the Zygo ZeGage Plus is ~10mm, the Keyence VK-X1100, is ~7mm, the Keyence VR-5200 is ~65mm, and the FRT MicroProf is ~3mm. This depended on the magnification and the working distance of the objective. Each can also be configured to achieve greater z range, but it depends on the application. These are the objective travel ranges, but in general practice we would not use the scopes to these limits as the measuring times would be very long.

® 2021 Covalent Metrology Services, All rights reserved

02 **Has any one used chromatic dispersion for 300mm wafer bow measurement?**

Yes, our instrument in-house is limited by a 200mm stage. However, we have access to one that can measure a 300mm wafer

03 **Is there a handheld machine that can scan the datum with hard to access area?**

It depends on the parameter of interest on the datum. If it is surface roughness, there are handheld stylus profilometers. If it is a reference datum for flatness, that would be near impossible.

04 **Can you comment on the difficulties to measure transparent surfaces when sub micron z height information is desired?**

If ALD or thin deposited coating can be applied to the surface, it is possible to create a uniform coating that is reflective enough for the optical instruments. Also, depending on the optical properties, the Keyence VK-X1100, Zygo ZeGage, or FRT Chromatic Dispersion can sometimes register a signal from transparent substrates.

05 **Please re-iterate differences between laser confocal and traditional confocal. What is the advantage of using a laser?**

For the VK-X1100, the light source is a 404nm laser. The shorter wavelength of light in comparison to white light for example will have a smaller spot size.

06 **Can these methods be used to measure thin film thicknesses?**

Yes, it is possible but you will likely need to know the refractive indices of the material. The Keyence VK-X1100 and FRT Chromatic Dispersion can be used to measure thin film thicknesses. The basic principle used is that there is a measurable signal off both the front and back surfaces of the thin film. Our experience with using these techniques for thin film thickness is mixed, however. The film must be transparent, first of all. Beyond that, it generally only works well for homogenous thin films with very planar interfaces. The accuracy and resolution is not as good as ellipsometry, which is a much better instrument/technique to use.

® 2021 Covalent Metrology Services, All rights reserved

07 What is the max lateral resolution for WLI? I saw 160nm for Zygo, which i believe is below light diffraction limit, is it true?

160nm is the pixel resolution of the CCD for the highest magnification objective we have on the Zygo ZeGage Plus. Resolution is determined by the optical system with respect to the wavelength of the light used and the NA of the final lens. 160 nm (1600 Angstroms) is the field of view divided by the pixel size and is not the actual optical lateral resolution. This type of calculation assumes an isolated feature in a wide plane using phase contrast. For a more detailed explanation
https://iopscience.iop.org/article/10.1088/2051-672X/4/2/024004/pdf

About Covalent Metrology

Covalent Metrology is an advanced materials science and analytical services platform headquartered in the heart of Silicon Valley.

We succeed through a unique combination of cutting-edge analytical instruments and a world-class team of scientists: enabling us to provide our clients actionable, accurate and affordable data and insights to accelerate the development of product and technology innovations.

Get a quote at covalentmetrology.com

® 2021 Covalent Metrology Services, All rights reserved