COVALENT METROLOGY

COVALENT ACADEMY Q&A

Episode 2: Surface Roughness 101 – Which Technique is Right for You?

Presented By: *Chris Moore, PhD*

Vice President of Technology, Covalent Metrology

01 **Does 275 customers mean companies or individuals?**

Companies

02 **What about the profilometer with a stylus?**

This is covered later in the presentation

03 **For white light interferometry, by high resolution how high would that be spatially?**

Chris will present the answer later in the presentation. He will cover both lateral and vertical. It depends on which lens is chosen and this is covered in slide 27 and will discussed in more detail next week.

04 **AFM was already explained by Dr. Moore, thanks**

You are welcome

05 **What would you recommend to be effective in measuring surface features in a optic piece, that is about 4 inches in diameter? The surface has been abliated in an unpatterned fashion.**

As Chris has indicated: it depends. It depends on what you are trying to learn about your sample. We might recommend Chromatic Dispersion, AFM, or Laser Confocal. I would use a chromatic dispersion but it depends on what spatial and vertical resolution you need and over what area.

06 **Consideration: also x-y-resolution should be important here (as you mentioned before)'-- regarding "how do you choose a technique"**

Yes it is and you will find that information in the “horizontal” chart in the presentation. It will also be covered in more details in Episodes 3 and 4

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07 **For AFM at Nanometer Z resolutions, SVOCs that are common in ambient air, like DOP, DBP, Silicones, BHT, Caprolactam can adsorb, and should then give false positive Z height error. Shouldn't AFM be run under w C filter, ULPA, for SVOC, nanoparticle control. Is this commonly done or not?**

Although environmental contamination of a surface can affect the results it is normally not a problem for Roughness as it is often in the sub- monolayer regime. It is a more significant problem for surface chemistry and composition. Placing a sample is UHV does not guarantee you have a clean surface.

08 **Hi Doris, will the slides be available later?**

Yes they along with this Question and Answer session will be available on our Covalent Community site.

09 **Roughness is very important for Silicon wafer if etch on back side. How can I decide about roughness to my Silicon vendor?**

Silicon wafer roughness is normally measured using with AFM or white light interferometry.

10 **Don't most AFMs handle roughness up to approx 5 microns?**

It can, but other techniques might work better and faster at that level of roughness. For example, the laser confocal might give equivalent results more quickly. Depends if you are quoting Ra then the excursion are at least 3x that number which is beyond the range of most AFM's. If you are quoting peak to valley you are correct.

11 **Is slide 27 comparing field of view dimensions or the x-y resolution of the different techniques?**

For an imaging system the two are tied together. For a scanning probe system they are decoupled. This slide covers the range of features that can be observed.

12 **What do you think about the surface roughness that can be measured by ellipsometry? Is it useful?**

It can be very useful if you are looking to ranks surfaces. However, it is very difficult to correlate with other direct techniques.

13 **Would it be possible to touch again into Covalent interpretation of the different roughness parameters?**

Hopefully I did that but if not please contact me to discuss

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14 **This was super helpful and answered many questions I've had in a long time. Are these slides going to be available for download or viewing later?**

Yes they will be available on our Covalent Community site.

15 **What would ellipsometry methods for roughness look like in terms of reliability when compared to other techniques such as AFM or XRR?**

If the samples are similar they are very reliable. If the samples change and you need to remodel you can have difficulty.

16 **Do you care or measure changes in interfacial free energy changes enduced from roughness?**

This can be measured qualitatively, but need to keep in mind surface tension depends on equilibrium with the environment. Need to be able to manipulate and control environmental conditions: dry, humid, etc.

17 **Will I get these slides after the presentation only for my reference?**

Yes they will be available on the Covalent Community site

18 **Are there preferred/common methods/values (for example you mentioned Rz can be a good cross check for Ra measurements between samples for some techniques) used to cross-check certain roughness measurements, if so, is it often instrument specific?**

Considering that how Rz is calculated can differ from instrument to instrument it is difficult to use Rz. Since ra often depends on the length of scan you need to make sure you are comparing similar scans. In short yes it is very instrument dependent.

19 **One of your slides Ra and RZ but how can I get which one is important Ra or Rz?**

Both are important and which is more important depends on your process needs.

20 **Is any other technique available other than AFM to measure sub nm surface vertical roughness?**

Closest for a flat sample is White Light Interferometry but be careful on transparent materials.

21 **When is the recorded Webinars available? It will be good to revisit and watch the series at later time.**

It will be available by Monday of the next week on the Covalent Community site.

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22 **How to correlate XRR surface roughness vs AFM surface? How to distinguish vertical and horizontal surface roughness in XRR technique?**

The length scales are so dramatically different that AFM senses the roughness over top of the XRR roughness periodicity unless there is perfect lateral uniformity (AFM ~ums, XRR ~cms). So XRR would pick up rolling ocean waves of roughness while AFM would pick up the choppiness of the surface of a single wave. XRR can't distinguish between vertical and horizontal roughness and is actually picking up on electron density changes, so the surface can be perfectly smooth while the XRR roughness is nonzero due to electron density non-uniformity.

23 **AFM is typically used to investigate the surface height. is AFM calibrated in X Y so that feature width or pitch could be measured with an AFM?**

We use VLSI standard calibration samples to calibrate X, Y, and Z.

24 **What is the limitation of AFM? If the sample emit lot of 2ndary electron you need an ionizer to improve the roughness? What kind of AFM you have in covalent metrology?**

Several limitations: tip radius limits spatial resolution (best is about 8 nm), maximum scan size is small, and often requires careful operation and analysis. These will be discussed in more detail in episode 4 of the webinar series. Samples with static charge should be de-ionized prior to imaging to avoid discharge and damage the electronics of the scanner. At Covalent we have a Bruker Dimension Icon, Bruker Fast-scan with Scan Asyst, and soon to have a Anton Paar Tosca 400 AFM.

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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.

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