LIS - Frequently Asked Questions

What is confocal imaging?

Confocal imaging is the technique whereby the observer only sees things that are in a very narrow depth of focus. Anything that is above or below the focal plane (out of focus) is eliminated. In other words, you are only looking at a very thin focused "slice" of your wafer. The advantage of this is a clearer image (better signal to noise ratio) since the out of focus light (noise) is eliminated while the focused light (signal) is kept.

Why do you use a laser?

The laser is a monochromatic (single wavelength) light source whereas traditional white light is polychromatic (many wavelengths). This means that the confocal system can be optimized for a single wavelength rather than compromised for many wavelengths. In other words, we can achieve better resolution with the laser since the optics can be utilized near its theoretical maximum. The laser also provides for a more intense, brighter light source which is crucial in confocal systems which are inefficient vis- -vis light utilization.

Does your system have white light confocal?

No, only the laser imaging utilizes confocal technology. The white light portion of our system utilizes research-grade, non-confocal microscopy. Since the resolution of laser confocal exceeds that of white light confocal (not to mention its other imaging advantages), we felt the white light confocal was not a worthwhile feature.

How do you make a 3D image?

As discussed earlier, the confocal technology allows us to view narrow slices of focus. Therefore, one can imagine that as we move the wafer in Z (vertically) through focus, we are imaging a series or "stack" of narrow slices. To make a 3D image, we quickly store into computer memory 64 image slices at 64 different Z positions. After the data has been acquired, the computer reconstructs the 64 slices into a neat little stack. Moreover, since the reconstructed 3D image is in computer memory, it can be fully manipulated and analyzed (e.g. tilted, rotated, cut) for an increased understanding of your defect. This technique is not unlike that used by the medical imaging industry.

Do you tilt the sample?

No. All imaging is done normal (90) to the wafer plane. However once an image is acquired and stored into computer memory, it (the image data) can be rotated/tilted to the operator's content.

How many slices do you take? What is the thickness of each slice?

When obtaining either of our "surface" or "volume" images, the system is set at a default of 64 slices (this value can be increased to 128 if the operator so chooses). Slice thickness is automatically determined by the Ultrapointe. During an automatic image acquisition sequence, the system will determine the optimum start depth and finish depth; subsequently it will divide that distance by 64 to determine the slice thickness. The minimum slice thickness is 120 Angstroms (0.012µm).

Who makes your optics?

The objectives, turret, and lamphouse are manufactured by Olympus (pre-assembled). Additional optics are added for the laser confocal portion which are designed by Ultrapointe.

Does the system have darkfield capability?

Yes, the system has darkfield capability for the white light portion of the system. Please note that special darkfield objectives must be used in order to take advantage of this feature. Of the objectives which are offered on the Ultrapointe, only the 5X, 20X, and 50X objectives have darkfield capability. The 100X and 150X are brightfield-only objectives. We opted for brightfield only in the high mags because brightfield/darkfield objectives have poorer resolution than brightfield-only objectives.

What is your resolution?

Unlike traditional microscopes which can only provide a "top view", the Ultrapointe can see in all three dimensions - namely - the X, Y, and Z dimensions. Therefore, when specifying laser confocal resolution, we must provide the traditional top view resolution (or "XY resolution") and a "Z resolution" which quantifies our ability to detect small variations in height. The XY resolution of the Ultrapointe is approximately 0.15 m. The Z resolution of the Ultrapointe is 300 (0.030µm) based on our ability to see the reflected intensity variations associated with such a step height.

How big is the confocal pinhole?

The confocal pinhole diameter is 25µm.

What is your laser spot size?

Laser spot size is defined as the diameter of the laser beam at the wafer surface. When using the 488nm wavelength and the 100X objective, our spot size is approximately 300nm in diameter.

What kind of laser do you use? Will it damage the wafer?

The Ultrapointe uses an air-cooled, Argon-ion, gas laser rated at 25 milliWatts cw (Uniphase model no. 2014). The laser tube is designated as Class IIIa however the entire system has been approved as Class I by the FDA. In normal operating condition, the laser is typically running at an 8mW level. However even at full power, the laser will not cause any harm to your wafer. Incidentally, the laser produces three wavelengths - 458nm, 488nm, and 515nm - any of which are selectable by the operator.

What is the laser lifetime?

Ultrapointe waranties the laser for one year although our field data is showing a life expectancy of 18 months. Moreover, the customer has the ability to check the laser life via our software. Thus we will know months in advance of an impending laser failure.

Can the customer change the laser?

No. Changing the laser requires precise optical alignment which can only be done by factory authorized service engineers.

What is the maximum magnification?

We are reluctant to specify magnification because it does not reflect resolution. Increased magnification without an increase in resolution is often referred to as "empty magnification". For example, using a 20-inch video monitor results in higher magnification when compared to a 13-inch monitor, however there is no increase in resolution. Nonetheless, we will acquiesce. When using the 100X objective, the white light magnification is approximately 4,400X when displayed on our 13-inch video monitor. The laser image has a maximum magnification of approximately 20,000X at the same objective when displayed on our 20-inch computer monitor.

What is the field of view?

The laser image field of view (at 100X) is variable from 50 x 50 m to 6.25 x 6.25 m. The white light field of view at the same objective is 60 m horizontal by 45 m vertical.

What is the Integrated White Light Option?

The Ultrapointe has two types of images: (1) traditional white light images which are obtained from a CCD camera and displayed on a color video monitor, and (2) laser images which are displayed on the system's computer monitor. The Integrated White Light (IWL) option allows the user to display the white light image on the computer monitor. Thus a user with the IWL option would have a total of three images: (1) the white light image on the video monitor, (2) the same white light image on the computer monitor, and (3) the laser image on the computer monitor...all simultaneously! Further, the IWL option allows the user to digitize or "capture" white light images so that they can be stored as computer files. This is desirable for any customer who wishes to create a defect image database. Lastly, with the IWL option, the laser image and white light image can be printed on a single page with our optional Codonics digital printer.

What do the different colors in the laser image represent?

Since we use a single wavelength when scanning with the laser, the actual image data that is fed to our computer is monochromatic ("black and white"); not color. Thus regions with the greatest reflectance would be white and those that absorb the laser light would be black (with varying shades of gray in between). However the human eye has difficulty when it comes to discerning very subtle changes of gray. Thus in an effort to aid the human eye, Ultrapointe uses a "color map" which assigns a different color to each different shade of gray. By doing so, the user can quickly discern subtle changes in reflectance which are often associated with material changes. Note that if the user does not like our "false" color, then he/she can simply click on a button with the mouse to switch to a monochromatic image.

Do the colors represent material differences?

As previously mentioned, different colors represent different reflected intensities. However in practice, different materials will typically reflect a different amount of light. Metal, for example, will reflect more light than oxide. Thus when reviewing wafers with laser confocal, it is not uncommon to make conclusions about defect composition based on color by comparing it with the colors of the surrounding device features.

How long does it take to tilt and rotate an image?

Once the defect has been "scanned" to make the 3D image (a 10-second process), the image data is stored in the computer's RAM memory. Thus all subsequent image manipulations (e.g. tilt, rotate, zoom) are a function of the workstation's processing power and graphics display speed.

It should be mentioned at this point that 3D images can be displayed in two modes: low resolution and high res. High resolution mode displays the image with all the data that was acquired during the original scan (usually 512 x 512 x 64 pixels). This is an enormous amount of data and thus the time required to display the image on the screen is relatively long (12 seconds for the model 1010). This can seem long to someone who simply wants to tilt and rotate an image. As a result, all 3D images are first displayed in low res mode. Low res mode displays only one-fifth of the original scan data. In doing so, the display time is drastically reduced to less than 1 second. Now the operator can quickly position the image in the desired orientation (vis-   -vis tilt, rotate, zoom, cut, etc.) and then press the "Hi-Res" button to display the image in all its glory.

How long does it take to change wafer size?

Less than 1 minute! Our cassette interface plates possess special ID cutouts on their back side which specify the wafer size. When an interface plate is placed on the system, the system instantly detects the plate ID and automatically configures itself for the corresponding wafer size. Moreover, precise locating pins prevent the user from inserting the plate incorrectly. Lastly, if the wafer size should be changed, the software will ask for confirmation from the operator that the plate has been changed prior to loading the first wafer

What is the throughput? Can I observe 200 defects per hour?

Throughput is very difficult to quantify on review stations because the classification process requires human decision time. We can only specify throughput for those processes which we have control over...namely wafer transport and autofocus. It takes about 45 seconds to load a wafer, deskew, and go to the first defect. After that, the machine requires just under 2 seconds to move to the next defect and focus. Therefore 200 defects would consume a mere 7 minutes of "transport & focus time". The remaining 53 minutes could be used by the operator to decide each defect's classification (approximately 16 seconds per defect). This is more than enough time given that most experienced operators can classify a defect within three seconds.

Are you compatible with automated wafer inspection systems?

Absolutely...it's the primary application of our system. Currently we can read from, and write to, automated wafer inspections systems manufactured by KLA, Tencor, Inspex, OSI, and Hitachi. Moreover, we have special agreements with all these companies which ensure that we have access to the latest revisions of their file formats. If you have a machine from a supplier not mentioned above, then please let us know and we will work with them to achieve full compatibility.

Can I store defect images in an image database?

Yes. All Ultrapointe laser images can be captured and stored in either TIFF or JPEG format. TIFF is a commonly recognized storage format that is accepted by both the KLA and Tencor image databases. White light images can also be captured and stored in TIFF format if either of our Integrated White Light packages is purchased. The Ultrapointe can also automatically link defect images to the wafer map per KLA and Tencor specifications.

How big are the image files?

There are three different types of image files that can be saved on the Ultrapointe: (1) Surface image files, (2) Volume image files, and (3) TIFF image files. Surface and Volume files are stored in an Ultrapointe proprietary format; TIFF images are stored in the common Tagged Image File Format. Surface image files are 525-Kilobytes and Volume image files are 16.8-Megabytes. TIFF image file sizes vary depending on how the image was captured. If you capture an image in a small window, the TIFF file will be small. Likewise if you capture a full screen image, the file can become very large. To calculate the file size, simply use the following formula:

File Size = (X-resolution) x (Y-resolution) x 3

For example, a 512 x 512 image stored in TIFF would be 512 x 512 x 3 = 786,432 bytes = 786KB.

An important note about file types: Surface and Volume files contain the original data used to construct the Ultrapointe image. Thus when one loads a Surface or Volume file, the image can be displayed in its original clarity and it can be fully manipulated for further analysis (e.g. tilt, rotated, zoomed). A TIFF file is a "snapshot" of an image. When it is redisplayed, it cannot be manipulated in any way...it is "frozen". However the advantage of the TIFF file is that it is compatible with most other software programs

Do you have SECS compatibility?

Yes. We provide both GEM/SECS capability via RS-232 or per the new HSMS standard which uses Ethernet.

Why do I need 2 printers?

Ultrapointe offers two printers...a Sony analog printer and a Codonics digital printer. The analog printer is used to print white light images which come from our color CCD camera. The digital printer is used to print everything on our computer screen which includes the laser image. If you already have an analog printer, you could potentially use it to print our white light images.

Can the customer change the Halogen lamp? What is its lifetime?

Yes, our customers are trained to change the Halogen lamp and it is a relatively easy procedure. As for longevity, 4300 hours reflects the average life that we are seeing in the field. Actual lifetime will vary depending upon operating conditions. The failure mode is instant as with your regular household light bulbs.

If I lose power during operation and restart the system, what happens to the wafers?

Don't worry, your wafers will be safe. After initialization, the system will check to see if any wafers have been left on the stage, prealigner, or robot. If it detects a wafer, it will notify the operator and ask if it is okay to unload it. If the operator selects "yes", then the system will ask which wafer slot to return the wafer since the cassette may have changed during the power outage.