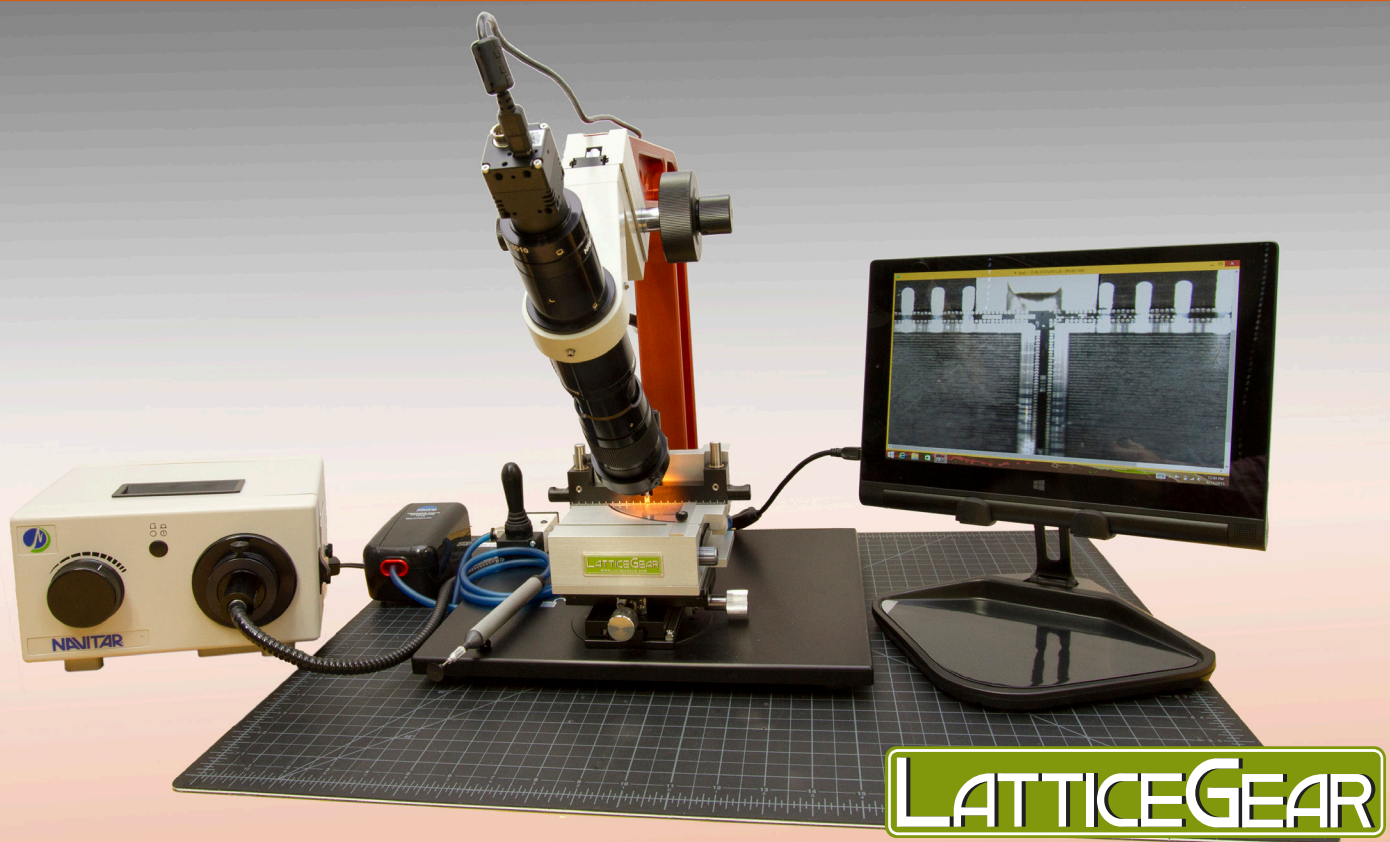


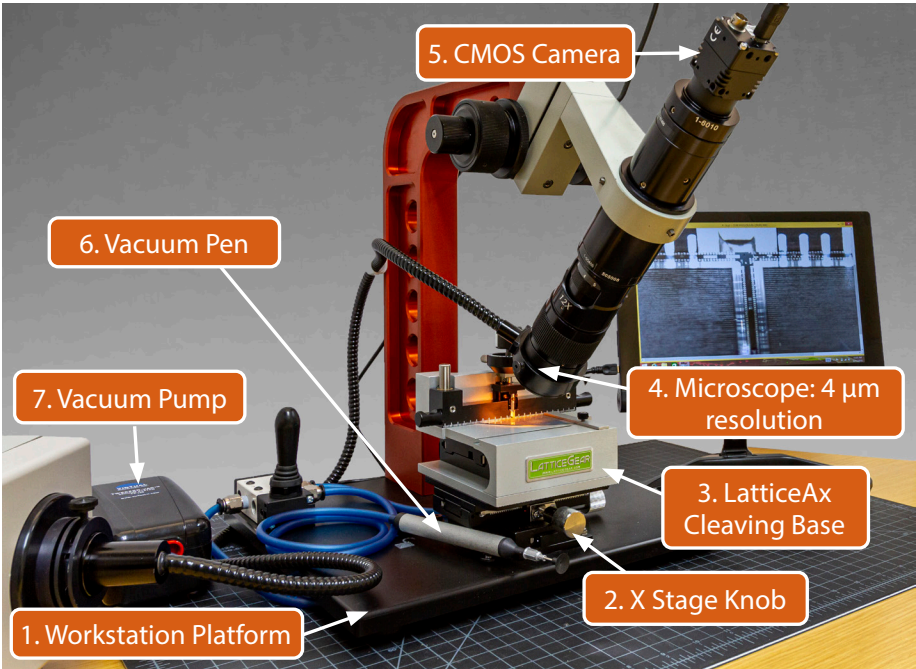
LatticeAx[®] 420 Cleaving System

Operation Manual



LatticeAx 420 Cleaving System Overview

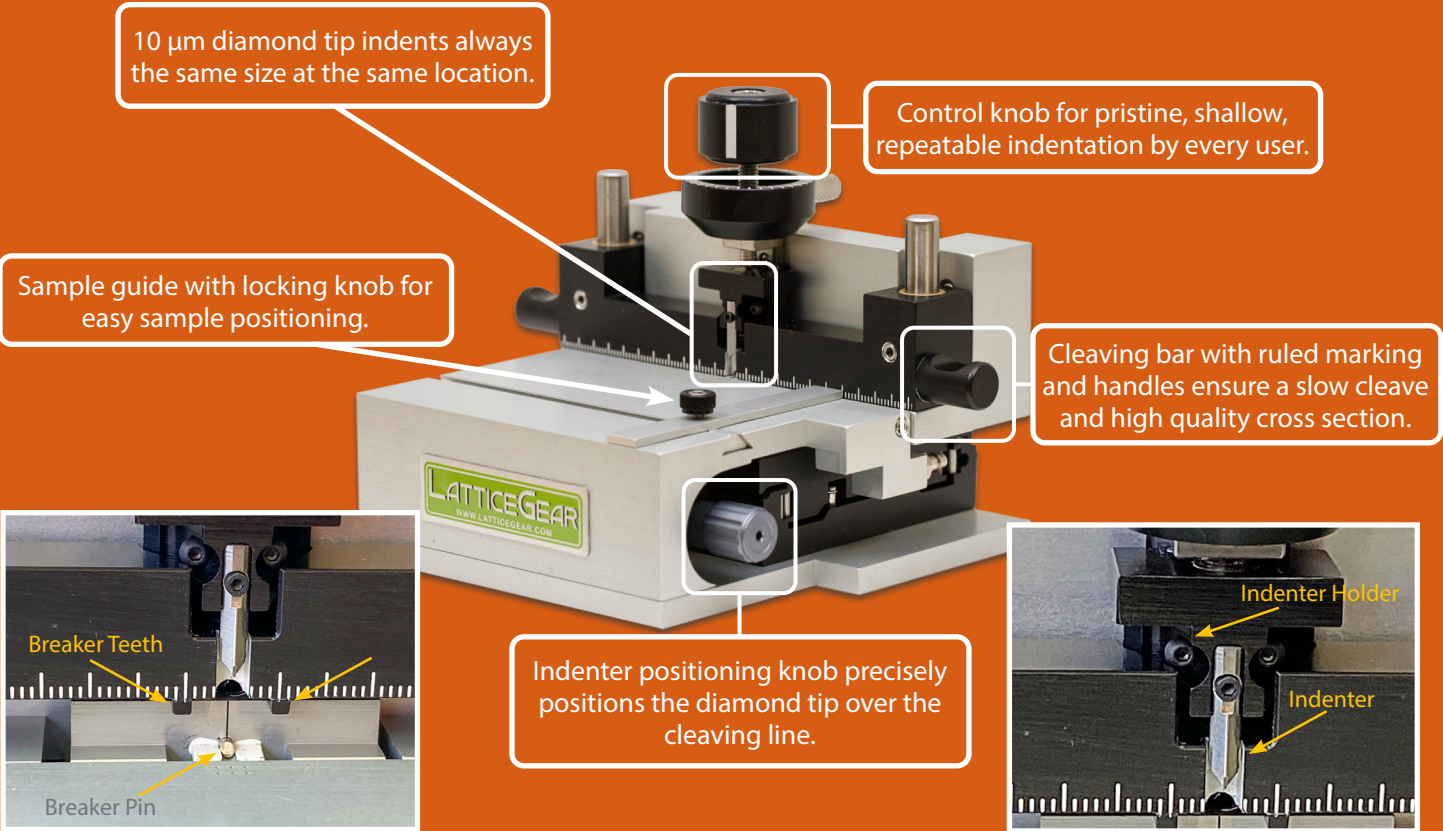
- 1. Workstation Platform
- 2. X Stage Knob
- 3. LatticeAx High Accuracy Cleaving Base
- 4. Microscope: 4 μm Resolution
- 5. CMOS Camera
- 6. Vacuum Pen
- 7. Vacuum Pump



Computer/monitor not included

Get to Know the LatticeAx Cleaving Base

Familiarize yourself with the cleaving base, including the control knob, the diamond tip indenter, the cleaving bar, the indenter positioning knob and the sample guide.



Getting Started: Camera

1. Turn on the computer and start the Sentech imaging software (StCamSWare). The software user interface will start but the image area will be dark (Figure 1).
2. Turn on power to the illuminator by pressing the small black button in the center of the control panel. Illuminate the sample by turning the intensity dial clockwise (Figure 2).
3. Turn the dial until the sample area is illuminated and an image appears on the display. If the image does not display, click menu Option – Live Video
4. To view the sample and locate the area of interest, the microscope has two variables, focus and magnification (Figures 3 and 4):
 - Focus the image by turning the bumpy dial on the microscope or use the coarse/fine focus mount on the microscope stand.
 - Change the magnification by turning the dial above the bumpy focus dial.

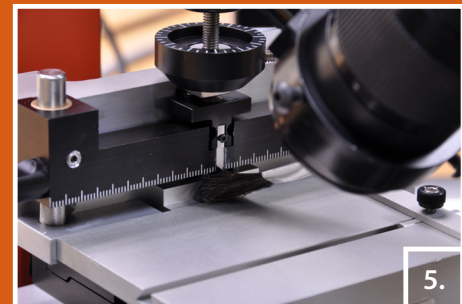
Tip: To keep the image of the sample in focus through the entire magnification range, follow this process:

- Set the Mag dial to the highest magnification
- Set the focus dial on the microscope such that it is the center of its range of motion.
- Focus on the sample using coarse focus (the large black dials on the focusing mount).

This will provide the best focus throughout the full range of magnification.

5. To operate the digital imaging software, review the section “Basic Features of the Sentech USB camera viewing software” on page 12 of this manual.
6. For detailed operation instructions refer to the Sentech USB Camera User Manual available on the memory stick provided.
7. Clean the stage (Figure 5), especially under the cleaving bar. Dust can disrupt the cleave quality and prevent the bar from sitting level. Use compressed air, a brush or the chamois-tipped swabs provided. If necessary, use isopropanol to clean the LatticeAx surfaces.

Make sure that all silicon particles are removed from the breaker pin region.



Getting Started: Using the Clock Dial and Indenter Knob

Samples of varying thickness and process levels require different indent depths to get the best cleave quality.

Indent depth (Z) is controlled by varying the # of turns of the indenter knob. This number is typically a fraction of a turn, $<1/4$ (3 hrs) turn.

To create a repeatable indent recipe, LatticeGear developed a simple clock dial that is used to calibrate the indent. Each long mark on the clock is 1 hour apart.

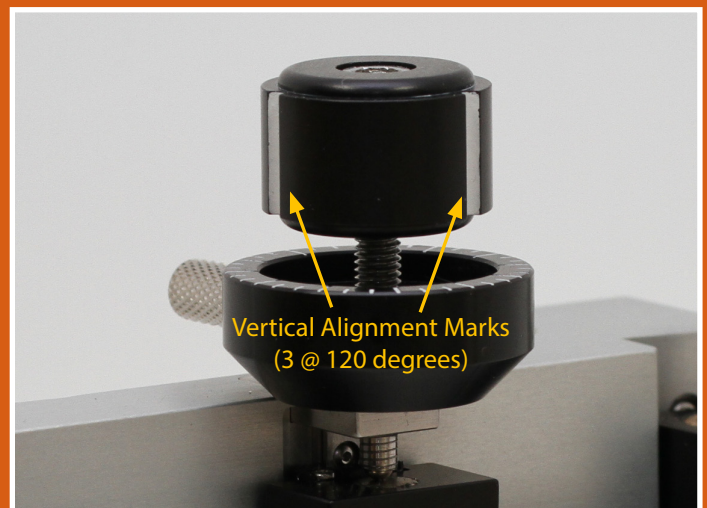
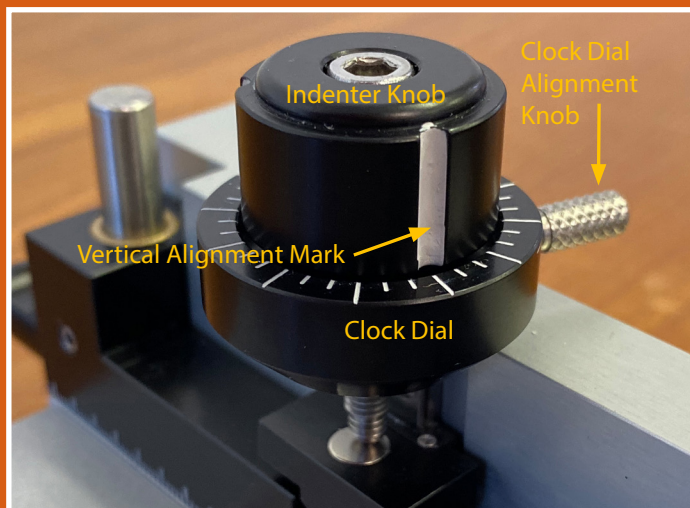
For a good cleave it is important to that the indent penetrate into the crystalline material. In general, thick and samples with metalization require a deeper indent (2-3 hrs) than thin (<500 microns) or front end samples (<1 hr).

How to obtain a repeatable indent

To make a repeatable indent first find the point where the indenter touches the sample surface. That becomes a reference point for "0" indent depth. From this point, turn the clock dial indenter knob clockwise to further lower the indenter in the Z direction, this makes the indent on the sample. Use the marks on the clock dial as described below to calibrate indent depth.

The clock dial rotates independently about the same axis as the indenter knob. The vertical alignment mark on the indenter knob can be aligned to a large mark on the clock dial creating a reference point for the indent. The reference point is relative to the position of the indenter knob when the diamond indenter is at the "0" indent depth which is equal to the sample surface.

Large increments on the dial represent one hour and the small increments 20 minutes.



Operating Instructions

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Appendix B: Basic Features of Sentech USB Camera Viewing Solution	12
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Position the Sample

1. Begin by making sure the breaker bar is down (Figure 6).
2. Center the diamond indenter by moving the indenter positioning knob (circled) until the center vacuum holes are aligned to the cleaving pin (Figures 7 and 8).
3. Set the sample on the LatticeAx with its front edge is flush against the cleaving bar (Figure 9).

Tip: Always start with a sample piece with a cleanly cleaved edge. The accuracy of the final cleave is largely determined by the quality of the first edge.

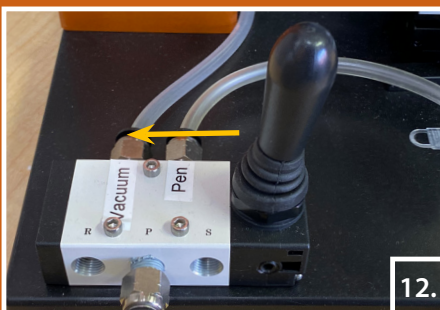
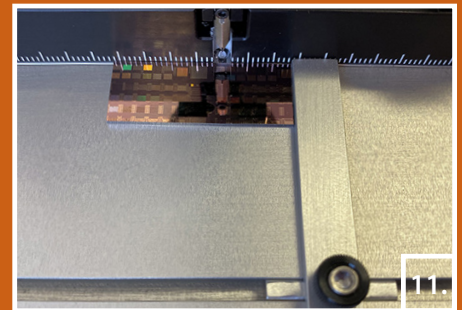
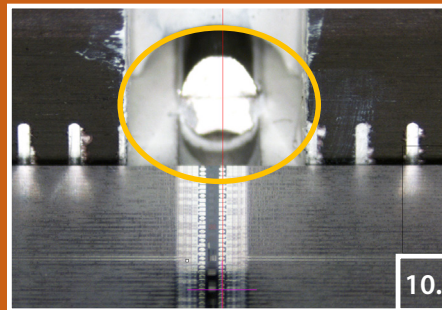
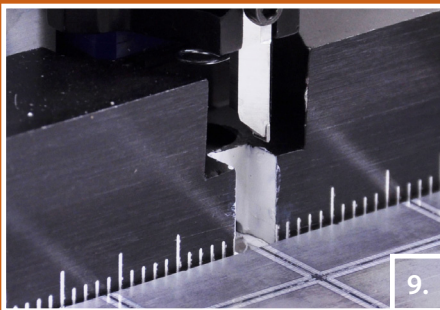
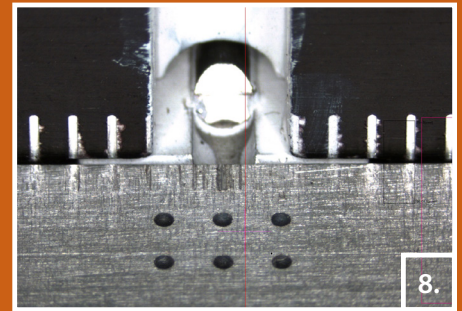
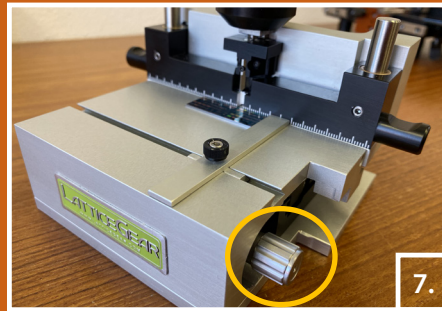
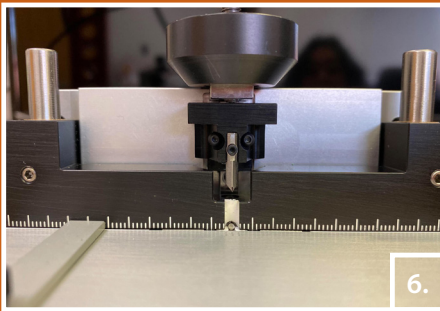
4. Coarse positioning
 - Manually move the sample so the area of interest (AOI) is in the cleaving zone (circled region Figure

10). It does not need to be in the center.

- Once set, move the guide so it is flush with the side edge of the sample. Lock the guide (turning the screw) to secure it in place.
- Make sure the front face of the sample is flush with the breaker bar
- Verify that your target is in the cleaving zone

5. Turn on the vacuum pump power.

Use vacuum to hold the sample in place. Push the switch to the VACUUM position (direction of the arrow) to hold the sample. To vent the sample and/or use the vacuum pen push towards the user to the PEN position (Figure 12).



Indent Prior to Cleaving

1. Lower the indenter by turning the indenter knob clockwise until it is in the field of view (Figures 13 and 14).
2. Position the diamond indenter over the sample by lowering the spring-loaded indenter holder (Z-direction) and turning the indenter knob until the diamond tip is close to the sample surface.

Tip: If you cannot see the indenter, go to a lower magnification and use the indenter positioning knob to move the tip until it is centered over the cleaving region.

Fine Positioning of the Area of Interest (AOI)

For small <20 micron targets go to higher magnification and position the feature in the center of the field using the cross hairs to align to the target (Figure 15).

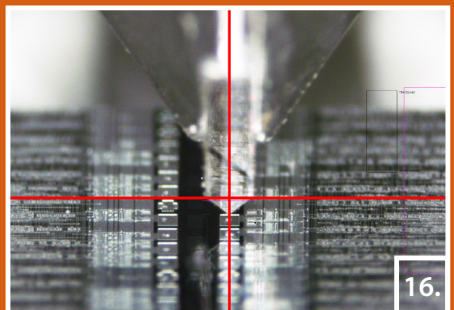
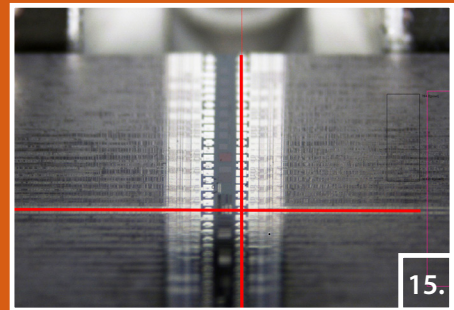
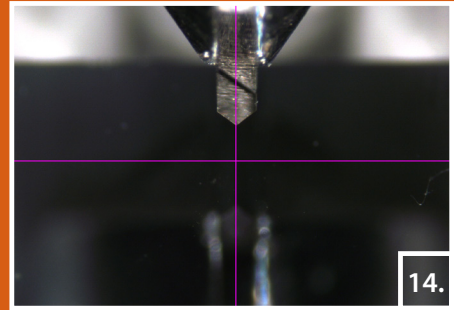
3. Focus the sample and continue to lower the indenter to the sample surface

Tip: You can use the mirror image to judge the tip distance to surface. When the actual image and reflected image meet, the indenter is touching the wafer surface. See the tips on “How to judge the indenter position prior to cleaving” on the following page.

Align the indenter tip over the cross hairs by turning the indenter–positioner knob located on the right side of the LatticeAx. Note that the apex of the knife defines where the indent will be made on the sample (Figure 16).

4. Go back and forth between positioning the indenter over the line and lowering the indenter onto the sample. When the indenter touches the sample, STOP. You will see the sample flex.
5. For a repeatable indent, align a vertical mark to a large mark on the clock dial by rotating the dial using clock dial alignment knob. Tighten the silver knurled knob (circled in Figure 17)
6. Turn the indenter knob (watching the reference line) 20 min. – 3 hrs. Each small increment is 20 minutes; the large lines are 1 hour apart.

Tip: If you are cleaving a sample for the first time start with 40 min to 1 hr. For tips on how to use the clock dial see the section on “Using the Clock Dial and Indenter Knob” on page 4.



Note: Different size / type of samples require different force. Silicon samples <400 μm thick and III-V materials require an indent of minimum depth ($\ll 1$ hr). Fully processed devices full wafer thickness (>700 μm may need 2-3 hrs to penetrate into the silicon. For most samples using one two “clicks” or lines on the dial will suffice.)

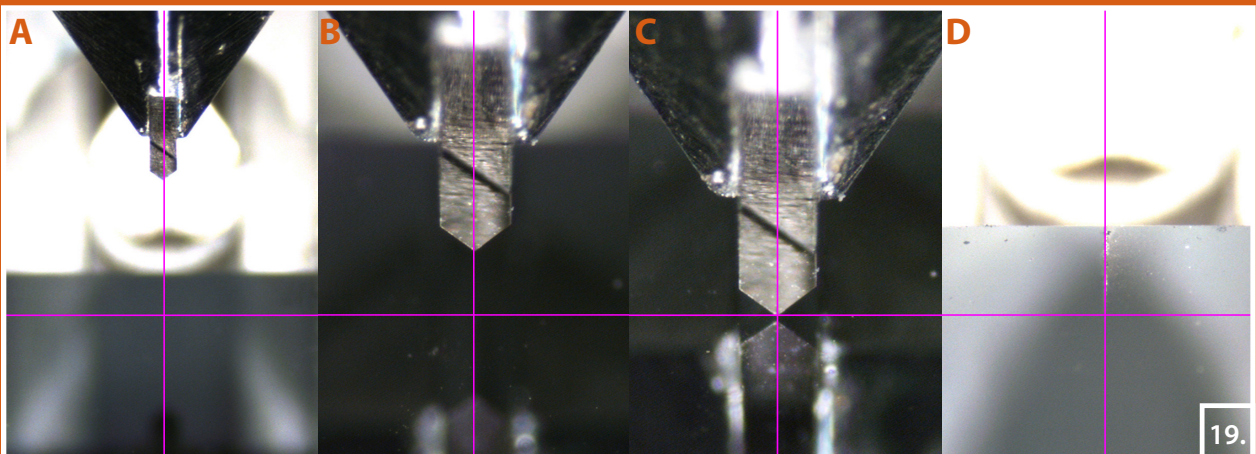
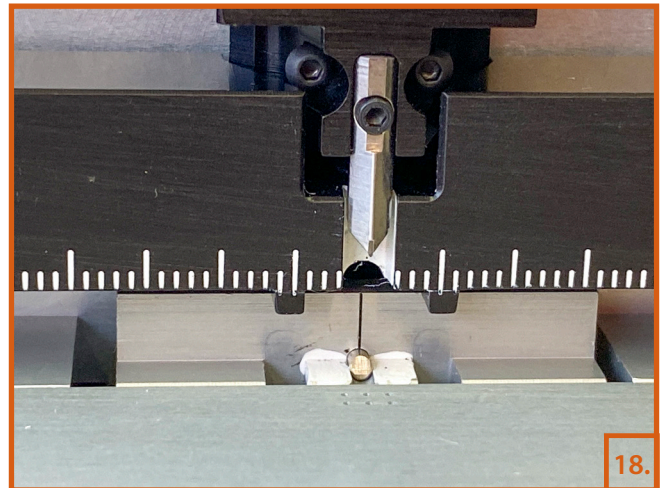
7. Raise the breaker bar. Turn the indenter knob counter clockwise until the indenter is no longer on the surface of the sample and the screw is in its metal housing. Use the handles on the breaker bar to lift it to the “up” position. It should stay up (Figure 18).

How to judge the indenter position prior to cleaving

The images below show the indenter as it approaches the sample surface (Figure 19A), just before tip touch-down (Figure 19B), at touch down on the sample (Figure 19C), and after indent (Figure 19D). The purple horizontal and vertical lines are useful as guides.

Align the target in the cross-hair and position the indenter with the indenter-positioning knob so it makes contact with the sample at the point of intersection.

To display the cross hairs, go to the Draw Properties Dialog as shown in Figure X and select the Grid tab. Select one horizontal and one vertical grid to get the cross hair to display.



Cleaving the Sample

1. View the indentation. The indent should extend to the edge of the sample. Figure 20, shows an indent on a piece of a patterned wafer.
2. Push the vacuum switch to the "PEN" position to vent the sample. **Do not release the guide.**
3. Position the sample for cleaving

Using the chamois stick provided or flat tipped tweezers slide the sample – while it remains against the guide – under the breaker bar until it is flush with the "back wall" and on top of the breaker pin (Figure 21).

It is very important that the indentation is aligned to the vertical mark on the back wall. The orange arrow points to the fine indent (Figure 22).

Tip: To position the indentation accurately, watch the screen and slide the sample.

If you kept the guide in place after indenting and used it to guide the sample to the back wall, the indent will be aligned with the vertical mark.

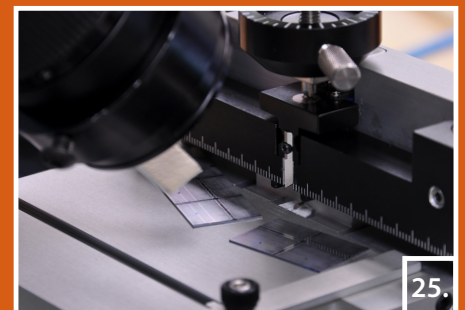
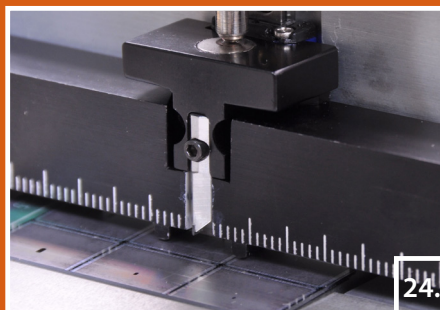
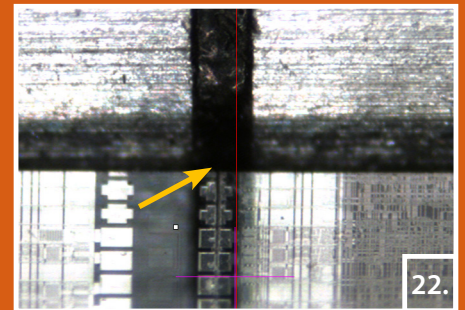
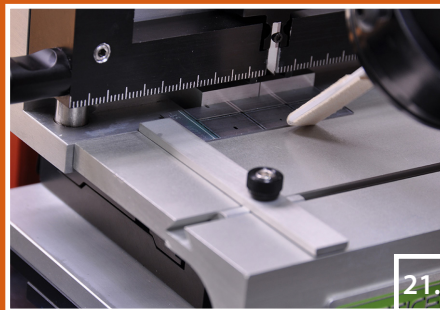
Note: This step is very critical because the accuracy by which you position the indent on the pin will determine

the quality of the cleave. If the side of the sample against the guide is not straight you will need to check the position of the indent plane.

4. Turn the indenter knob clockwise until the breaker feet land on the sample surface (Figure 23). You can position the real-time view to see the feet by moving the XY stage.
5. Release the guide.
6. Slowly turn the indenter knob turn the knob ($\lll 1$ hr turn); the sample will cleave (Figure 24).

Tip: If the indentation is good the sample should cleave easily, without excessive force.

7. Lift the breaker bar so it is not contacting the sample.
8. Use the vacuum pen, tweezers or the chamois tip sticks provided to retrieve your cleaved pieces and move them to the sample table



Appendix

Appendix A: Using the XY Stage Lock

The LatticeAx XY stage has been upgraded to support increased friction and stage lock for X motion. For high accuracy cleaving, and once the target is set, it is critical that there be no movement in the X direction during the indenting process. This can be achieved in two ways:

- Increase the friction (make it harder to move in the X direction) for X motion. The stage ships with a default setting;

Or

- Lock the X-axis.

Increasing the friction with the set screws allows the LatticeAx to be used normally and this should suffice in preventing the X-axis from moving during the indenting process. With the new stage lock it is also possible to lock all X motion.

Operation of the X-axis friction screws and stage lock

1. Changing the default setting of the X-axis friction screws (Figure 26).

The friction screws are located on the back of the XY Stage. Using a 5/64" allen wrench, tighten or loosen the set screws (circled in yellow).

The X motion should not be locked. When set correctly it will have smooth motion.

2. X-axis lock (Figure 27).

Reach to the back of the stage and turn the large black knob on the back of the stage clockwise. This locks the X-axis. When indenting is complete, remember to release the X motion by turning the knob counter clockwise until it turns freely.



Appendix B: Basic Features of Sentech USB Camera Viewing Software

Drawing tools (Draw Tab)

The drawing tools are always displayed below the menu items (Figure 28). Take a few minutes to draw graphics on the screen.

The default color of the graphic is black. Go to the Pen/Brush tab in the Draw Property dialog (Figure 29). Change the color of the graphic by double clicking on the pen color. A palate of colors will be displayed; select the desired color and click OK. The Pen/Brush tab also has line thickness and other features that can be changed, as well as the ability to save the configuration.

Burning the graphic on the image

When saving images, it is sometimes desired to burn in the graphic on the image. Go to the Global tab in the Draw Property dialog. Check the “Draw To Snap Shot” box.

Taking a snapshot and saving a single image

Click the “Capture” menu item (Figure 31). To acquire an image, click on “Snapshot”. This will put the image in the temporary buffer. You will need to save the image by clicking right on the image and saving locally or on your network.

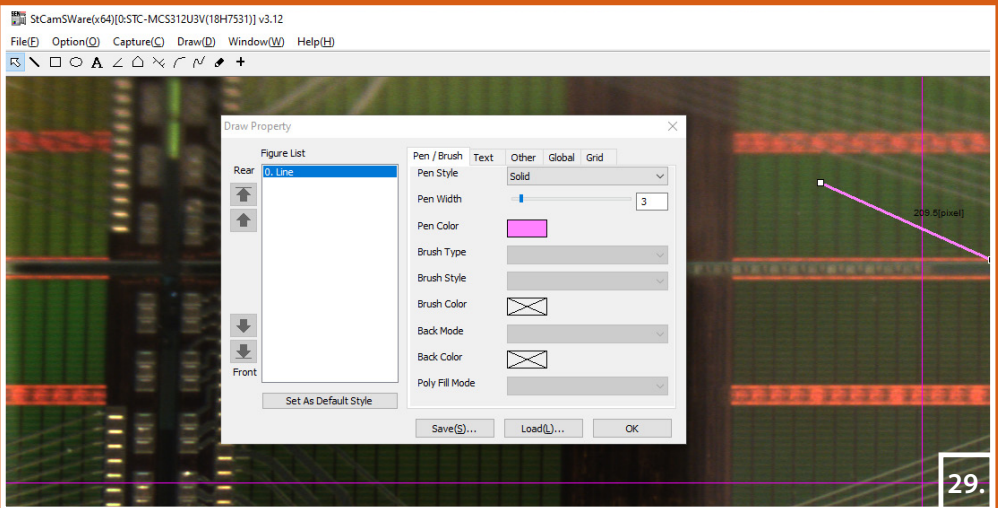
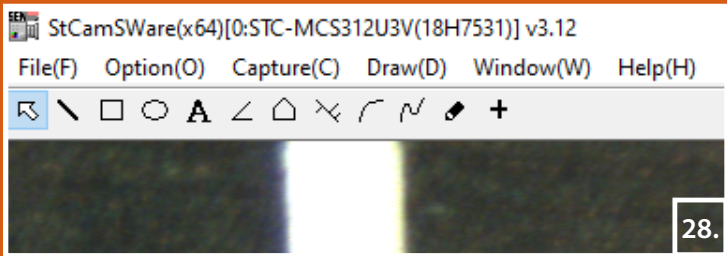
Note: when the user interface is closed, the images will be removed from the buffer. A dialog provides a warning prior to deleting the images.

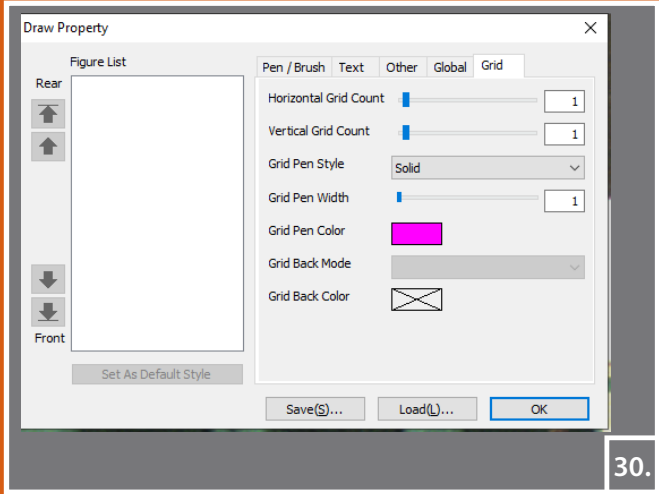
Capturing and saving in one click

When saving numerous images or just to be sure the images are saved, it is recommended that the “Direct Save Snapshot” feature be used (see Figure 31). First set up the desired image directory by clicking on “Direct Save Snap Shot Setting”. Select the image directory and then the path for the image. In the example in Figure 32, the images were saved to DropBox. Snapshot number was added to create the path and image sequencing. “Example” in the dialog shows the path of the image.

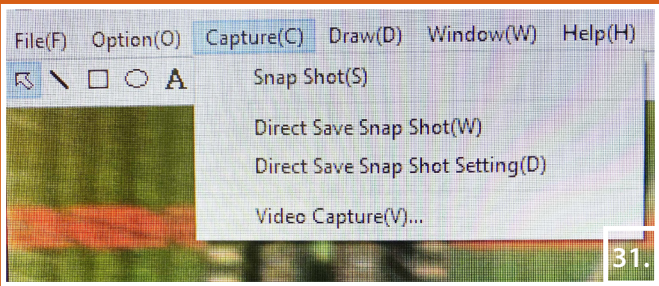
Setting the frame rate

The optimum settings for your camera are shown below in Figure 33. The Gain/Shutter menu shows the camera running at 1/25 clock speed. This is not required but is useful, as it will save lifetime of your lamp.

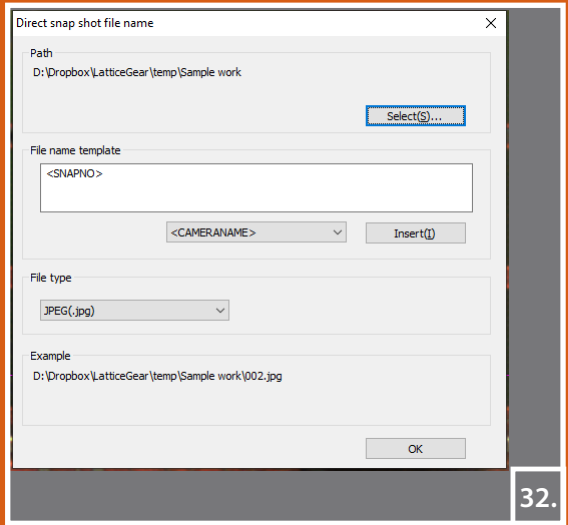




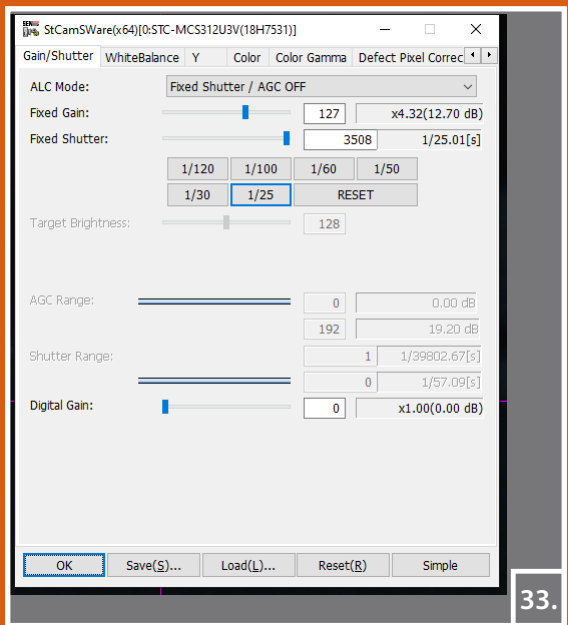
30.



31.



32.



33.

Appendix C: Adjustments and Maintenance

Replacing the Diamond Indenter

For instructions on how to replace the diamond indenter, watch the video at <https://www.youtube.com/watch?v=VZKquLCape0> or follow the instructions below.

1. Unpack the new diamond indenter. The package contains a diamond indenter with set screw and an allen wrench.
2. Remove the LatticeAx from its stage by gripping the tool on its sides as shown on the right. Rock it side to side while lifting to until it has detached (Figure 34).
3. Set the LatticeAx on its “back”, this makes it easy to access the diamond indenter set screw (Figure 35).
4. Remove the old diamond indenter:
 - Loosen the screw with the allen wrench provided until it is disengaged with the slot in the indenter holder and then slide the indenter out (Figure 36).
 - Store the old knife and screw as they can be used as a spares.
5. Install the new indenter.
 - Hold the new indenter by the screw and slide it into the slot in the indenter holder, flat side down, the screw will be facing up (Figure 37).
 - Tighten the screw with the allen wrench until it is secure.
6. Reinstall the LatticeAx on the X-Y stage by aligning the dowel pins on the stage with the holes on the base plate of the LatticeAx.

Adjusting Breaker Bar Movement

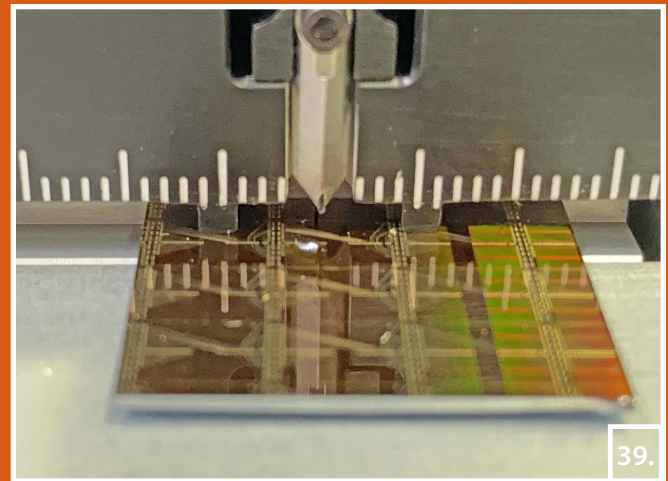
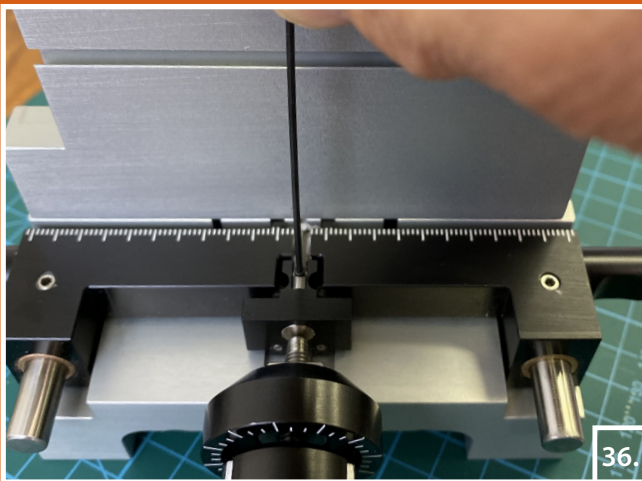
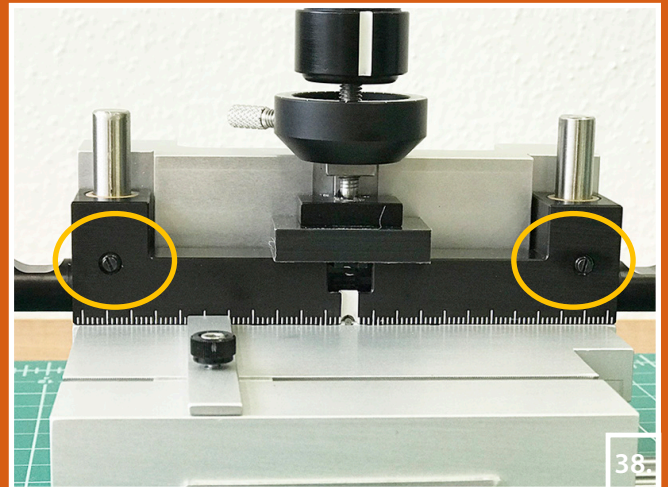
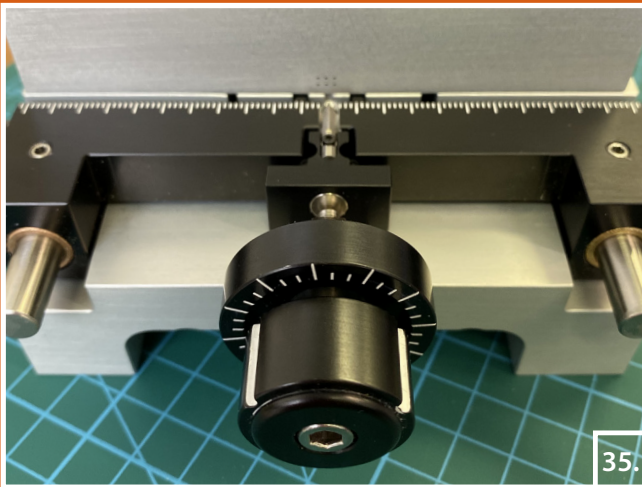
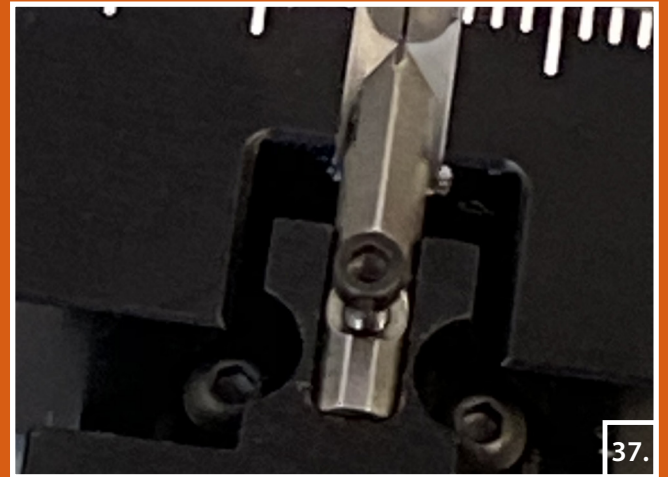
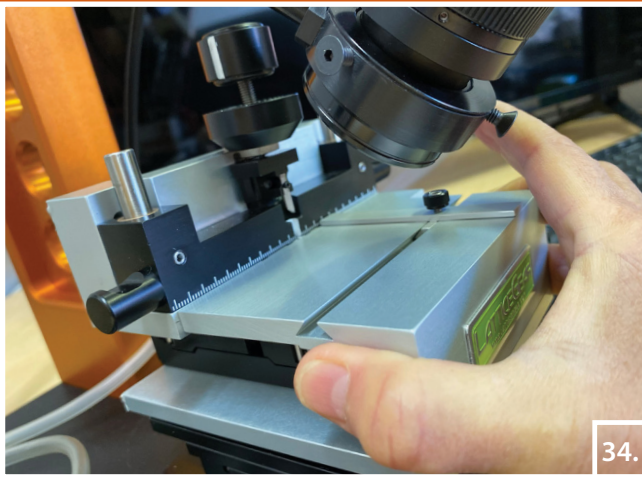
For repeatable, high quality cleaves it is recommended that the Indenter knob be used to cleave the sample in a controlled manner. The smoothness of the breaker bar movement is adjusted at the factory prior to shipment. It is adjusted such that the breaker bar will move smoothly and the breaker teeth will land on the sample without cleaving or otherwise damaging the sample. In addition, when lifting the breaker prior to cleaving, the bar should remain in the up position while positioning the sample on the breaker pin.

1. Using a slotted screwdriver (one was provided in Accessories and tools kit), loosen the two friction, set screws on the front of the breaker bar (circled in orange) until the breaker bar moves freely up and down (Figure 38).
2. Now adjust the friction by tightening the screws with the wrench until they are just touching the vertical posts. You will feel a resistance when this is the case.
3. Lift the breaker bar and put a test sample in the cleaving position
4. Turn the Clock Dial knob clockwise until the breaker teeth set onto the sample (Figure 39). If the motion is smooth the adjustment is complete. If not, repeat steps 2–4, either tightening or loosening the set screws until the motion is smooth. If you are having trouble adjusting, it may be useful to loosen the screws and start over and adjust the screws one at a time. Adjust one screw and then test and then adjust the other.

Cleaning the Cleaving Area

On a weekly basis it is recommended that the cleaving area be cleaned to remove particles that may interfere with the cleaving process.

Using compressed air, remove particles from the circled region. Isopropanol can be used for final cleaning.



Tools and Accessories Kit

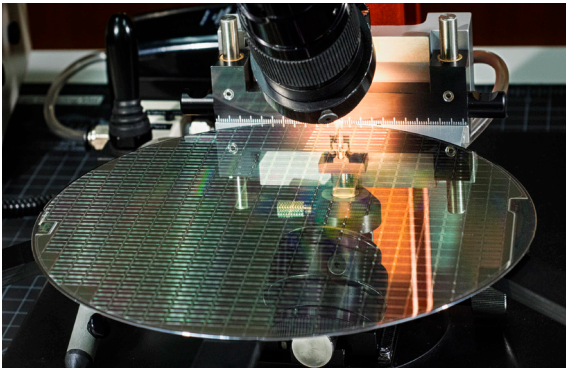
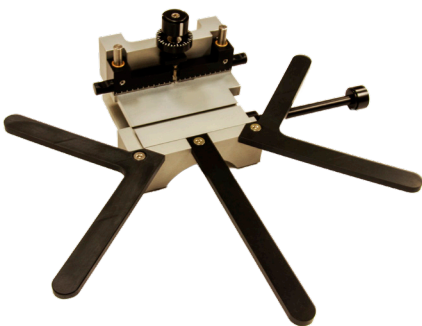
Included with the LatticeAx 420 is a bag of tools and accessories that will assist you in assembling the station, organizing your work area and achieving a clean, accurate cleave.

Tool	Use
Brush	Clearing dust and debris away from sample
Velcro	Securing vacuum pen to workstation platform when not in use
Cable ties	Securing cables
Tweezers	Rubber tipped, for non-damaging sample handling
Chamois Swabs	To clean around the cleaving area of the LatticeAx
Rulers	Metric and imperial/US units – one flexible clear and one slim metal
Allen Wrenches	
.05	Indenter installation
5/64	Adjusting the breaker bar
3/16	Adjusting the positioning guides
5/32	Adjusting the block to platform

LatticeAx Consumables and Options

Standard Microline Indenter (DK-K-101)	Diamond indenter standard with the LatticeAx
High Angle Indenter (DK-K-200)	Diamond indenter for high accuracy
Short Indenter (DK-K-101.5)	Diamond indenter shallow indents
Large Sample Platform (MC-LSPL-200)	Added support for wafers up to 300mm
LatticeAx Option Package (LGAX-OPT1)	Cleaving and scribing tools plus two standard indenters

Large Sample Platform: (left) on LatticeAx Cleaving Base; and (right) in use on LatticeAx 420 with 300 mm wafer.



LatticeAx 420 Set-up and Operation rev. 20-030620

