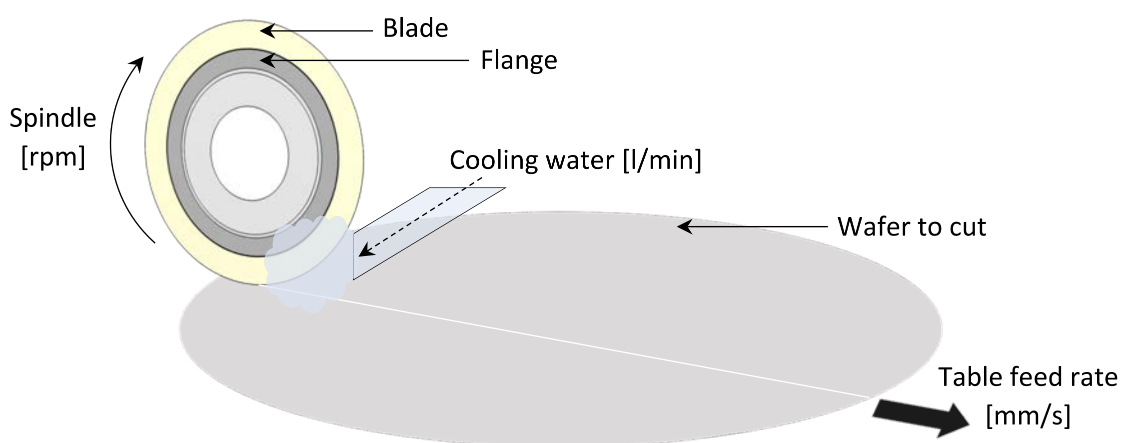
I. Dicing and dicing blades overview

Dicing is used for cutting partially (scribing) or completely (singulation) a wide range of materials such as semiconductor compounds, ceramics, various glass types, composites… If the blade and the dicing parameters are correctly selected according to the specificity of the material to cut, perfect edges can be created, even for very hard and brittles materials.

Dicing blades have diamond particles embedded in a bond matrix. They hold together with a binder of either resin bond (soft strength), sintered metal bond (medium strength) or electroplated nickel bond (hard strength). During dicing, each diamond particle embedded in the blade slowly breaks/shatters as it grinds away material from the substrate, and new particles captured in the matrix continuously offer new sharp point until the blade wears out. The concentration and the size of the diamond particles, together with the type and the thickness of the matrix, make the structure of the blades and have a direct impact on the finish quality of a cutting job.

As a consequence, the materials to cut will have a strong impact on the selection of the correct types of dicing blades.
For hard and brittle materials (e.g. sapphire), soft bond dicing blades, such as resin bond, are usually recommended, whereas a harder bond material, such as electroplated nickel bond, will be preferred for softer materials.
Comparatively to the material to cut, a bond matrix that is too soft may release diamond particles at an excessive rate and may wear out very fast (short lifetime). On the opposite, a bond matrix that is too hard will result in a low amount of released diamond particles and hence in low cutting ability; regular dressing of the blade will be needed to constantly expose next layers of fresh and sharp diamond particles.

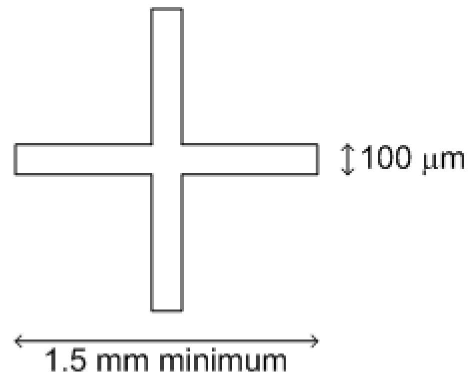
During dicing, the high rotation speed of the blade and the strong friction of the diamonds particles on the diced substrate generate an important amount of heat which is important to evacuate. Cooling water is supplied at close proximity of the dicing blade in order to thermally stabilize the process and to enhance blade lifetime.



II. Get your sample ready for dicing

- **Alignment marks**

For dicing across full length of the substrates and for properly aligning with the structures, it is recommended to have dicing aligning marks. To ease the alignment procedure, it is important to have the marks visible by eye. In order to nicely match the vision capacity of the dicing tool as well, do not exceed the following dimensions:



- **Surface protection**

It is heavily advised to protect sensitive structures that may be damaged during the process (water supply + creation of particles or "mud" during dicing).

Any AZ type photoresist works (AZ ECI, 1512, 9221, 9260), as long as thick enough to nicely cover the structures and as long as great care is taken to promote correct adhesion of that resist to the substrate. Poor adhesion of the resist on the substrate will lead to peel-off during the dicing process (because of the pressured water supply!) and will not help. An extended bake after spin-coating (5 @ 120°C) often helps improve resist adhesion.

When the dicing is complete, the protective resist is wet-removed into Remover1165 hot solvent. Wet removal of the resist allows to properly lift-off trapped particles and to recover a spotless surface after dicing.

III. Available blades and recipes at CMi

<table>
<tr><th>Blade #</th><th>Blade bond type</th><th>Blade thickness</th><th>Flange/blade outer diam.</th><th>Max allowed thickness to cut</th></tr>
<tr><td>1</td><td rowspan="3">Resin</td><td>0.25mm</td><td>51mm/56mm</td><td>1.5mm</td></tr>
<tr><td>2</td><td>0.07mm</td><td>51mm/54mm</td><td>1mm</td></tr>
<tr><td>3</td><td>0.25mm</td><td>50mm/56mm</td><td>2.5mm</td></tr>
<tr><td>4</td><td rowspan="2">Nickel</td><td>0.1mm</td><td>49mm/52mm</td><td>1mm</td></tr>
<tr><td>5</td><td>0.03mm</td><td>49.4mm/52mm</td><td>1mm</td></tr>
</table>

<table>
<tr><th>Material</th><th>Substrate thickness</th><th>Blade</th><th>Rotation</th><th>Feed rate</th><th>Single/multiple path</th></tr>
<tr><td rowspan="2">Glass, fused silica</td><td>From 250µm to 750µm</td><td>1, 3</td><td rowspan="4">25’000rpm</td><td rowspan="4">1mm/s</td><td rowspan="3">Single</td></tr>
<tr><td>Less than 250µm</td><td>2</td></tr>
<tr><td>Bonded Silicon + Glass</td><td>Any within allowed range</td><td>1, 3</td></tr>
<tr><td>Glass, fused silica</td><td>More than 1mm</td><td>3</td><td>Multiple*</td></tr>
<tr><td>Silicon</td><td>Any, up to 1mm</td><td>4, 5</td><td>30’000rpm</td><td>5mm/s</td><td>Single</td></tr>
</table>

* Special recipe setting required for low-speed blade down Z-motion. Contact CMi staff.

IV. Step-by-step operation procedure

Never put your hands in the area of the blade and the chuck!
When an alarm rings, reset it with the key [ALRM CLEAR] after acknowledgment of the message!
At wafer unloading, do not let the water flow out on the chuck!

➢ Getting started

1. CMi tool access control → login to "DAD321 – Scie a wafers" (zone9 computer).
2. Switch machine ON → turn the **KEY ON** at front of the tool to the **START** position before letting it rest at the **ON** position.
3. Press **SYS INIT** button on the keyboard when prompted by the machine (see bottom left of the screen). It will home the microscope and the table of the tool. The message *"Initialization completed"*. The SYST INIT LED on the keyboard should engage.
4. Confirm into software the blade that is now present on the tool: Main menu → **F5** (Blade maintenance) → **F1** (Blade replacement):
   - If the selected blade is OK: → **ENTER.**
   - If the selected blade is not OK: **F5**, use the ↓ to select the correct blade and **ENTER.**
5. **EXIT** 2X to go back to the main menu.

Zone 09

Available | In Use | Blocked | Process End | Off Time

Username: yleungki Password: 07:49:38

Log In

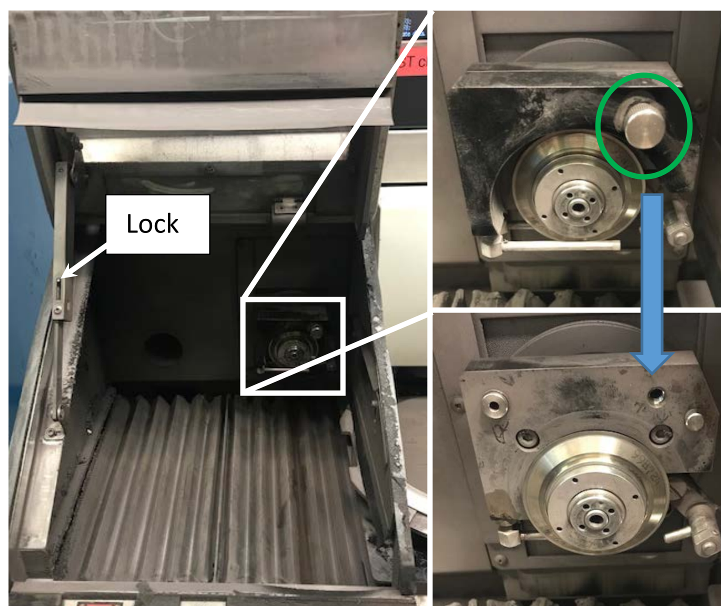
		Login / Logout Time		Timer	User	Booking
	Z09 DAD 321 - Scie a wafers	31.05.2018	17:11:50	14:37:47		Available

➢ **Blade selection and preparation**

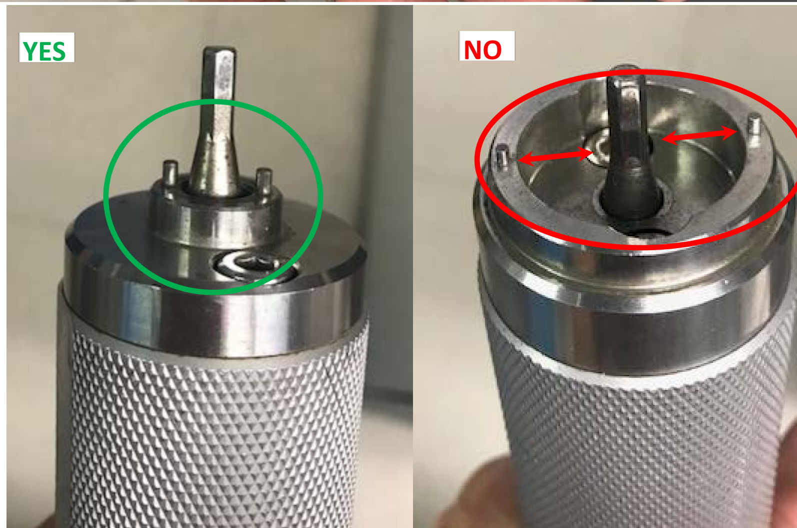
The blade replacement because of damage or wear-out, is exclusively made by CMi staff!
IT IS STRICTLY FORBIDDEN TO REMOVE THE FLANGE THAT HOLDS THE BLADE SOLID (33 MM DIAMETER NUT)

1. If the blade you need is not already installed on the tool, proceed as follows:

   - Main menu → **F5** (Blade maintenance) → **F1** (Blade replacement).
   - Gently turn the key to **Axis Release** (returns to Axis Lock by itself) and open the glass window.
   - Remove the black shield (screw at top right of the shield to remove).
   - Take the torque wrench (should be set at 35) and fit it into the mount of the blade.
   - Turn the torque wrench until the mount comes loose (info: reverse thread).
   - Remove the blade with its flange. If it is somehow locked, use the special black gripping tool to make the blade loose on its axis. Then pull the blade with your fingers.
   - Mount the new blade, secure it with the torque wrench (reverse thread!), place the black shield back in position, secure it with its locking screw, and close the glass window.
   - **F5** (Blade select), choose the blade and press **ENTER**. Update the choice again: **ENTER.** The message *"Data Updated"* should appear. Press **EXIT** to reach the main menu.



35

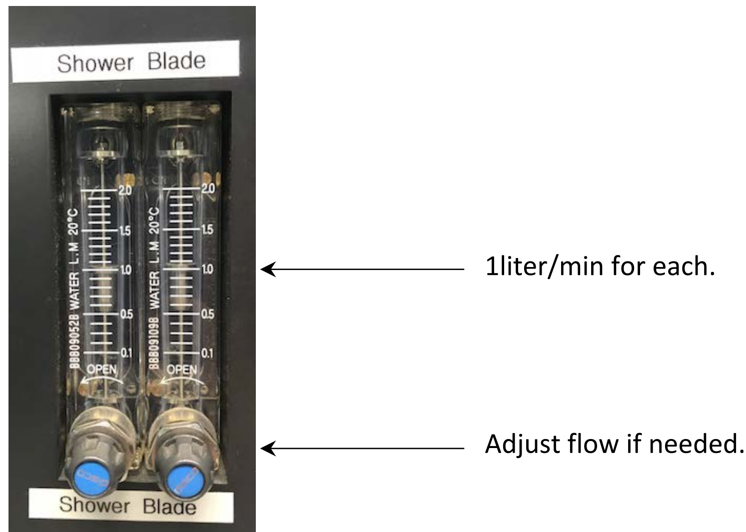

YES
NO

2. <u>Blade rotation speed</u>

Main menu → **F5** (Blade maintenance) → **F7** (Setup data). Change <u>only</u> the spindle revolution speed if needed, press **ENTER** (*"Data Updated"*) and come back to the main menu with **EXIT** 2X.

3. <u>Blade warmup</u>

Start the water with **CUT WATER.** Confirm the water flow is ~1liter/min on both controllers. Start the rotation of the blade with **SPINDL** and wait for the message "Spindle ON". Both SPINDL and CUT WATER LEDs should engage on the keyboard.



Wait for a 10min warmup time before proceeding to setup of the tool.

Use this 10min time to mount your substrate on tape and to edit the dicing recipe.

- **Recipe setup**

Programs that begin with 0 are reserved for maintenance purposes. They can be copied but should <u>not</u> be modified.

1. <u>To copy a program</u>

Main menu → **F4** (Device data list), choose the program and copy **F2** (copy), enter a number and **ENTER.**

Edit the program → **ENTER**. Activate **SHIFT** to enter the name.

Move the program to your folder **F3** (Move).

2. <u>Parameter menu</u>

To change the entry of each parameter below, use **F1** (select).

- UNIT: **mm**.
- CUT MODE:

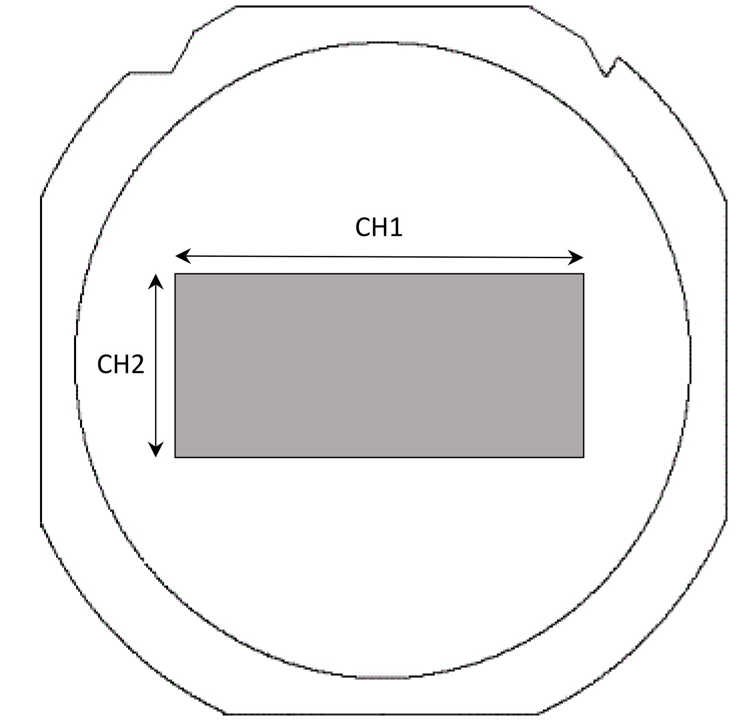
A: if cut distance is fixed and constant for <u>both</u> CH1 and CH2.
AS: if different cut distances needed in the same job or partial cutting of the wafer (not full area).

- CUT SHAPE: **Round** or **Square.**

- SPINDLE REV: check the value according to blade/material to cut.
- WORK SIZE: do not confuse CH1 and CH2 channels! See picture next page.

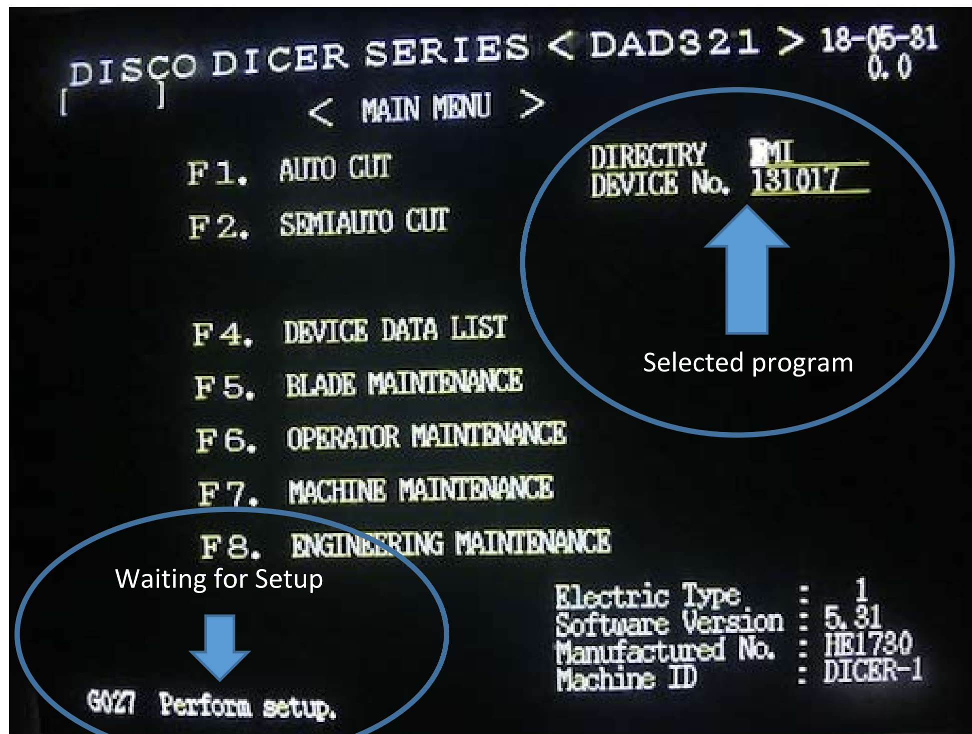
RND WORK SIZE: diameter of the "round" substrate. Foresee a margin of ~2mm. The reference axis is the center of rotation of the chuck.

SQR WORK SIZE: dimensions of the "working rectangle". Foresee a margin of ~2mm.



- WORK THICKNESS: thickness of the substrate.
- TAPE THICKNESS: 0.15mm for UV-tape.
- BLADE HEIGHT: distance between the chuck and the bottom of the cutting. Put 0.08mm for UV-tape if dicing all the way through the substrate.
- FEED SPEED: check the value according to blade/material to cut.
- Y INDEX: step between cut for CH1 and CH2.

When all the parameters are correct, press **ENTER**. *"Data Updated"* appears. Then press **EXIT** until reaching the main menu. By then, the selected program should be visible at top right of the main menu. The tool now waits for next step: SETUP.



➢ **Tool setup and adjustment of the cut**

1. Blade setup

- Main menu → **F5** (blade maintenance) → **F3** (Setup functions) → **F1** (Chuck table setup). Control the 4 parameters according to the installed blade:
  - Rpm: 30'000 for silicon – 25'000 for glass/SiO2.
  - Blade OD: according to the loaded blade.
  - Chuck table size: 6inch.
  - SETUP kind: porous.
  - If parameters are correct: **ENTER**.
  - If parameters are not correct: press **EXIT** twice to reach blade maintenance menu.
  - **F1** (Blade replacement) → **F5** (Blade select) and select the correct blade. **EXIT** twice to reach blade maintenance menu and **F3** (Setup functions) → **F1** (Chuck table setup) to confirm the 4 parameters (point above here)

- The tool waits for **ENTER** again (message at bottom left) for the blade to go down touch and feel the table surface. When it does, after you clicked ENTER, eliminate the water droplets with the compressed air gun!
- Press **ENTER** and the message *"Setup completed"* appears. Go back to main menu with **EXIT**. Make sure the LED SETUP of the keyboard is engaged.

2. Adjustment of the blade cut with the microscope

- Load a dummy wafer that corresponds to your application and to the installed blade. Make sure the frame is correctly loaded and locked on the dicing table (pins align with the frame).
- Press **C/T VAC** and control that the needle is in the green zone of the vacuum sensor.
- Main menu → **F5** (Blade maintenance) → **F5** (Hair line alignment correction)

!! IMPORTANT !!
Check ALL the values: SIZES, HEIGHTS, CUT SPEED ,SPINDLE REV….
Make sure values corresponds to the loaded dummy wafer.
The values shown on screen are from the previous user!!

- **ENTER** if parameters are OK. If not, change them. Then move the chuck table C/T to a fresh spot on the wafer (where there is not cut yet).**START** sawing test.
- When the cut is made, switch **CUT WATER** off and align the dashed white lines on screen. Use the **Y^** and **Yᵛ** to move the lines. Use of the **Y^** must be last. Use **HAIR WIDE** and **HAIR NARROW** to better match the mark of the cut. Confirm with **ENTER**.
- Press **C/T VAC** and unload the dummy wafer.

➢ **Dicing the sample**

- Load your wafer. Make sure the frame is correctly loaded and locked on the dicing table (pins align with the frame).
- Press **C/T VAC** and control that the needle is in the green zone of the vacuum sensor.

If needed, it is possible to confirm the CH1 and CH2 steps size by use of the function **F8** (Measure) and the possibility to reset the meter **F3**. **INDEX** + **θU** turns the chuck of ¼ of revolution to the left. **INDEX** + **θT** turns the chuck of ¼ of revolution to the right.

AUTOCUT: press **F1** from the Main menu

- Alignment of the wafer
  - Adjust the luminosity of the monitor and the focus of the microscope by means of the adequate buttons.
  - Use **Y^** and **Yᵛ** to align the lines on an element of the wafer (e.g. main wafer flat (AS Prog) or dicing alignment marks). Use **SLOW** to change the speed of motion. Use of the **Y^** must be last.
  - Press **F5**: the table moves towards the left.
  - Use **Y^** and **Yᵛ** again to align on the wafer. Use of the **Y^** must be last**.**
  - Press **F5**: the table moves towards the right.
  - Control the alignment (adjustment done).

- Cutting position
  - Use **Y^**, **Yᵛ, HAIR WIDE** and **HAIR NARROW** to align the lines on screen with the markers on the wafer. Use of the **Y^** must be last. Use of **DISPLAY MODE** may be needed for removing text visible on screen.
  - Control the steps of CH1: **INDEX** and **X>** and **X<** to jump from one marker to another. If the steps are not correct:

1. Measure the real step size: **F8** (Measure) and the possibility to reset the meter **F3**
2. Press **EXIT** only once and correct the value in the recipe: **DEVICE DATA** on the keyboard. Save and press **EXIT** only once.

- Press **ENTER** to confirm the position of cutting. The wafer turns 90 degrees or any other value indicated in the program.

- Control the alignment and the steps of CH2: **INDEX** and **X>** and **X<** to jump from one marker to another. If the steps are not correct:

1. Measure the real step size: **F8** (Measure) and the possibility to reset the meter **F3**
2. Press **EXIT** only once and correct the value in the recipe: **DEVICE DATA** on the keyboard. Save and press **EXIT** only once.

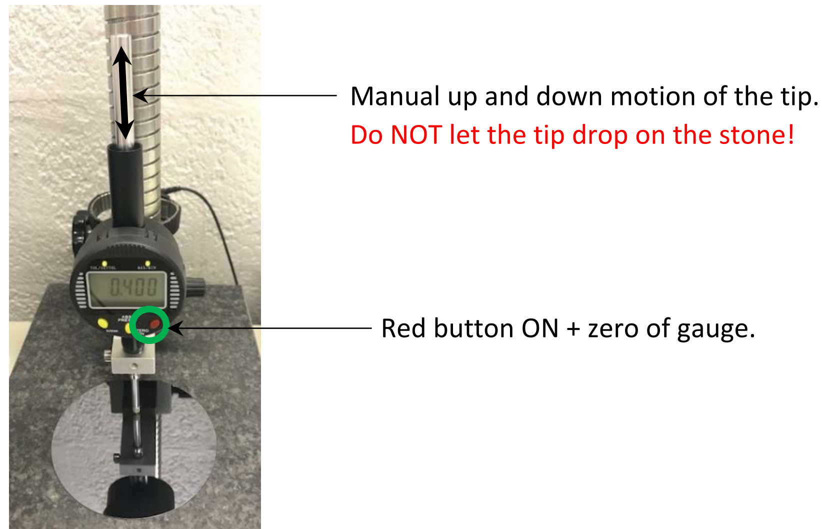
- Press **START** to initiate the cutting. It is possible to press **STOP** anytime in order to visually check the cuts, but the tool will first complete the on-going line before stopping.
- Once the cut is complete, press **ALRMCLR** to stop the alarm and then **C/T VAC**. The message *"Press C/T VAC key to axis move"* appears. Press **C/T VAC** again: the table moves on the right, the microscope moves towards the back and the clamping of the wafer is released.
- Get the wafer. **Make sure no water flows/drops on the chuck table.**

Stopping the machine

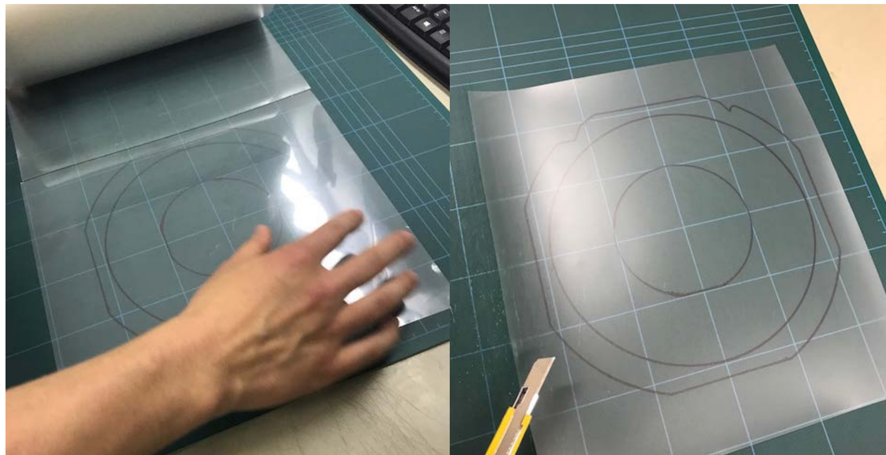
1. Exit the program.
2. Stop the blade **SPNDL**.
3. When spindle is off, turn off the dicing tool (KEY to **OFF**) and close all supplies (power-supply, water and compressed air).
4. "DAD321 – Scie a wafers" on zone9 computer: logoff.

- **Wafer mounting on tape**

If needed, first confirm thickness of the substrate with the prober.



For proper handling by the dicing machine, the wafer has to be supported by a special UV-tape mounted on a calibrated metallic frame. The UV-tape is 0.15mm thick and has a protective liner film that covers the glue.



Fetch the roll of UV-tape and cut a piece large enough for the metallic frames.

Make sure you place the UV-tape back in its bag as soon as possible and that you properly store it back away from room light !

Remove the transparent protective liner. Place the UV-tape with sticky face up !

Drop one frame on the UV-tape. While holding the frame flat at the edge of the table, manually stretch (slightly!) the tape from the periphery to have a surface with no wrinkles.

Cut the tape by following the shape of the frame with a cutting blade.

Always mount parts in the middle of the tape/frame (as much as possible).

Mind the side of the wafer in contact with the tape.

Enhance the gluing capacity of the UV-tape by baking it 2min @ 55°C on the hotplate.