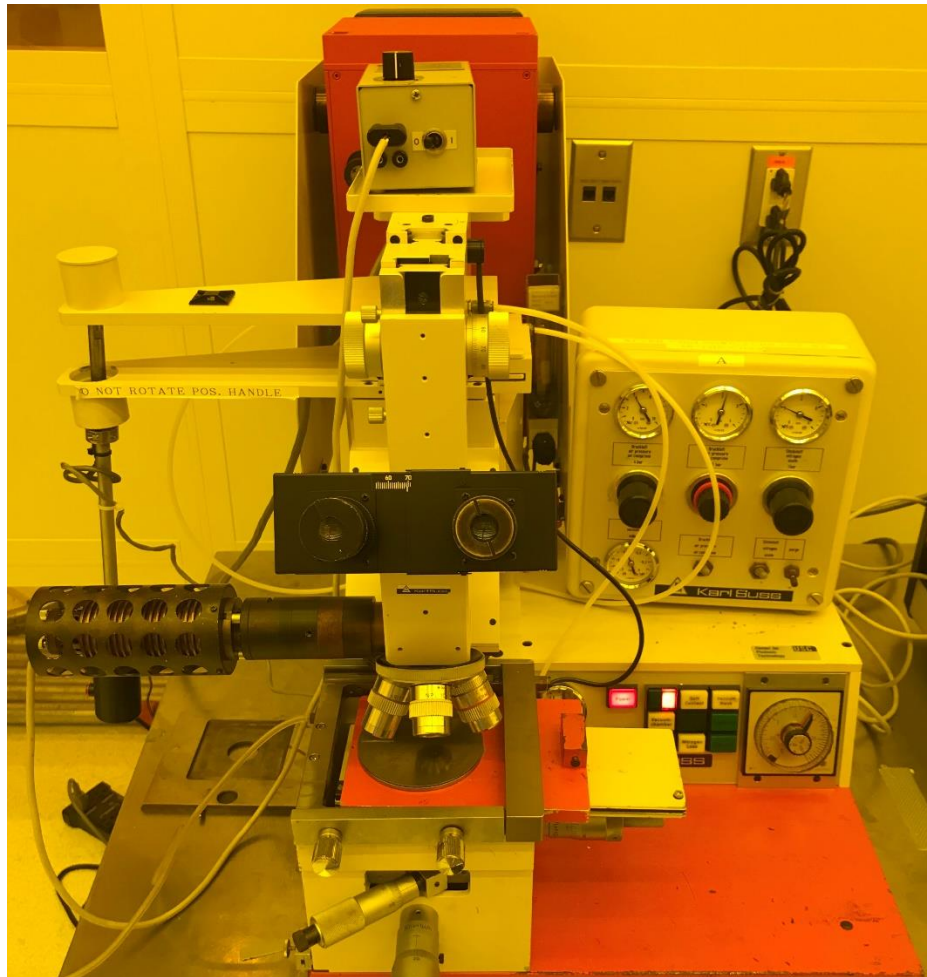


STANDARD OPERATING PROCEDURE FOR MASK ALIGNER MJB3

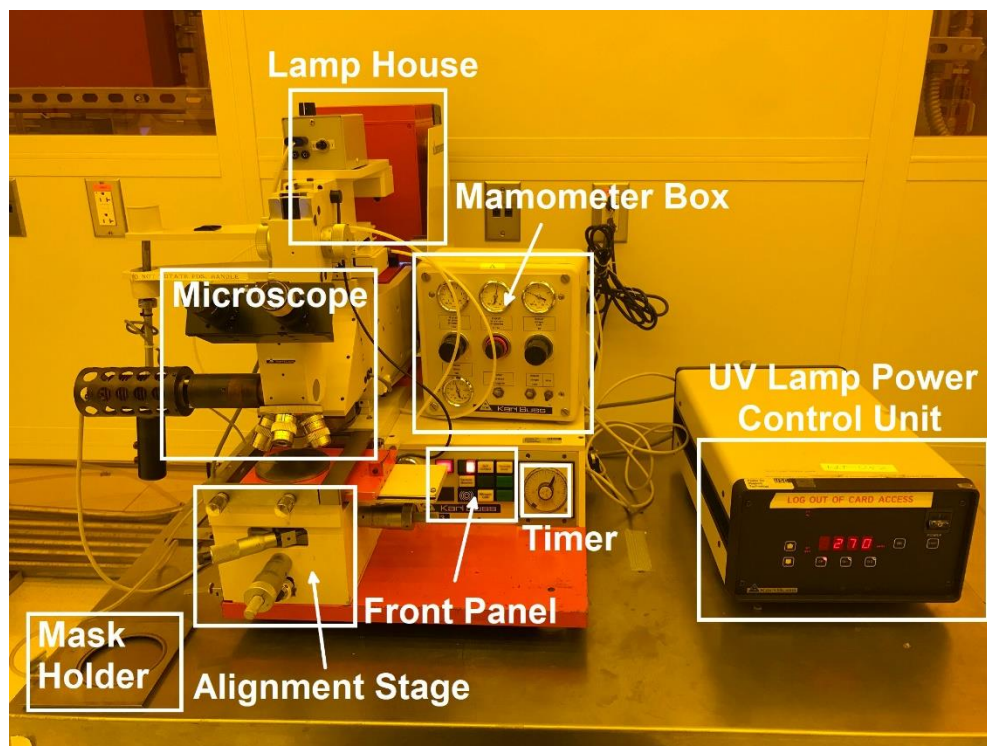


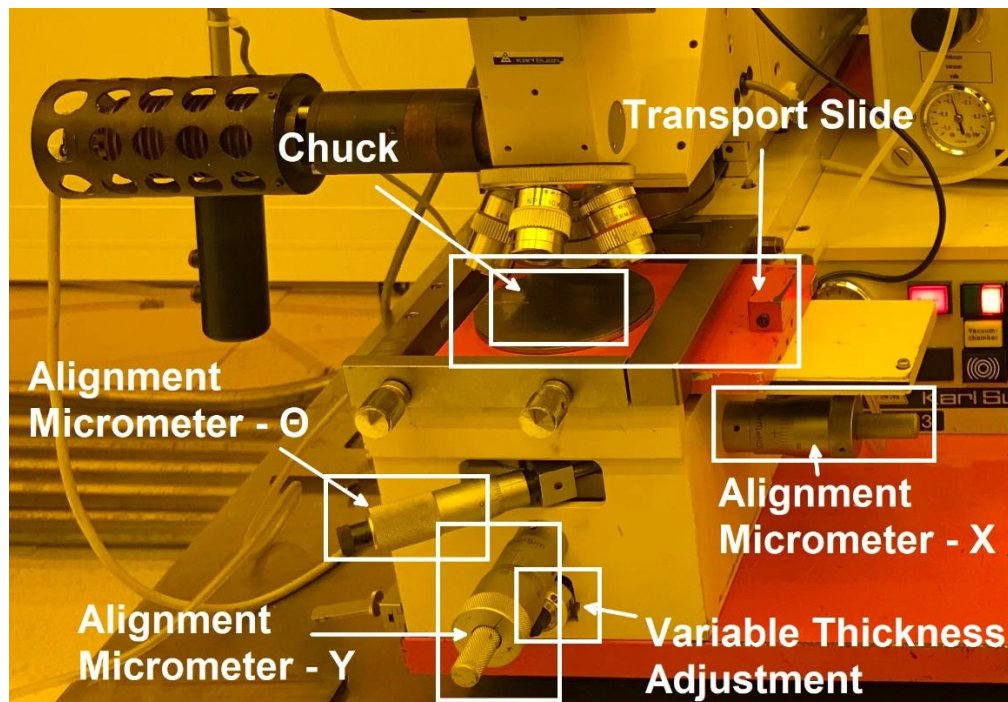
USC University of
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OVERVIEW

The cleanroom has two mask aligners labelled MJB3 A located in the Advanced Photo Bay and MJB3 B located in the Photo Bay. Both aligners are similar in terms of operation.

The SUSS MJB 3 Mask Aligner is designed for high resolution photolithography in a laboratory. The MJB 3 offers flexibility in the handling of irregularly shaped substrates of differing thicknesses, as well as standard size wafers up to 3" diameter. The SUSS MJB 3 Standard is equipped with a 200W lamp house containing a relatively simple and yet comparatively high resolution optical system. A 200W mercury short-arc lamp is used. Primary exposure wavelengths are 350-500nm. The aligner performs exposures in hard contact mode (nitrogen pressure under the substrate) and soft contact mode (vacuum under the substrate). Line/space resolution of 1.5 microns and alignment accuracies of 0.2 microns can be obtained with the MJB 3 Standard under optimum conditions.





SPECIFICATION

- Model: MJB3 Main System
- Manufacturer: Suss MicroTec / Karl Suss
- Configured for Top Side Alignment
- Max Wafer Size: 3" Diameter
- 200 Watt Lamphouse
- Microscope
- Eyepieces: 10x
- Objectives: 3.5x, 10x, 20x
- Exposure Mode: Vacuum contact, Hard contact, Soft contact
- Light Source for Microscope
- Exposure Resolution: 0.8 Microns (under optimum conditions)
- Alignment Resolution: 0.25um (operator dependent)

WARNINGS

- The UV lamp power control unit is the black box next to the mask aligner and is used to set the power/intensity of the UV lamp. The UV lamp power control unit is always on and is set to 270 Watts when not in use.
- **DO NOT** power off the UV lamp.
- If UV lamp is off, **DO NOT** power the on the UV lamp. Contact staff.
- **DO NOT** look directly at the ultraviolet light or its reflection. The aligners' lamps output 365nm, 405nm and 436 nm wavelengths light for a total of approximately 12mW/cm² intensity.
- Beware of moving parts on the aligner. The microscope assembly moves up and down.
- The exposure tool will move forward when exposing a wafer. Be careful to avoid putting any body part, clothing, or other material in the path of the moving parts.
- **DO NOT** place heavy or sharp objects on the touch panel

- **DO NOT** lean on the anti-vibration table
- **DO NOT** turn any knobs more than a few degrees at a time. Turn all knobs with care.
- Handle all equipment gently and with care.
- **DO NOT** use acetone to clean the chuck. If needed, use a towel with some methanol or IPA.
- If you are having issues with any irregular problems, report the problem to a staff and take a photo.

SAFETY HAZARDS

- High Pressure Lamps
: The light source for the concentrated ultraviolet illumination required to expose the wafer is a high pressure lamp. Special precautions must be taken when working with such lamps.
- Electrical Hazards
: The voltage and current required to run a high pressure lamp constitute a lethal combination. Starting ignition voltages are 30 KV and open circuit potentials range up to 180 VDC at currents between 5 and 50 amps. When performing any maintenance on the exposure lamp power supply, lamp housing, or the lamp itself, insure that the power line to the power supply is disconnected.
- Lamp Explosion
: These exposure lamps operate at extremely high pressure (50-70 atm.). Explosion is therefore a possibility if they are handled or operated improperly. They may fail due to improper cooling, improper setting of the power supply, usage outside the manufacturer's guidelines, etc. Additionally, some high pressure lamps, even when cold, are still above atmospheric pressure and should be handled with protective face shields and gloves. The lamphouse is designed to minimize damage of the interior of the equipment and avoid any possible injury to the operator should a lamp explosion occur. All assemblies and protective covers must be in place during operation of the machine. Some of these lamps contain hazardous elements, like mercury. If a lamp should break, take precautions to avoid touching the fragments and/or breathing the vapor.
NOTE: Careful handling of the lamp and proper operation of the equipment will substantially reduce the possibility of lamp explosions.
- Exhaust Requirements:
High pressure lamps produce small amounts of ozone due to the interaction of the radiation emitted below a wavelength of 250 nm with air. Ozone attacks the mucous membranes of the respiratory system, producing symptoms similar to pneumonia. The effects are cumulative. The smaller wattage lamps, cadmium-xenon to 200 watts and mercury to 500 watts, should only be operated in a well ventilated area. Larger wattage lamps should be vented out of the room.
- Eye and Skin Safety:
The ultraviolet light produced by these lamps can cause erythema of the skin (similar to sunburn) and conjunctivitis. In addition, the large Infrared output can cause retinal burns resulting in blindness. Every SUSS mask aligner is equipped with light guards, and the high-pressure lamp and exposure path are enclosed. The mask aligner should not be operated unless all these protective covers and devices are in place.
- Broken Wafers:
Since fragments of broken wafers and substrates can be very sharp, there is a risk of injury to the operator or maintenance personnel when trying to remove them from the machine. Extra care should be taken and proper tools, i.e. tweezers. should be used to minimize this risk.
- Moving Parts:

The operator should take extra care to keep loose clothing, long hair, etc. from getting caught in the machine. See-through covers are provided in certain cases to allow the operator to observe the operation of the machine. These covers should not be removed, as they prevent the operator from reaching into the moving equipment.

MEASURE UV LAMP POWER

1. Turn on the UV Intensity Meter Model 1000
2. Move the Transport Slide out of the Alignment Stage and remove any Mask Holders from the Alignment Stage.
3. Put the Head of the UV Intensity Meter at center of the Alignment Stage
4. Pull the Separation Lever towards the back of the machine



5. Turn the Contact Lever counterclockwise (toward the rear of the machine)
6. The Contact light on the front panel will illuminate
7. Set the time for 10 seconds at the Exposure Timer (located at the right side of the Front Panel)
Cf. In order to set the timer, two controls are used: an Inner Knob marked "s", "10s", "m", "10m", "h", and "10h" which is used to set the Multiplier, and an Outer Knob which is used to move the timer pointer. The scale for the timer pointer is graduated from 0 to 3; The exposure time is determined by multiplying the pointer setting by the multiplier set on the inner knob.

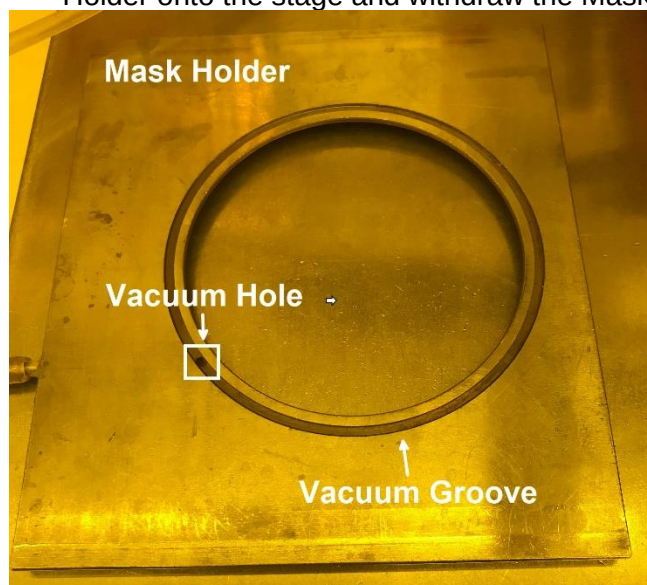


8. Press Exposure button at the Front Panel
9. Record the power from the UV Intensity Meter. Increase the power by pressing up-arrow button as you want to. **DO NOT** go over 400 W
10. Calculate the power that you want to expose to your sample
(Example: $80 \text{ [mJ/cm}^2\text{]} / 5 \text{ [mW/cm}^2\text{]} = 16 \text{ seconds}$)

11. Set the time at the Exposure Timer as you want to expose
12. Turn the Contact Lever clockwise
13. Push the Separation Lever to front of tool.
14. Take out and turn off the UV Intensity Meter

LOAD THE MASK

1. To load a mask into the Mask Holder, first loosen the two knurled knobs which clamp the Mask Holder onto the stage and withdraw the Mask Holder

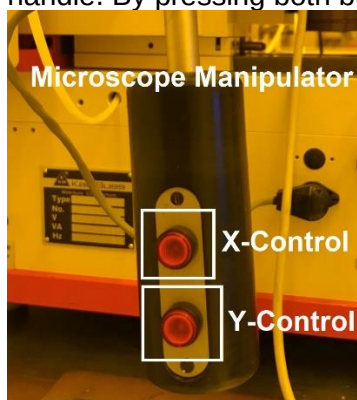


2. Carefully place the Mask Holder on a flat surface, with the Vacuum Groove up
3. Check that the Mask Vacuum button on the front panel is in the OFF position
4. Place the mask on the Mask Holder with the patterned side up
5. Press the Mask Vacuum button. This will fix the mask to the Mask Holder by vacuum
6. Invert the Mask Holder and reinsert it into the stage
7. Clamp the Mask Holder securely in place using the two knurled knobs

LOAD THE SUBSTRATE AND ALIGN SUBSTRATE TO MASK

1. Take out the Transport Slide
2. Place the substrate on the Chuck
3. Insert the Chuck into the stage by carefully pushing the Transport Slide to the left until it reaches the stop
4. Pull the Separation Lever towards the back of the tool
5. Slowly Turn the Contact Lever CCW while checking the gap between mask and substrate.
6. The Variable Thickness Adjustment knob is for a continuous motion in the Z-direction (unlike the fixed motion of the levers). Turning CCW will raise the sample stage and CW will lower the sample stage. One full turn raises/lowers the stage 150um. **Seek staff approval before adjusting this dial. Turning it clockwise too many times will cause it to malfunction.**
7. If the substrate is in contact with the mask before fully rotating the Contact Lever, the stage can be lowered by turning the Variable Thickness Adjustment knob clockwise.
8. The Contact light on the front panel will illuminate when the Contact Lever is fully turned counterclockwise

9. Turn on Microscope Illuminator. Illuminator for MJB3 B is located in front of UV Lamp House for and needs to switch to ON to illuminate. Illuminator for MJB3 A is located to the left of the tool for MJB3 A and only needs to rotate clockwise to illuminate.
10. Focus the Microscope on the mask and substrate
11. In order to align the substrate, it must first be separated from the mask. Pull the Separation Lever toward the front of the machine
12. The Contact light will go out and the Separation light will illuminate
13. Align the substrate to the mask using the Alignment Micrometer X, Y, and Theta (Θ) (The X and Y micrometers are equipped with both a coarse and fine adjustment.)
14. Move the Microscope with the Microscope Manipulator. The Microscope Manipulator is equipped with pneumatic brakes which you unlock by pressing the buttons on the manipulator handle. By pressing both buttons, you may scan the microscope in any direction



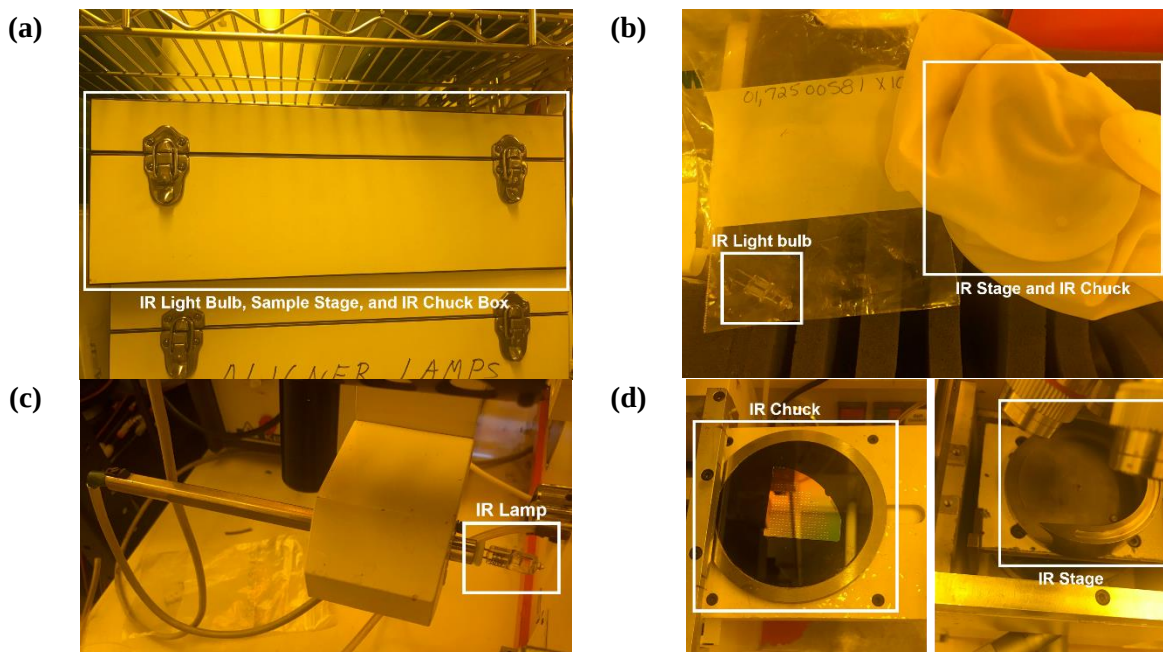
15. If the microscope is equipped with an objective revolver, a low magnification objective should be used for coarse alignment and the magnification steadily increased until satisfactory alignment is obtained
16. When you have obtained a satisfactory alignment, move the substrate back into contact with the mask by pushing the Separation Lever all the way to its rear most position
17. The Separation light will go out and the Contact light will illuminate
18. The substrate is now ready for exposure

EXPOSURE AND UNLOADING THE SUBSTRATE

1. You can operate the mask aligner in 3 different configurations:
 - A. Press ST and then SOFT CONT button for **Soft Contact Mode** – Soft Contact Mode allows a vacuum to hold the substrate to the chuck. There is a small space between the substrate and the mask which results in lower resolution.
 - B. Only press ST button for **Hard Contact Mode** – Hard Contact Mode allows nitrogen to flow from beneath the substrate to push it towards the mask. This mode has higher resolution, but may cause damage to mask.
 - C. Press HP (High Precision) button for **Vacuum Contact Mode** – Vacuum Contact Mode allows a vacuum to draw between the substrate and mask. This mode results in the best resolution, but poses the greatest risk of damage to the mask.
2. Check the exposure time on the Exposure Timer located at the right end of the front panel
3. Press the Exposure button.
When the Exposure button is pressed, the microscope will then first elevate an amount sufficient to allow the objective to clear the Mask Holder. The Lamp House now moves forward into position over the mask. When the Lamp House reaches the front most position, the exposure shutter opens and exposure takes place for the amount of time set on the exposure timer.

4. After exposure, the shutter closes and the Lamp House automatically retracts. The microscope lift is released and the microscope moves back down to its original position.
5. With exposure complete, the substrate may now be unloaded.
6. Rotate the Contact Lever clockwise (toward the front of the tool), releasing the substrate from the mask.
7. Push the Separation Lever towards the front of the tool
8. Pull the transport slide carefully to the right and remove the substrate from the chuck.
9. To take out a mask from the tool, first loosen the two knurled knobs which clamp the Mask Holder onto the stage and withdraw the Mask Holder
10. Carefully place the Mask Holder on a flat surface with the mask up
11. Press the Mask Vacuum button at the front panel to Off
12. Take out the mask from the Mask Holder
13. Make sure the power at Lamp ignition should be back to 270 W
14. Turn off the microscope illuminator. Switch to OFF for MJB3 B illuminator and rotate fully counterclockwise for MJB3 A illuminator.

Backside Alignment: Put the IR light Bulb, IR Stage, and IR Chuck



(e)



(f)



(a) Box for backside alignment, (b) IR light bulb, IR stage, and IR chuck in the box, (c) IR light bulb holder, (d) IR stage and IR chuck replacement, (e) IR monitor and (f) Light power supply

1. Take out the IR light bulb, IR stage, and IR chuck from the box located in the small room next to the alignment room.
2. Put the IR light bulb at the IR light bulb holder. (There is no direction or polarity of the IR light bulb)
3. Take out the standard chuck along with outer ring and replace it with the IR chuck. (Black part is transparent to the IR.)
4. Take out the standard stage by gently pulling it up and replace it with the IR stage. Open side should be at left so that IR light bulb comes in underneath the sample.
5. Push in the IR light bulb holder underneath the sample
6. Turn on the IR monitor. You can control the brightness and contrast as you want
7. Control the brightness of either microscope (frontside) or IR (backside) by rotating the silver knobs at the power supply. (You can only turn on the one light source out of a time.)

DO NOT change the scanner to automatic. It should be always at manual.

8. After finishing the backside alignment, take out the IR light bulb, IR stage, and IR chuck, and place them back to the box.