

# Mask aligner and UV lamp

## Suss MJB-3



# Introduction

The Suss MJB-3 mask aligner is designed for high resolution photolithography. The photolithography is the process of transferring geometric shapes defined on a mask to the surface of a sample. The steps involved in photolithography are: photoresist deposition, baking, mask alignment, exposure and development (Illustration 1). This system provides a precise sample-mask alignment, the nominal alignment resolution is  $0.1\ \mu\text{m}$ , and is equipped with a UV lamp for the exposure.

The UV light is provided by a mercury short-arc lamp with a primary exposure wavelengths of 350-450 nm. The nominal photolithography resolution under optimum conditions (UV light intensity and exposure time) is  $0.6\ \mu\text{m}$ .

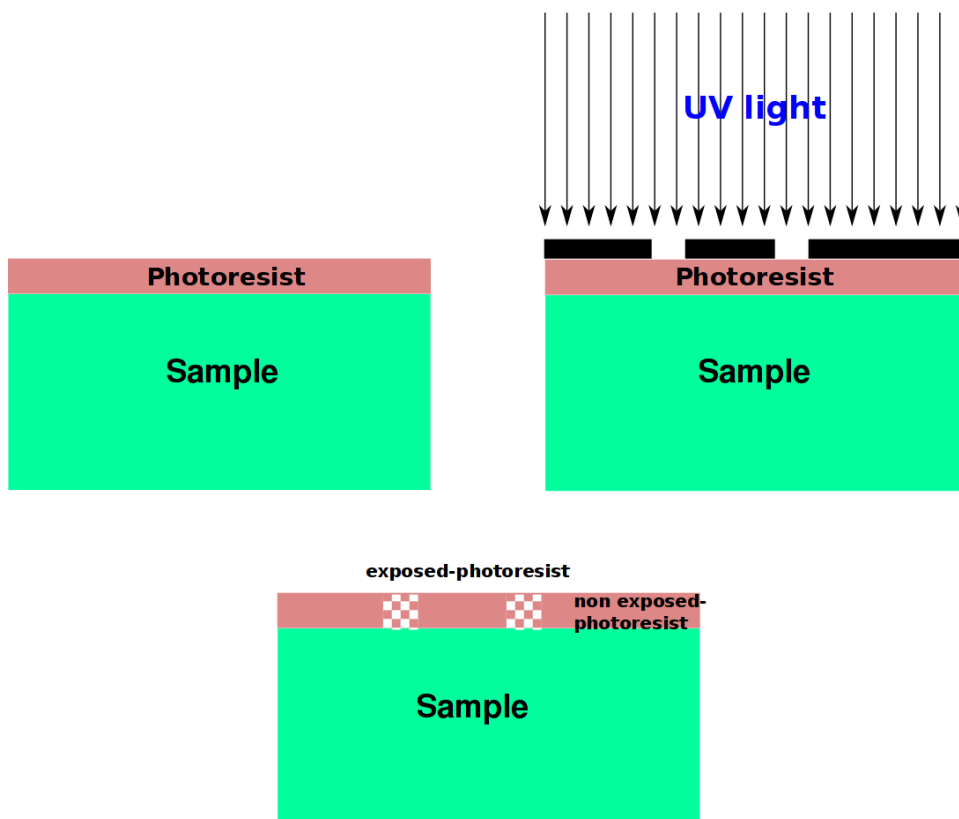


Illustration 1: Simplified schema of the photolithography procedure. After the deposition of the photoresist the sample is aligned to the mask and exposed to UV light. After the development the pattern of the mask is transferred on the sample.

## Overview

The Suss MJB-3 is relatively easy to use. First one loads a mask into the machine, then places the sample on the chuck and inserts it into the alignment stage. At this point one approaches the sample to the mask and starts the alignment moving the sample chuck using the X, Y, and Theta micrometric screws and the microscope using the precision manipulator. Once the alignment is satisfying, the sample can be put in contact with the mask. The sample is now ready for the exposure. Before starting the exposure, the exposure time has to be set on the counter. After the exposure, the sample is separated from the mask and unloaded taking out the chuck where it is placed. The main components of the system are shown in Illustration (2).

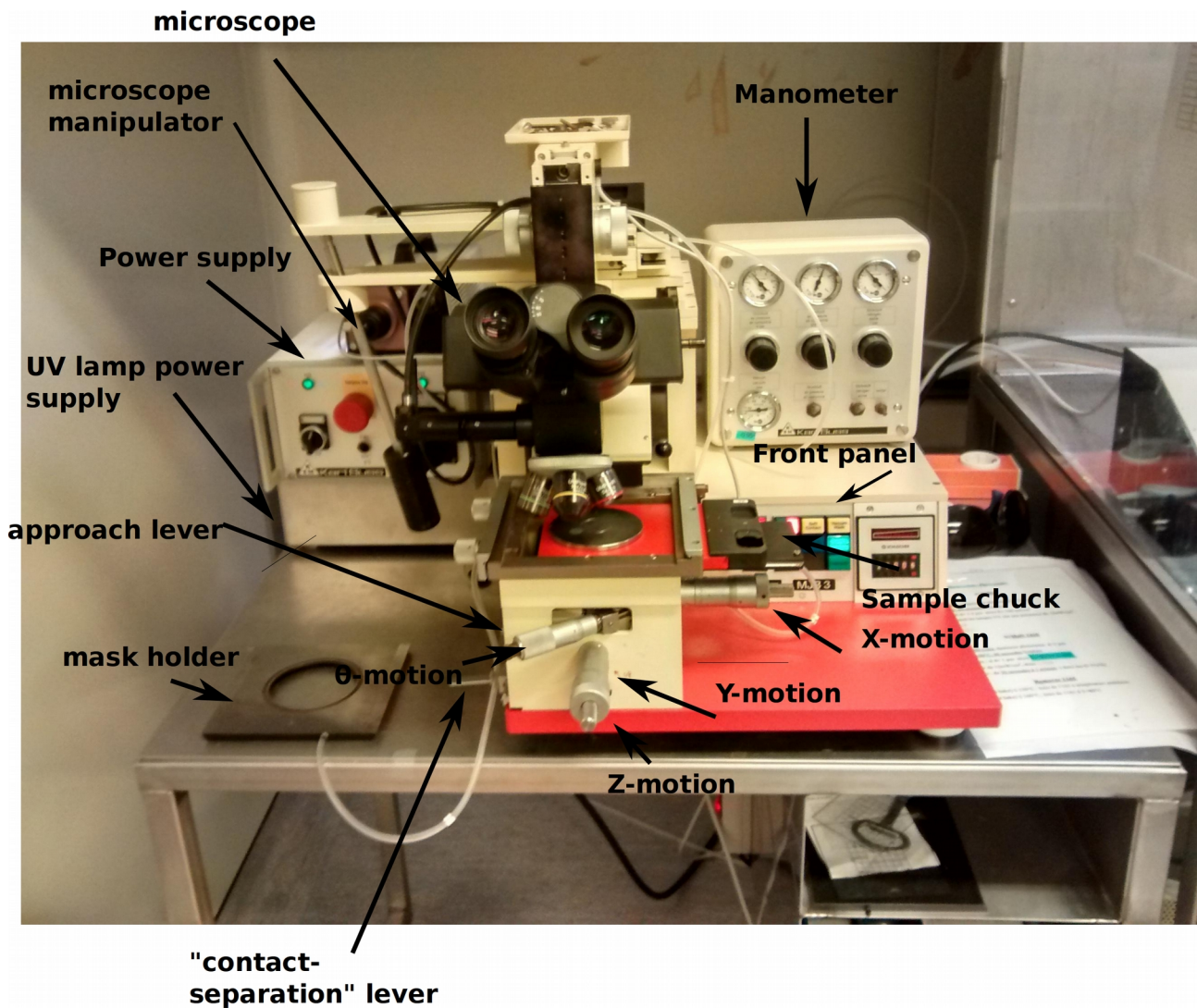


Illustration 2: Overview of the instruments main components.

## Detailed procedure

1. Before entering the clean-room remember to open the compressed air (the yellow valve on the wall on the left, Illustration (3)) and to switch ON the vacuum pump (located under the table on the left, Illustration (4)). The mask aligner requires the vacuum pump to keep the mask on its holder and the compressed air to move the microscope and the UV lamp.

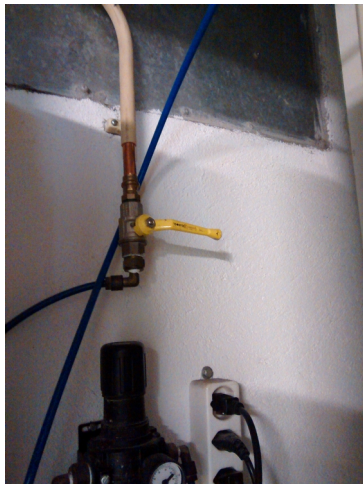


Illustration 3: Dried air valve.



Illustration 4: Vacuum pump used by the mask aligner.

2. Switch ON the mask aligner by turning the H1 and H2 knobs on the power supply panel (Illustrations (5) and (6)) and the UV lamp by pressing the button located behind the UV lamp power supply (Illustration (7)).



Illustration 5: Switch H1.



Illustration 6: Switch H2.



Illustration 7: UV lamp power.

3. Position the mask on the mask holder. The coating on the mask has to face up in order to be in contact with the sample (Illustration (9)). The mask is kept on the holder by the vacuum: in order to make the vacuum between the mask and the holder press the yellow button labelled "vacuum mask" (Illustration (8)). To release the vacuum and detach the mask press again the "vacuum mask" button or switch OFF H1.

!! Remember to unload the mask holder before releasing the vacuum in order to prevent the mask from falling on the sample chuck.



Illustration 8: Vacuum mask button.

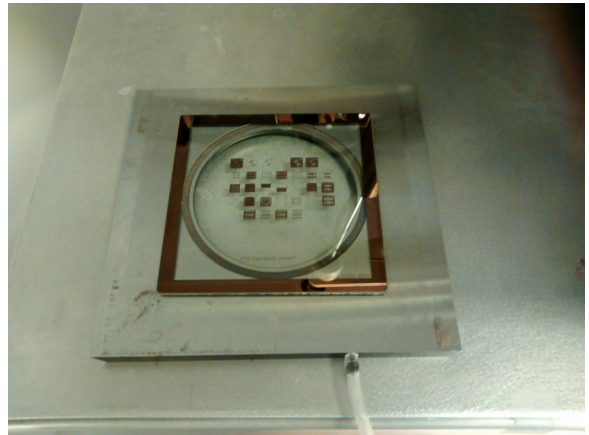


Illustration 9: Mask holder with the mask correctly positioned facing up.

4. Position the mask under the microscope (Illustration (10)) and fix it by screwing the two screws on the left (Illustration (11)).

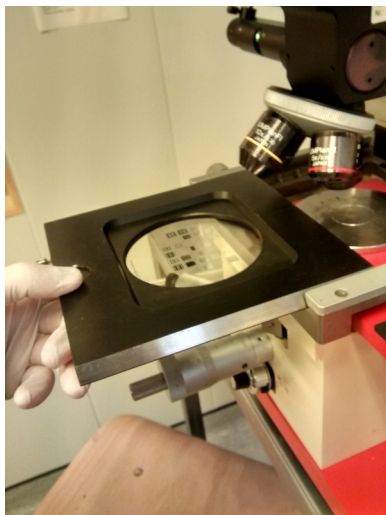


Illustration 10: Mask location.

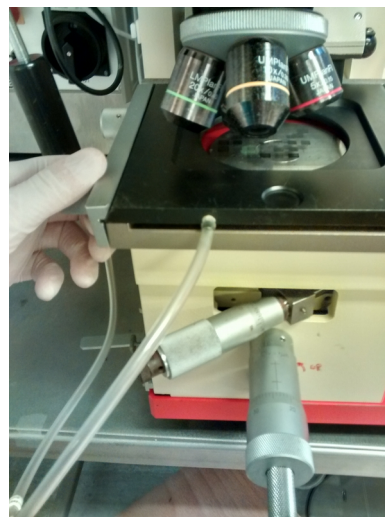


Illustration 11: Screws to fix the mask holder.

5. Position the sample on the sample chuck and insert it into the alignment stage pushing from right to left (Illustration (12)). Try to place the sample under the pattern that has to be used.

- Put the sample in contact with the mask by turning the contact lever counterclockwise and by pushing the separation lever (Illustration (14)). The contact light on the front panel of the machine should switch ON. If the sample-mask contact is not satisfying, one can adjust the sample height using the Z-micrometric screw (Illustration (15)).

!! Pay attention not to put too much pressure between the sample and the mask, you risk to break the sample or the mask.

- Fine tune the sample-mask alignment. First, pull the separation lever towards the front of the machine in order to be able to move the sample. Then, align the sample to the mask moving the chuck by using the X, Y and Theta (chuck rotation) micrometric screws (Illustration (13)). During this procedure the microscope can be scanned over the sample by using the precision manipulator. One can change the microscope zoom in order to improve the alignment accuracy. When the alignment is satisfying put the sample back in contact with the mask pushing the separation lever (once again, the contact light should be switched ON). The system is now ready for the exposure.

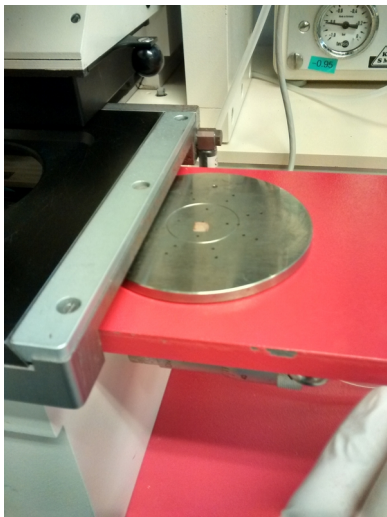


Illustration 12: Sample chuck.

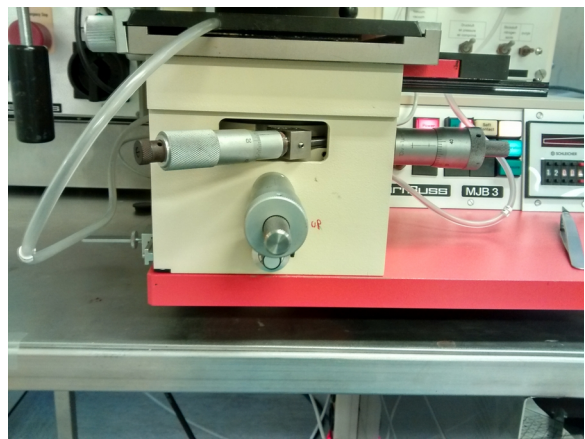


Illustration 13: Alignment screws. X direction on the right and Y direction in front. The diagonal screw rotates the sample holder.

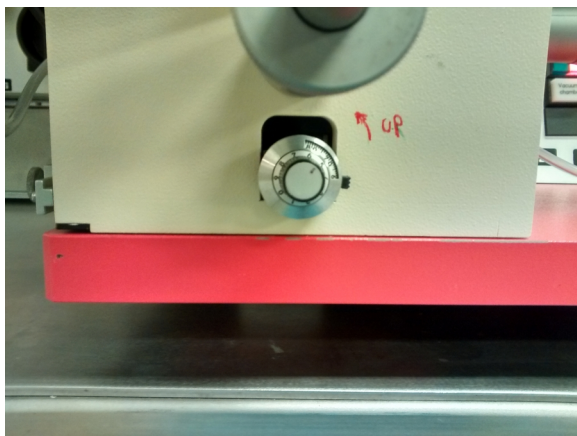


Illustration 14: Micrometric screw for the sample approach.



Illustration 15: Approaching levers.

8. Set the desired exposure time (Illustration (18)). This parameter depends on the UV light intensity and on the photoresist type. In the cleanroom we have a table with the exposure time recommended for the most common photoresist types as a function of the UV-lamp intensity. The lamp intensity is measured every month. The result of the last measurement is reported and pasted on the wall (on the right of the mask aligner).
  9. Press the button "exposure" on the front panel (Illustration (18)). In order to expose, the systems moves the microscope out and aligns the UV lamp to the mask (Illustration (16) and (17)). Once the exposure is finished, the UV-lamp is moved back to its original position.
- !! The UV-light can damage the eyes, don't look at the lamp during the exposure.

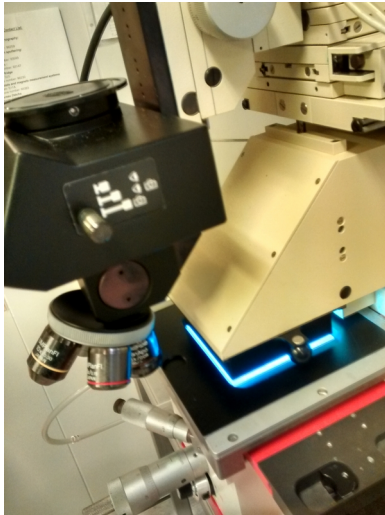


Illustration 17: Exposure.



Illustration 16: Lamp-mask alignment.



Illustration 18: Time setting.

10. Separate the sample from the mask by pulling the separation lever and by turning the contact lever (Illustration (15)). Unload the sample chuck, remove the mask and detach it from its holder.
11. Develop your photoresist, if it didn't work make sure that the UV lamp was ON and restart from point 2. If everything went fine enjoy science!
12. Once the development is satisfying, switch OFF the system (UV-power supply, H2 and H1).