**MICRO-FABRICATION OF GOLD STRUCTURES BY LIFT-OFF USING 5UM TECHNOLOGY**

***Version 1.0***

**Produced by: Edgar Unigarro Calpa**

# OBJECTIVE

To describe the micro-fabrication technique using lift-off process and 5 um technology of the SF100 micro-printing system in samples with thin films of Chrome-Gold deposited with the Edwards evaporator in the physical-chemical processing room.

# REQUIREMENTS

To follow this tutorial, it is necessary to have training in: Deposition of thin photosensitive films with Spinner. Exposure and development using the SF100 micro-printing equipment. Sample heating on hotplate. Deposition of thin films using the Edwards physical evaporation system.

# DESCRIPTION OF THE PROCESS

The lift-off process involves generating a negative pattern of the micro-printing mask that is desired in a particular sample so that when a layer of another material is deposited, the exposed areas adhere to the substrate. Microfabrication is achieved by removing the mask that removes the deposited material from the protected areas of the substrate, leaving only the desired pattern on the substrate. This tutorial describes the steps to perform the microfabrication of interdigitated electrodes in Chrome-Gold using 5 um manufacturing technology.

It is important that after generating the mask, the deposition of the manufacturing material is done immediately, and similarly, the mask removal by ultrasound should be done immediately after finishing the manufacturing material deposition. Intervals greater than 12 hours between the processes can affect the results obtained in the manufacturing..

# STEP BY STEP

## SAMPLE PREPARATION

1. Cut the samples of the substrate that you want to use to the appropriate sizes for the process.
2. Make sure you have the necessary elements to clean the samples and the containers to perform the cleaning. In the process described below, glass is used, so acetone is a good material for cleaning. Acetone can also be used on clean silicon wafers. Request beakers for sonication of the samples.
3. Make sure you have the water and air or nitrogen supplies depending on the substrate requirements.
4. Request the evaporation materials for this case, Chrome and Gold, and the tungsten evaporation boats.
5. Check the supplies of SC1827 photoresist, MF318 developer, and PR1000 remover, and request supplies from the laboratory assistant if necessary.
6. Turn on the equipment in the Photolithography room, the light, and the process cabin extraction, place the hotplate at 120°C, the spinner, and the SF100 computer.
7. Clean the substrate using the sonicator at low power for 4 minutes, making sure there are no elements that could affect the adhesion of the manufacturing material to the substrate.
8. Perform the photoresist deposition on the samples according to the thickness of the layer that you want to generate. The standard laboratory configuration can be used for this; place the samples on the spinner and cover with photoresist, use the spinner with a configuration of Speed 5000rpm with an acceleration of 5000rpm/s for 50 s.
9. The samples should be cured on a hotplate for the time recommended by the laboratory standard. It is recommended to cure the 5um samples for 70 s at a temperature of 120ºC.

## EXPOSURE WITH SF100

1. Turn on the SF100 lamp. Ask the cleanroom personnel to remove or install equipment accessories, such as the reducing lens, if necessary.
2. Perform the focusing process for the technology you want to work with. To perform the focus, it is recommended to use a glass slide with a flat white part that allows the image projected by the equipment in the stereoscope to be seen clearly. Place a sample of the substrate being tested under the glass slide. Once the focal point is reached, swap the positions, placing new samples for exposure.
3. Select the mask with the pattern you want to fabricate. For the lift-off process with positive photoresist SC1827, the structure you want to fabricate should appear black. If necessary, the exposure software has an option to invert the color of the mask.
4. Expose the mask for 25 seconds. The exposure time may vary depending on different factors. It is recommended to make adjustments to the exposure time depending on the results.
5. To reveal, immerse the sample in the developer in the containers arranged in the extraction chamber of the photolithography room. Leave the sample still for one minute, then shake irregularly for one minute.
6. Rinse the sample with deionized water and dry with air or nitrogen, depending on the availability or requirements of the sample.
7. Check the exposure results using the microscopes in the laboratory. The lift-off samples should be completely free of photoresist in the fabrication areas.
8. Expose the samples to UV light for 3 minutes using the fluorescent lamps located on the reducing table. It is important to perform this step so that the photoresist is easier to remove once the fabrication material is deposited
   1. **METAL LAYER EVAPORATION**
9. Before turning on the evaporator, make sure to open the cooling water supply.
10. Turn on the evaporator and press the start button to heat the vacuum pumps.
11. Check the pressure in the bell jar. If necessary, press the vent button to remove the glass bell when the pressure is level with the ambient pressure.
12. Place the evaporation containers on the base of the evaporator with the materials you want to evaporate. For the deposition of the Chromium-Gold metal layer, place a piece of chromium in the first container, and in the other containers, place the necessary pieces of gold for the desired thickness.
13. Before starting the evaporation, it is important to consider the adherence of the fabrication material to the substrate. In the case of gold, it is necessary to place a layer of chromium. The thicknesses of the deposited material layers can affect the results in the sample fabrication. In this experiment, between 5 and 10 nm of Chromium were used as a layer to improve the adhesion of gold to the substrate, with 100 nm Gold layers.
14. Once the samples are placed, the bell jar must be placed, and wait for the DP Ready screen, which indicates that the diffusion pump is ready for the process.
15. Once you have this screen, press the cycle button and wait until the pressure reaches a value less than 5e-5 mBar, which can be monitored on the evaporator screen. This process usually takes around 3 hours.
16. In the evaporation control, the parameters of the metallic layer that you want to deposit must be loaded. To do this, select the layer according to the information in the manual located in the laboratory. To add new materials, speak with the Clean Room personnel.
17. When the desired pressure value is reached, the evaporation of the metallic layers is performed by increasing the current in the tungsten boat. To do this, use the knob on the evaporation control panel.
18. Once the evaporation is complete, decrease the current in the tungsten boat to zero, change to a new boat for another evaporation, or proceed to turn off the equipment.
19. To turn off the equipment, first press the Stop button to stop the vacuum pumps and wait for the chamber to stabilize for 30 minutes.
20. Press the Vent button to equalize with external pressure. Once the pressure is equalized, the equipment can be turned off once the screen displays the Standby message.
21. Remove the chamber, store the samples, and then replace the chamber.

## MASK REMOVAL

1. Prepare the sonicator to work in 1-minute intervals at low power.
2. Place acetone in a container to completely cover the sample.
3. Place the container with the sample in the sonicator and perform 1-minute cycles until all the material is removed, leaving only the desired structures.
4. Rinse the sample with deionized water and dry with air or nitrogen depending on availability or sample requirements.

# CHANGE CONTROL

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