POSITIVE LITOGRAPHY

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1. Wafer Preparation

Wafer Cleaning

The ideal process of silicon wafer cleaning is widely known as RCA cleaning process as it was first developed by RCA Labs. The RCA cleaning process consists of selectively removing organic and inorganic contamination that reside on the wafer surface without attacking the silicon wafer itself. In our Lab, we use a variation that is simpler as given below.

- The silicon wafer is kept in a water bath at around 70 ^{0}C for initial cleaning.
- Make sure that all of the equipment (wafer holder, tweezer, etc) are clean. If necessary, use acetone to clean them.
- Acetone is used to remove all organic, inorganic and metallic contaminant from the wafer surface.
- To remove acetone from the surface, rinse the wafer with water.

All the processes above are done in the fume-hood.

Dehydration Bake

- N_2 gun is used to spray-dry the wafer before baking. It is important to preheat the hot plate to reach 115 ^{0}C before using it.
- Use tweezer to put the wafer on the hot plate and then bake it to dehydrate the water for one minute.
- Cool down the wafer before coating with photoresist as the wafer is expected to be at room temperature during coating.

2. Photoresist Coating & Soft Bake

Use Shipley positive photoresist and spin-coating.

- Apply a couple of drops of Shipley (approx. 1 ml) coating on the wafer. Control of the amount of the solution is important as adequate solution to cover the whole surface of wafer is needed. Avoid excessive drops that could possibly cause air bubbles in the coating that will reduce the quality.
- Make sure that the wafer is placed it at the center of the spinner to maintain balance then spin at 2000 rpm for 45 seconds.
- After spinning, soft-bake the coated wafer on a hot plate at 115 ^{0}C for 1 minute to finalize the coating process.

Since the lithography will be done at room temperature, it will be necessary to cool it down before lithography.

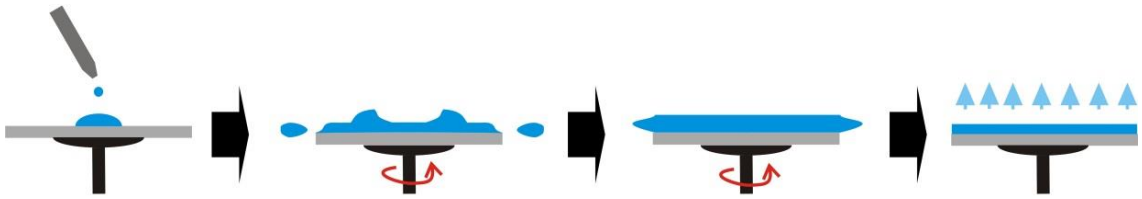

Figure 1. Spin Coating and Soft Bake Process Map

3. Photolitography

Photolitography is the process of transferring designs from a photomask to the wafer. UV light is used for exposing the photoresist. The UV light used has a wavelength range from 300-500 nm.

- Before starting, make sure that the UV source is ready by turning the power on and warming it up for 5-10 minutes. Make sure also that the mask to be used is clean. Proper cleaning of the mask should be done, if necessary.
- A Mask-aligner is used to center the wafer and place the mask on top of the wafer. A vacuum condition must be maintained between the wafer surface and the mask to get the best result. For this purpose, air suction is used to obtain a vacuum surface.
- To expose the wafer with UV, slide the mask aligner to the UV source area.
- Then, expose the wafer after setting the exposure timer. Typically, 40 seconds is adequate.

The dose of UV exposure is determined from the swing curve for the photoresist. With light intensity of UV source set at 23 mW/second, the exposure time is determined from such a graph to be 40 seconds.

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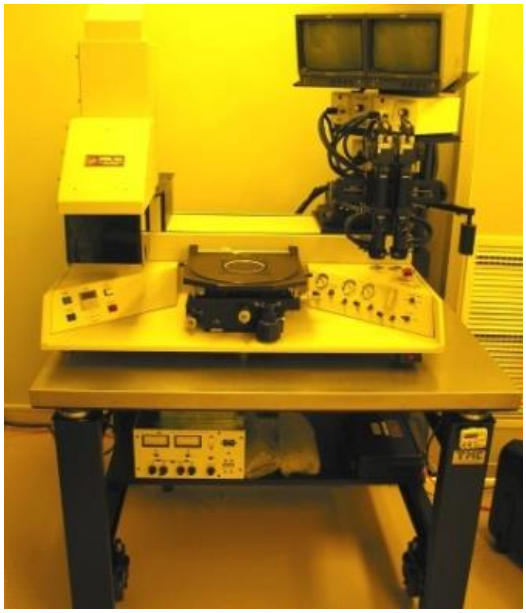

Figure 2. Mask Aligner with UV Exposure Unit

4. Developing and Resist Strip to Develop Features

Prepare a developer solution with Microposit 351 Developer mixed with water at a ratio of 5:1. Typical development time is about two minutes; but visual observation is needed to estimate the best development time. Inadequate development time will result in an underdeveloped feature, whereas over-developing the wafer might cause the loss of features.

Using a wafer holder or tweezer will be helpful to manipulate the wafer and agitate it gently during development.

5. Characterization/Imaging

Use Hirox 3D microscope for optical characterization of the final chip. There are two knobs that can be used to move the object in vertical and horizontal direction to center the object. Typically, you will need to use 50x to get full image and 100x magnification to have a detailed visualization. Make sure to use the focus knob properly, to get the best resolution.

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Figure 3. Hirox 3D Digital Microscope

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