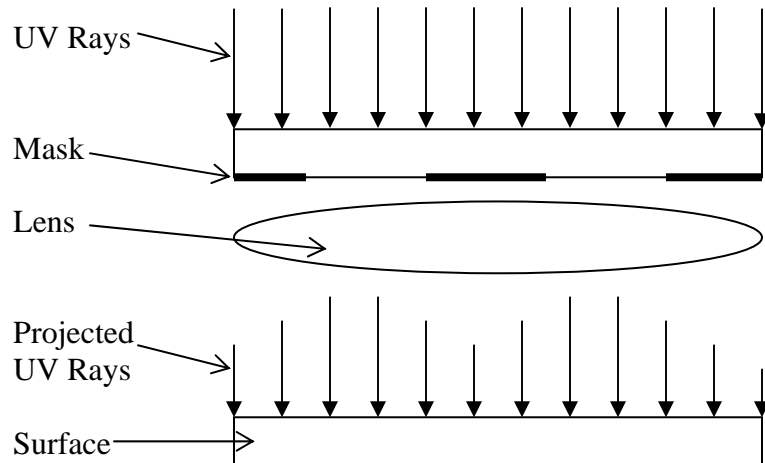


UV Lithography

UV lithography is perhaps the most commonly used photolithography technique in operation today. As the name implies, the crux of UV lithography centers around the properties and attributes of UV (ultraviolet) light. The overall concept of UV lithography is quite simple. UV light is shined through a mask onto a photoresist covered wafer. As the diagram shows, the mask stops some of the light from proceeding onto the resist covered surface.



Overall Process

The overall process of UV lithography contains about 8 steps:

1. Surface Preparation
2. Resist Coating
3. Pre-Bake
4. Mask Alignment
5. Exposure
6. Development
7. Post-Bake
8. Photoresist removal/Processing

1. Surface Preparation

Because of the extreme delicacy of the lithography process, great care must be taken when preparing a surface for lithography. All surface contaminants must be cleaned to perfection. Some common surface irritants include dust, lint, bacteria, water, and oil. To remove such pesky particles, the surface is soaked and rinsed in a number of different chemicals. The surface is then primed with more chemicals to aid in the resist adhesion.

2. Resist Coating

After the surface is cleaned and primed, the photoresist is applied by a method known as spin coating. Simply put, the surface is spun rapidly inside a vacuum, while being coated with the photoresist. The photoresist bonds uniformly to the surface, with the excess flying off during spinning. A coating solvent is then used to dissolve the buildup along the edge of the surface.

3. Pre-Bake

The pre-bake is a simple process of heating the surface in a convection oven or through a heated plate placed below the surface. The purpose of the pre-bake is to evaporate the excess coating solvent and to compact and harden the photoresist.

4. Mask Alignment

- **Photomask:** A photomask is a desired pattern that can be transferred onto a surface by means of light waves. The mask creates a sort of shadow between the light and the surface. Less light passes through sections blocked by the mask. Masks can be created by several different ways, but one of the most common and accurate methods is using an electron beam to etch a desired mask.

The mask must be aligned correctly in reference to the surface. This procedure is accomplished by hand using certain marks on the mask and the surface, or by using an automatic pattern recognition device. There are several different ways the mask can be placed in reference to the surface, including:

- **Contact:** The mask is in contact with the surface during exposure.
- **Proximity:** The mask is close but not touching the surface during exposure.
- **Projection:** The mask is not close to the surface, and the light passing between them is subject to imaging optics.

5. Exposure

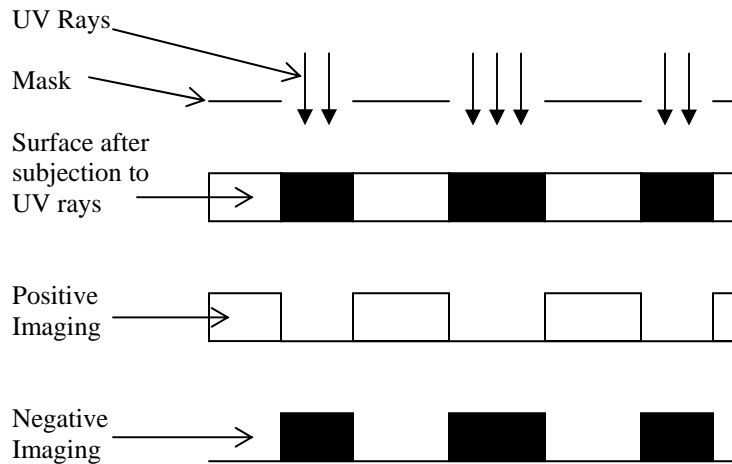
The photoresist, surface, and mask are subjected to UV light via a UV lamp.

6. Development

During the development stage, chemicals are applied to the surface causing either a positive photoresist reaction or a negative photoresist reaction.

- **Negative:** The molecules in the resist that are subjected to the most UV rays are bonded strongly together in long chains (polymerization). After the subsequent development process, the non-polymerized sections of the resist decompose and only the polymerized resist remains.

- **Positive:** Opposite of a negative photoresist. Sections of the resist are chemically altered to decompose when exposed to UV light; therefore after the development, only the sections not exposed to UV light remains.



7. Post Bake

The post bake is used to stabilize and harden the photoresist. It also removes any trace of development chemicals.

8. Photoresist Removal/Processing

Remember that the photoresist is only a means to an end; the important thing is the surface either underneath or below the photoresist. To remove the excess photoresist, simple solvents are used. The following cases are the results when the photoresist is applied on top or on bottom of the desired surface.

- **Etch-back:** The photoresist is applied overtop the layer that is wanted to be patterned. The unwanted material is etched away.
- **Lift-off:** A layer is deposited over top of the photoresist. When the resist is removed, the unwanted layer is also removed.

References:

Darling, R.B., EE-527

Fundamentals of Microfabrication