Lab Report

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1 Objective

To observe and learn the process of lithography in the laboratory, focusing on laser writer lithography for creating high-resolution patterns on substrates.

2 Theory

Lithography is a crucial microfabrication technique used to create intricate patterns on substrates. Laser writer lithography, a maskless method, directly writes patterns onto photoresist-coated surfaces using a focused laser beam. This enables high-resolution designs and rapid prototyping without the need for physical masks. In this process, the substrate is coated with photoresist, a light-sensitive material whose chemical properties change upon laser exposure.

Positive photoresists become more soluble in the developer solution after laser exposure, whereas negative photoresists harden, allowing unexposed areas to be removed. This versatile technique is widely employed in precision patterning for semiconductor manufacturing, microelectronics, and other fields requiring high-resolution fabrication.

3 Materials Used

- Positive or negative photoresist (e.g., Shipley S1813)
- Substrate (e.g., Silicon wafer, glass)
- Laser writer lithography system
- Developer solution (e.g., MF-319 for positive resist)
- Spin coater
- Acetone, IPA (Isopropyl Alcohol) for cleaning
- Hotplate
- Nitrile gloves
- Tweezers
- Nitrogen gas blower or air gun

4 Procedure

1. Clean the substrate with acetone or IPA and dry using nitrogen gas.
2. Spin coat the substrate with positive or negative photoresist.
3. Perform a soft bake at 90°C for 60 seconds to remove solvents.
4. Load the substrate into the laser writer lithography system.
5. Adjust laser power, focus, and exposure time to achieve the desired resolution.
6. Expose the photoresist to the laser to create the pattern.
7. Develop the exposed substrate in the developer solution for 30-60 seconds.
8. Rinse in deionized water and dry using nitrogen gas.
9. Perform a hard bake at 120°C for 90 seconds to stabilize the pattern.
10. Inspect the substrate under a microscope for defects and pattern accuracy.

5 Observations

Laser Power	Laser Exposure Time	Laser Spot Size	Developing Time	Pattern Resolution	Hard Bake Temp	Hard Bake Time
140 mJ/cm^3	6min 16s	1 μm	40 s	0.6 μm	120 $^{\circ}C$	60s

Table 1: Observation table

6 Result

The lithography process was successfully observed and executed. A high-resolution pattern was created on the photoresist-coated substrate using laser writer lithography, followed by successful development and stabilization. After the process, the substrate was inspected for defects and pattern accuracy, demonstrating the effectiveness and precision of laser lithography for efficient and high-quality patterning.