

PMMA/LOL-2000 Bi-layer E-Beam Resist Process for Metal Lift-off of sub 50nm features

Purpose:

This bi-layer process is designed for the patterning, metallization, and lift-off of sub 50 nm features.

Equipment:

1. SVG Track Coater/Developer
2. Nanospec Film Thickness Monitor
3. FEI 430 NanoSEM E-Beam Lithography System
4. E-Beam Evaporator

Spin Coating Process:

1. A new wafer is strongly recommended to use. If re-using an old wafer, clean with a Piranha solution, then rinse with DI water and dry with a nitrogen gun.
2. Bake the wafer on an open-faced hot plate for 10 minutes at 200°C to remove the adherent layer of water molecules.
3. Remove the wafer from the hotplate and let it cool for 2 minutes.
4. While the wafer is cooling, program the SVG Track Coater with the following recipe for LOL-2000:

	Seconds	RPM	Temp °C
Dispense	20	60	20
Spread	7	400	20
Spin	45	6000	20
Wash	8	2000	20
Bake	120	0	220

5. Allow the temperature of the hotplate to reach the desired setting. While waiting it's a good idea to complete a quick test run of the recipe using a dummy wafer.
6. Load the wafer in the Load Cassette and Press Start.
7. Dispense ~5ml of the LOL-2000 in the center of the wafer using a glass syringe and a 0.1um filter during the "Dispense" event.
8. After the "Baking" event, allow the wafer to cool for at least 5 minutes on the cooling chuck.
9. Measure on the Nanospec to determine film thickness. Using the above recipe should yield ~175nm film.
10. While waiting for the wafer to cool program and test the following recipe for PMMA:

	Seconds	RPM	Temp °C
Dispense	25	50	20
Spread	6	400	20
Spin	45	3000	20
Wash	8	2000	20
Bake	300	0	180

11. Load the cooled wafer back on the "Load Cassette" and press Start to begin the new recipe.
12. Dispense ~5ml of 2% PMMA in Anisole on the center of the wafer using a clean glass syringe and a new 0.1 μm filter during the "Dispense" event.
13. Allow the wafer to cool for ~5 minutes on the cooling chuck.
14. Measure on the Nanospec. The total film thickness should be ~255nm (PMMA recipe should yield ~80nm film).

Exposure Process:

1. Expose using the FEI 430 NanoSEM EBL System at 30kV 1.6 spot size. If using the bi-layer for the first time, it is a good idea to complete a dose array to determine exact dose for the feature size desired.
 - a. Area dose ~300 $\mu\text{C}/\text{cm}^2$
 - b. Line dose
 - c. Point dose
2. Develop in MIBK:IPA (1:3) solution with slight agitation for 70 seconds.
3. Rinse in an IPA bath for 60 seconds.
4. Dry with nitrogen gun.
5. Bake under lamp for 5 minutes to remove solvents.
6. Inspect in SEM using 5kV, 2.0 spot size to determine if pattern cleared fully.

Descum Process:

1. Mix a 1:5:5 solution of CD-26:H₂O:IPA
2. Immerse exposed sample in solution for 15 seconds
3. Rinse with DI water and dry with nitrogen gun

Metallization and Lift-Off:

1. Metallize in E-Beam Evaporator with desired metal. For bi-layer film thickness it is best to use ~10nm metal film.
2. Perform lift-off on a stirrer/hotplate under a fume hood. Place solvents in a Petri dish with a small stir bar.
 - a. Cyclohexanone bath for 5 minutes at 60C
 - b. Clean cyclohexanone bath for 5 minutes at 60C
 - c. IPA bath for 5 minutes at 60C
 - d. Clean IPA bath for 5 minutes at 60C
 - e. Spray rinse with IPA and dry with nitrogen gun.
3. Inspect metalized pattern in FEI SEM.

Process Overview

