T-Topping Study Report

Updated on 10/2/2015

Critical Factors

- Use of an Omega 360 nm long pass optical filter in place of a borosilicate plate significantly reduces the presence of T-topping of overexposed SU8 resist.

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Goal

Test the difference between borosilicate and the 360nm long pass filter for various levels of overexposure during mask exposure step of SU-8 master fabrication for T-topping phenomena.

Materials

- SU-8 2050
- 3 inch diameter silicon wafers
- Transparency photomasks
- Omega 360 nm long pass filter (360LP)
- Borosilicate plate

Equipment

- Laurell spinner
- Hotplate
- ABM mask aligner

Protocol

SU-8 spinning

1. Set spin parameters:
    a. Vacuum = "req"
    b. Step 1 of 2: 500 rpm, accel = "100", 30 sec
    c. Step 2 of 2: 2000 rpm, accel = "300", 30 sec
2. Positioned and centered wafer on spinner chuck
3. Poured SU-8 2025 photoresist without air entrapment to ~ 50 mm diameter
4. Spun the wafer
5. Transferred spun wafer to 65 ºC hot plate for appropriate bake time
6. Transferred spun wafer to 95 ºC hot plate for appropriate bake time

Resist exposure and development

1. Started the ABM UV lamp (channel A, 365nm) After suitable warmup period, measured bulb exposure power:
    a. Using power meter set to channel A, measured power through transparency, glass blank, and Omega Optical filter
        i. Alternatively, a recent power output value can be found in the power output log located in the ABM Operating Procedure binder
    b. Computed required exposure time based on exposure energy values given on SU-8 data sheets
        i. $Exposure\ time = \frac{Exposure\ energy\ needed}{ABM\ power\ output}$
2. Positioned wafer and photomask
    a. The mask used for this experiment consisted of a series of 25µm clear sections separated by 50 µm opaque sections.
3. Positioned foil aperture to block portions of the wafer that are not to be exposed
4. Contacted to 360LP filter or borosilicate plate
5. Exposed wafer
6. Repeat
7. Post-exposure bake at 65 ºC and then 95 ºC for appropriate bake time
8. Developed in bath of SU-8 developer for 5-10 min with periodic agitation
9. Rinsed with acetone and IPA and nitrogen blow-dried

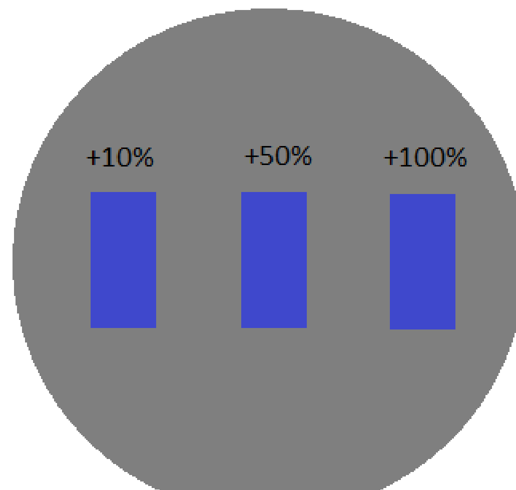

Figure 1: Schematic of layout of mask exposures. Exposure times were calculated from the suggested times from the SU-8 data sheet and overexposed by the indicated percentage.

Results

Borosilicate Plate

Overexposure of SU-8 using only a borosilicate plate quickly results in observable T-topping as can be seen in Figure 2 at just 10% overexposure. The T-topping gets more pronounced with further overexposure.

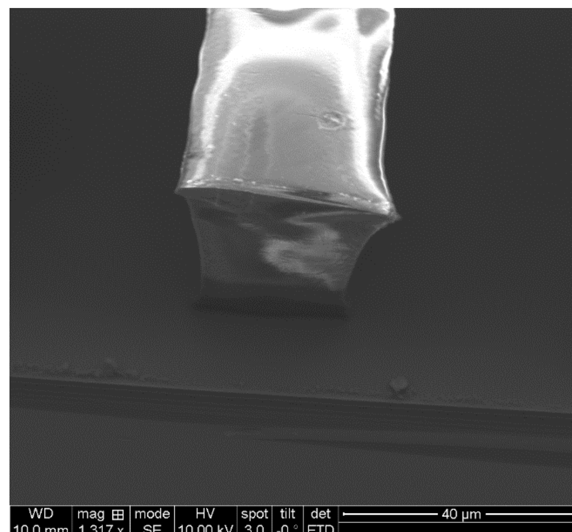

Figure 2: SEM of SU-8 feature overexposed by 10% with borosilicate plate

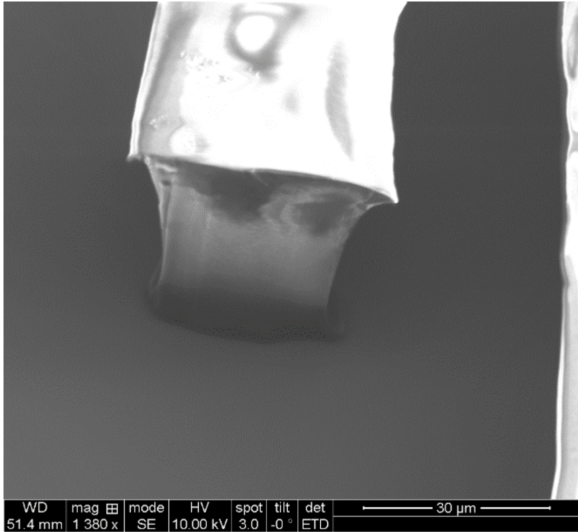

Figure 3: SEM of SU-8 feature overexposed by 50% with borosilicate plate

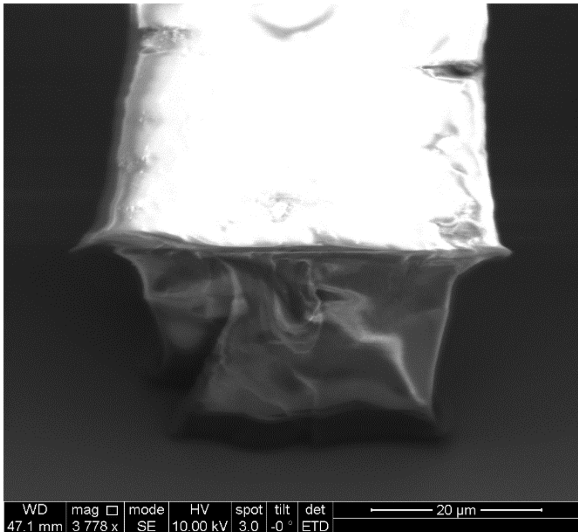

Figure 4: SEM of SU-8 features overexposed by 100% with borosilicate plate

Omega 360 Long Pass Optical Filter (360LP)

Usage of the 360LP filter diminishes the effects of overexposure. Even at 100% overexposure (Figure 7) there is barely any sign of T-topping.

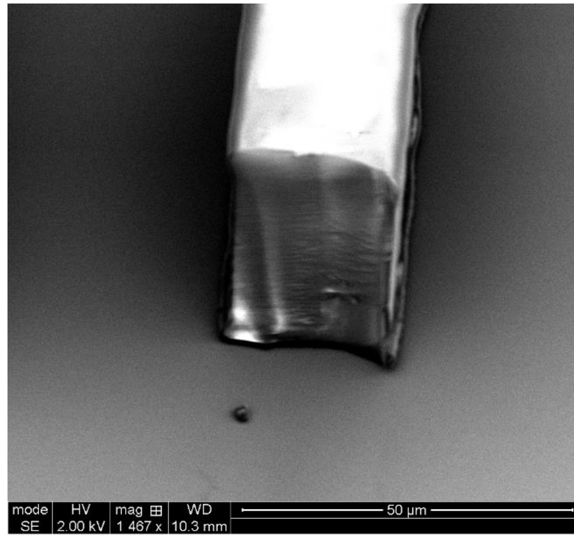

Figure 5: SEM of SU-8 feature overexposed by 10% with 360LP filter

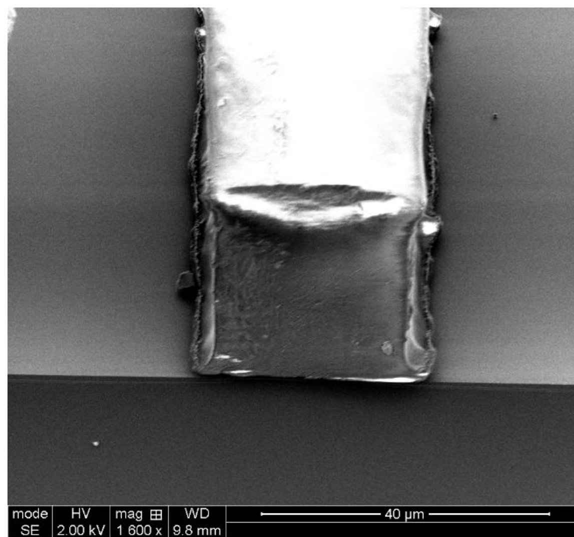

Figure 6: SEM of SU-8 feature overexposed by 50% with 360LP filter

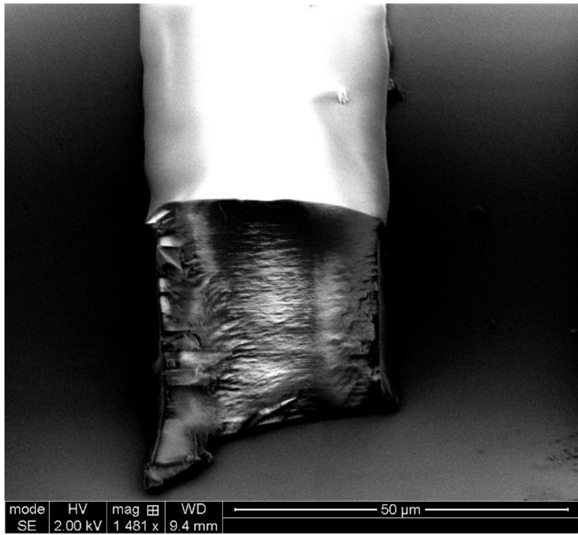

Figure 7: SEM of SU-8 feature overexposed by 100% with 360LP filter