How to make tall (150 – 250 micron) features in SU-8 on Silicon

Materials:
SU-8 2150
new silicon wafers
Acetone, isopropanol, SU-8 developer

Tools needed:
Class II resist room RC8 spinner
SU-8 hot plates
resist oven (in either resist spinning room)
High-temperature PDMS oven (Duffield 224) -or- YES Polyimide Oven (clean room)

NOTE:
This is a new process so plan on adjusting the parameters based on your material and features.
Any work in the class II resist room requires a short orientation/training by Beth beforehand.
You should be trained on the RC8 spinner and SU-8 hot plates beforehand.

Process (for 170 micron-thick SU-8 mold for casting PDMS)
1.Dehydrate new wafers just before spinning (oven ≥ 12 hours at 90 °C or hotplate ≥ 30 minutes at 130 °C).

2.Load wafer onto RC8 and pour symmetric, 2-inch puddle of SU-8 2150. Pour in an expanding spiral pattern because a tall puddle and wait for the random trapped bubbles to dissipate as the puddle slightly spreads. Otherwise, a tall puddle will stick to the lid when it closes.

3.Program oo1 to spread the resist to within a cm of the edge (500 rpm, 20 sec, 100 rpm/sec).

4.Program oo1 to apply the resist at target thickness:
Ex. 3200 rpm,45 sec,300 rpm/sec average 150 um (120-180 variation)
Ex. 3000 rpm,45 sec,300 rpm/sec average 190 um (120-240 variation)
Ex. 2700 rpm,45 sec,300 rpm/sec average 225 um (150-300 variation)
*(**NOTE**: the tachometer on the RC8 shows slower than actual speed)*
The wide variation is due several factors: uneven spreading of the puddle, an edge bead that reflows towards the wafer center during pre-bake and/or unlevel hot plates. Plan on making extra wafers and have many copies of your device on a wafer.

5.Using an acetone-wetted wipe, clean the backside of the wafer. *You may also like to try to wipe away the edge bead. If you clear the outer 5 mm, the SU-8 can re-flow towards the edge instead of the center. Sometimes it works, sometimes it doesn't.*

6.Place the wafer on a leveled, room-temperature SU-8 hotplate. Cover the wafer with a glass petri dish. Leave a space for solvent to escape by overlapping the dish with the edge of the hot plate or propping it up with a couple glass slides.

7.Ramp from room temperature to 65 °C (ramp rate of 5 °C/min).
Hold at 65 °C for 10 min.
Ramp to 95 °C.
Remove the glass cover dish.
Hold at 95 °C for 90 min.
Turn off the hotplate and wait for it to cool to room temperature (1 hr)

THE WAFERS CAN BE STORED OVERNIGHT AT THIS STEP. ONCE WAFERS ARE EXPOSED, THE PROCESS HAS TO BE COMPLETED.

8.Expose on ABM with a 360 LP filter 560 – 670 mJ/cm. Break exposures into 15-sec intervals with 15-sec rest intervals.
Run a dose matrix since this is feature-specific. Large features tend to crack with overexposure.

9.Place wafers on room-temperature hot plates, and wait 10 minutes for complete Lewis acid formation.

10.Ramp from room temperature to 65 °C.
Hold at 65 °C for 3 minutes
Ramp to 95 °C
Hold at 95 °C for 30 minutes
Ramp to room temperature by turning the hot plates down (1 hour)

11.Develop in SU-8 developer. *This can take a long time (hours instead of minutes), especially if there are confined spaces or closely pitched features. In this case, load the wafers in a holder and suspend them above a slowly moving stir bar on a stir plate.* Occasionally rearrange the wafers so that all are exposed to the stir bar equally.

12.Dip the wafer in a fresh bowl of SU-8 developer for 30 seconds.
Rinse with IPA and dip in a bowl of IPA. If there is any white precipitate forming around the features, the edges are not developed yet. Put it back into SU-8 developer (and possibly freshen the developer).

13.Do a final dip in IPA for 30 seconds. Dry with nitrogen.

14.Optional Hard bake to repair stress cracks or prepare SU-8 for high temperatures.
- YES Polyimide oven Recipe 1 (200 °C) takes 6 hours mostly for cool down.
- High-temperature PDMS oven in 224 Duffield
  - ramp from room temperature to 190 °C
  - hold at 190 °C for 30 minutes
  - Turn off the oven and remove the wafers when it has cooled.