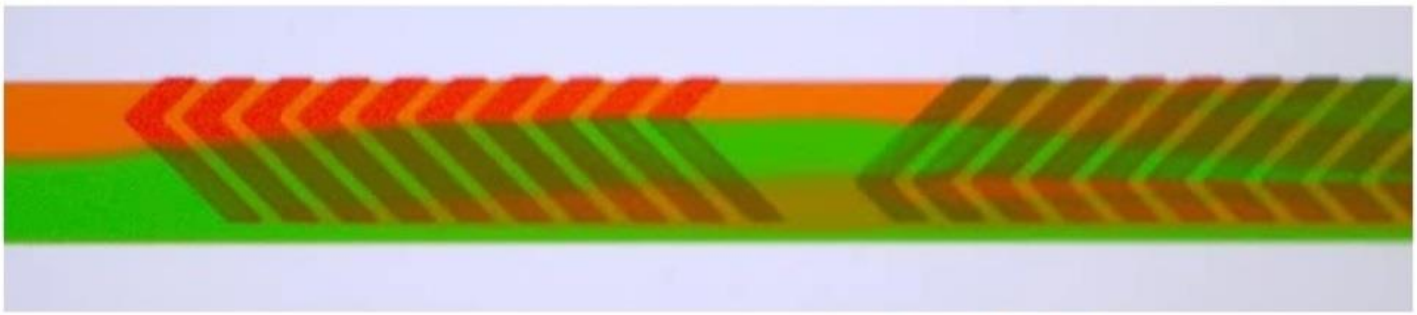
KMPR Master Fabrication Protocol

Updated September 2017



SINGH Center for Nanotechnology

Penn University of Pennsylvania

Table of Contents

Materials

- KMPR-1050
- SU-8 (KMPR) developer
- 3 inch diameter silicon wafers
- Acetone
- Isopropyl alcohol (IPA)
- PDMS (base + curing agent)

Equipment

- Spin coater
- Hotplate
- ABM mask aligner
- Vacuum chamber
- Anatech barrel asher

Video References

- Spin coating thick resist (http://repository.upenn.edu/scn_video/2)
- ABM mask aligner (http://repository.upenn.edu/scn_video/6)
- Developing with SU8 resist (http://repository.upenn.edu/scn_video/4)
- PDMS degassing (http://repository.upenn.edu/scn_video/5)

Protocol

Resist Spinning

1. Bake wafer at 200C for 10 minutes
2. Set spin parameters:
    a. Step 1 of 2: 500 rpm, accel = "100", 30 sec
    b. Step 2 of 2: Refer to KMPR data sheet to determine the spin speed necessary for desired thickness, 30 sec (Figure 1)
3. Position and center wafer on spinner chuck
4. Pour KMPR photoresist without air entrapment in the center of the silicon wafer (Image 1)
5. Spin the wafer
6. If performing multiple spins, wipe spinner hood between wafers to prevent excess KMPR from dripping onto samples

Image 1

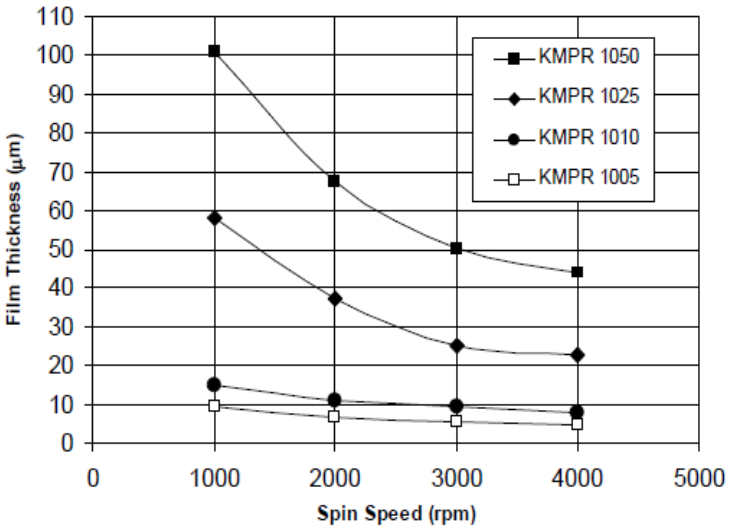


Figure 1. Spin speed vs. Thickness for KMPR® 1000 resists (21°C US & EU)

Soft Bake

1. Refer below to KMPR data sheet for appropriate soft bake time (Table 2)

THICKNESS microns	SOFT BAKE TIME minutes @ 100°C
5 - 11	5
12 - 20	7
21 - 30	12
31 - 55	15
56 - 80	20

Table 2. Soft Bake Times

Exposure

1. Calculate the necessary exposure time
   a. Refer to KMPR data sheet for necessary exposure energy (Table 3, 4, 5 and Figure 2)
   b. The power output of the UV lamp can be found in Table 5 or in the Power Output log in the Data Sheet binder
   c. Exposure Time = Exposure Energy ÷ Power Output
   d. Set timer to the above result
2. Position wafer and photomask
3. Bring wafer into contact with the mask by pressing the WEC button (image 3) and switching the contact switch upward (Image 4)
4. Expose wafer by using the Cycle button

THICKNESS microns	EXPOSURE ENERGY mJ/cm^2
5 - 11	235 - 335
12 - 20	355 - 485
21 - 30	500 - 645
31 - 55	665 - 1055
56 - 80	1070 - 1465

Table 3. Exposure Dose

	RELATIVE DOSE
Silicon	1X
Glass	1.5X
Pyrex	1.5X
Indium Tin Oxide	1.5X
Silicon Nitride	1.5 - 2X
Gold	1.5 - 2X
Aluminum	1.5 - 2X
Nickel Iron	1.5 - 2X
Copper	1.5 - 2X
Nickel	1.5 - 2X
Titanium	1.5 - 2X

Table 4. Exposure Doses for Substrates

Three things to check before exposure:

1. Contact mode enabled
2. Long pass filter in place (if using)
3. Exposure time is set

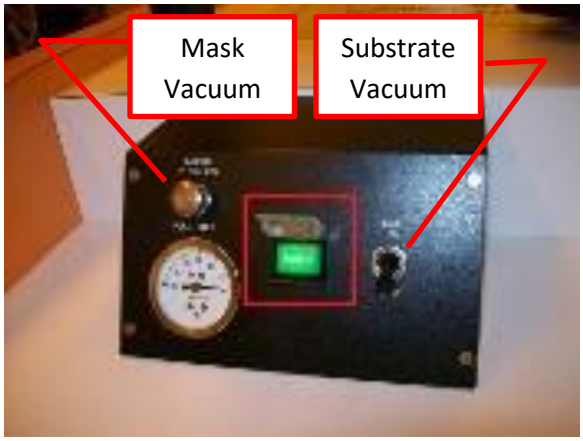


Image 2

	365nm					
Date	Nothing	Glass Mask	Glass + Film Mask	Glass Mask + LP Filter	Film Mask + LP Filter	Film Mask + Glass + LP Filter
Standard	25	22.1	18.4	13.7	12.8	10.4

Table 5. Lamp Power Output (Units: mW/cm²)

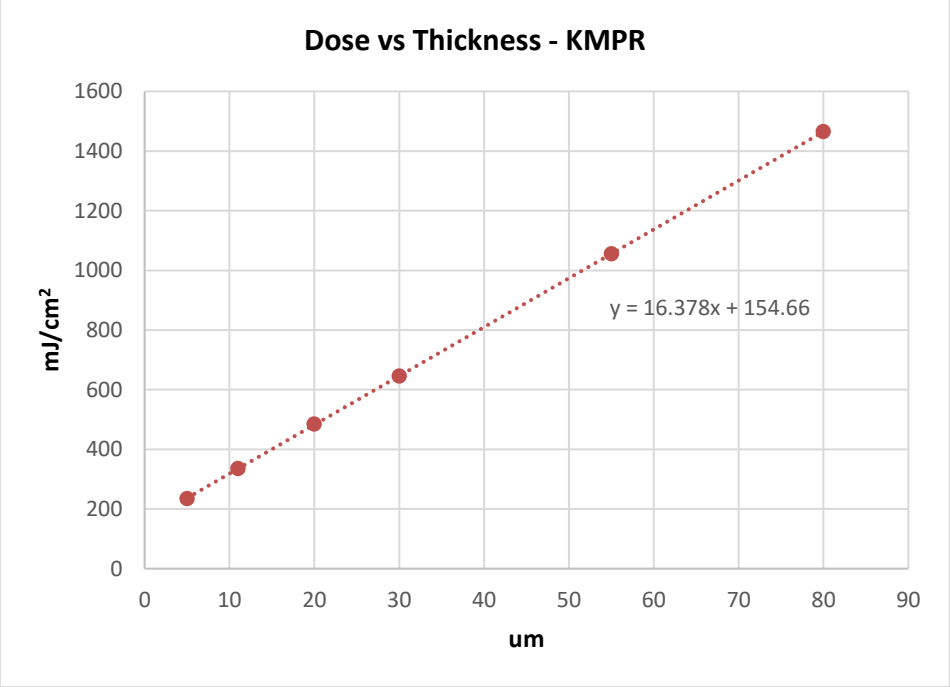


Figure 2

Image 3

Image 4

Post-Exposure Bake

1. Place wafer on the hotplate at 100°C for post-exposure bake
    a. 2 minutes for < 25 µm
    b. 3 minutes for 25 to 50 µm
    c. 4 minutes for > 50 µm

Development

1. Pour just enough SU-8 developer into glass container such that the wafer will be fully submerged when placed into the bath
2. Carefully place the wafer into the bath
3. Develop in bath of SU-8 developer with constant agitation (Image 5)
4. Development is complete when developer is completely clear and there are no signs of undeveloped resist coming off the surface
5. Rinse in acetone and IPA
6. Place the wafer flat on a cleanroom wipe
7. With the nitrogen gun, blow/push the IPA off the surface of the wafer, starting at the center, until dry (Image 6)
    a. Appearance of a white film during IPA rinse indicates the resist is underdeveloped—simply place the wafer back into the developer bath to complete development

Image 5

Image 6

PDMS Preparation

1. Vigorously mix PDMS *base* and PDMS *curing agent* at a 10:1 ratio by weight (use scale) for about 5 minutes
    a. For sufficient coverage in a circular aluminum dish, approximately 35g of PDMS is needed
2. Pour PDMS over the fabricated master in a circular aluminum dish
3. Place the dish into the vacuum chamber and degas the mixture for 30 minutes or until all bubbles have disappeared

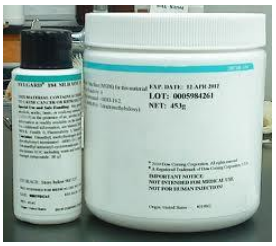


Image 7

   a. Remaining air bubbles in surface can be ruptured by blowing on the surface
4. Place the dish into the oven or on a hotplate at 80-100 °C—curing should complete in 20-30 minutes (note: styrene dishes begin to deform at higher than 65C)

Plasma Bonding

1. Place slide and PDMS mold on glass slide or dish with features facing up (Image 8)
2. Vent Anatech and place samples in chamber
3. Select PDMS from recipe list
4. Press "Start Vacuum" to start process (the button below must read "Auto" (Image 9)
   a. Recipe shown in Image 10
5. Process will automatically vent
6. Remove samples
7. Place the PDMS mold on the glass with a very gently press
8. Heating for 20 minutes at 60C – 100C will improve the bond

Image 8

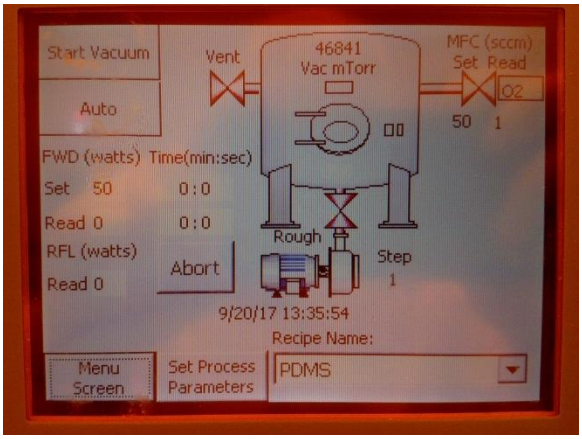


Image 9

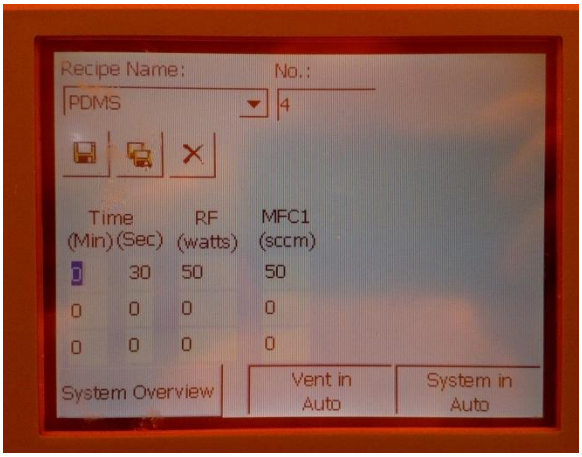


Image 10

Notes: