

SU-8 Post-Development Bake (Hard Bake) Study

Updated on 14 July 2017

Critical Factors

The post-development bake (hard bake or annealing step) at 150°C for 30 minutes is observed to improve adhesion of the under-exposed SU-8 structures with 2:1 aspect ratio.

A post-development step can also ensure that SU-8 2000 properties do not change in actual use. SU-8 2000 is a thermal resin and as such its properties can continue to change when exposed to a higher temperature than previously encountered.

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Goal

To test adhesion of under-exposed SU-8 to silicon substrate by post-development (PD) bake.

Results

Wafer Treatment	Result	Comments	Image
No treatment	The structures are not well adhered	Induced under exposure resulted in poor adhesion	Fig: 1, 3, 9, 11, 7, 5
No PD bake treatment wafer subjected to PDMS testing	The channels are peeled off along with PDMS	Weak adhesion resulted in channel peel off	Fig: 2, 4
5 min PD bake at 150°C	No significant change in the adhesion	The baking time of 5min is not sufficient to improve adhesion	Fig: 6, 8
30 min PD bake 150° C	The adhesion is improved	The absence of interference fringes at the edges means improved adhesion	Fig: 10, 12
30 min PD bake 150° C followed by PDMS testing	The structures remain intact after testing with PDMS	This shows improved adhesion due to bake	Fig: 14, 16

**To get reliable results, images of the same areas on the wafer are compared before and after treatment*

No PD bake followed by PDMS peel test

Before PDMS Peel Test

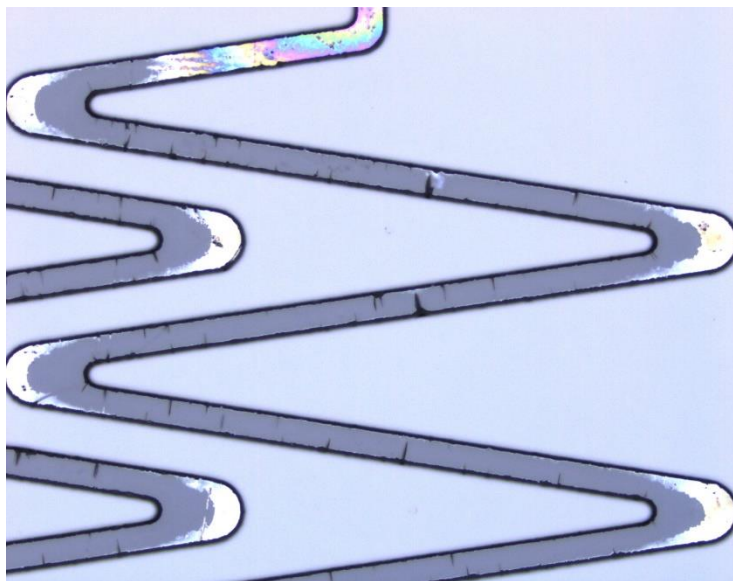


Figure 1 Under-exposed wafer prior to PD bake

After PDMS Peel Test

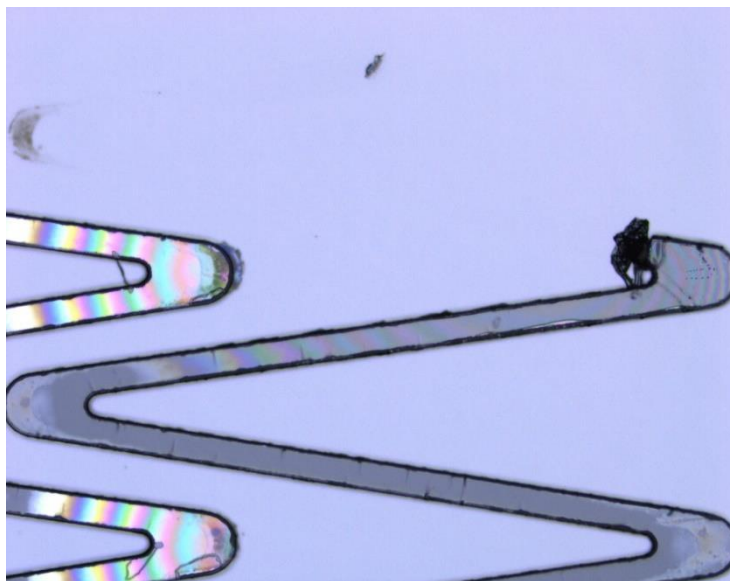


Figure 2 Delamination after PDMS peel test

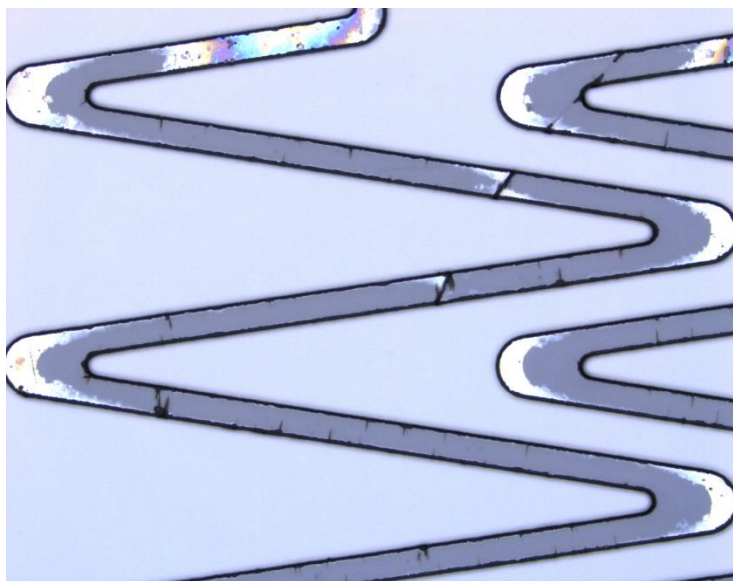


Figure 3 Under-exposed wafer prior to PD bake

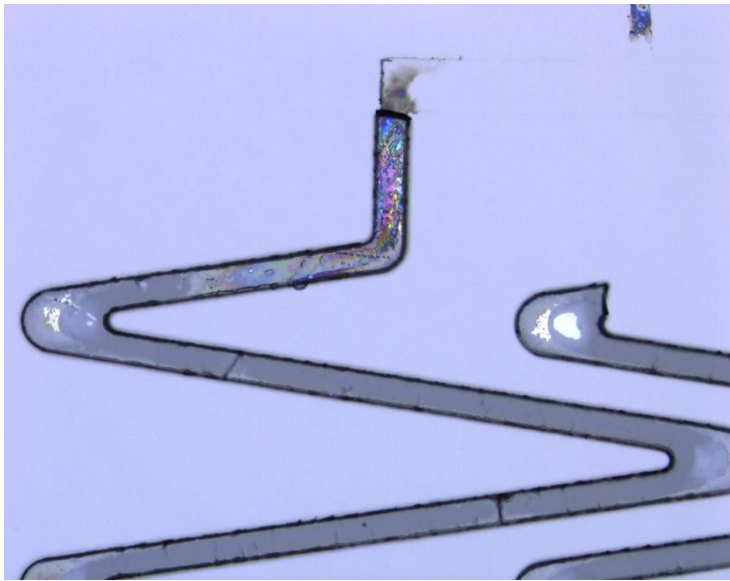


Figure 4 Delamination after PDMS peel test

5 min PD bake at 150°C

Before Bake

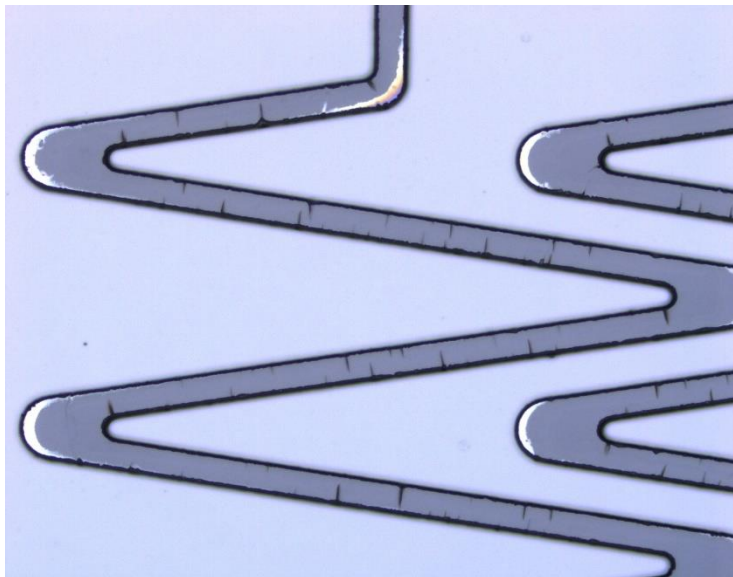


Figure 5 Under-exposed wafer prior to PD bake

After Bake

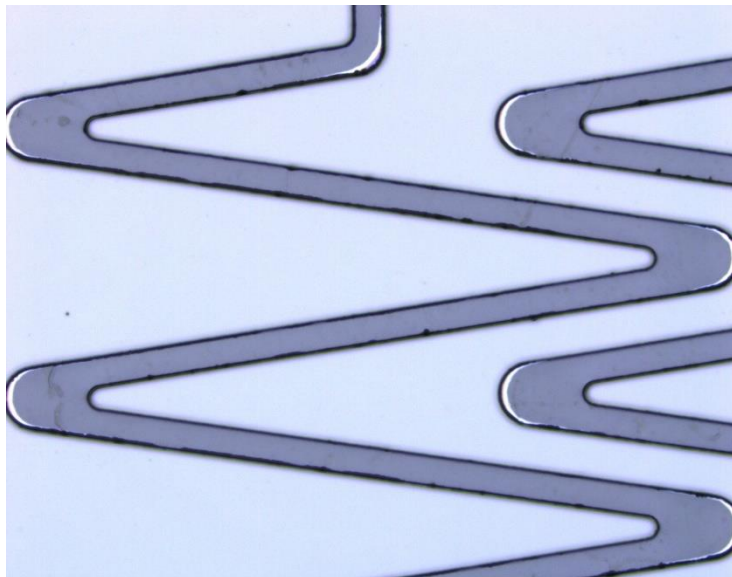


Figure 6 Insufficient time resulted in minor healing of interference fringes

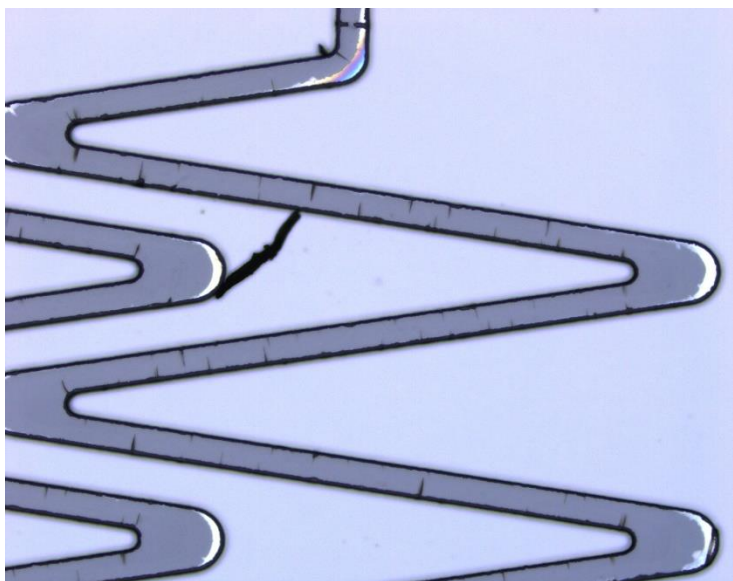


Figure 7 Under-exposed wafer prior to PD bake

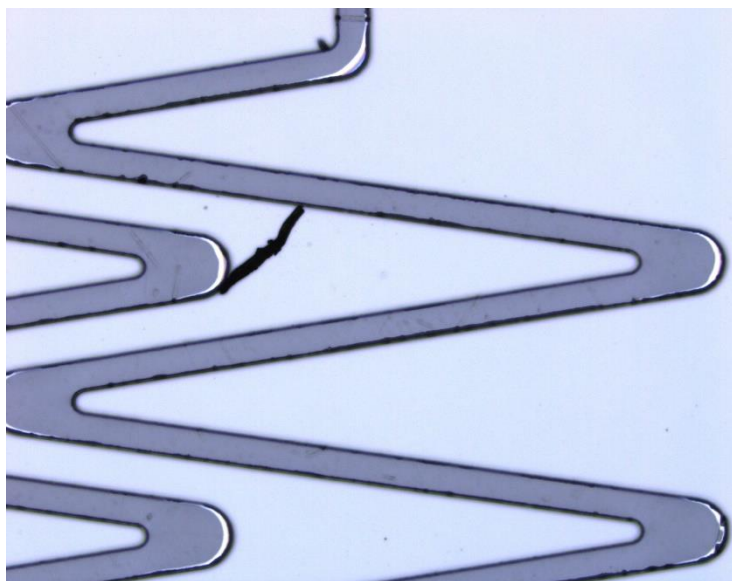


Figure8 Insufficient time resulted in minor healing of interference fringes

30 min PD bake at 150°C

Before Bake

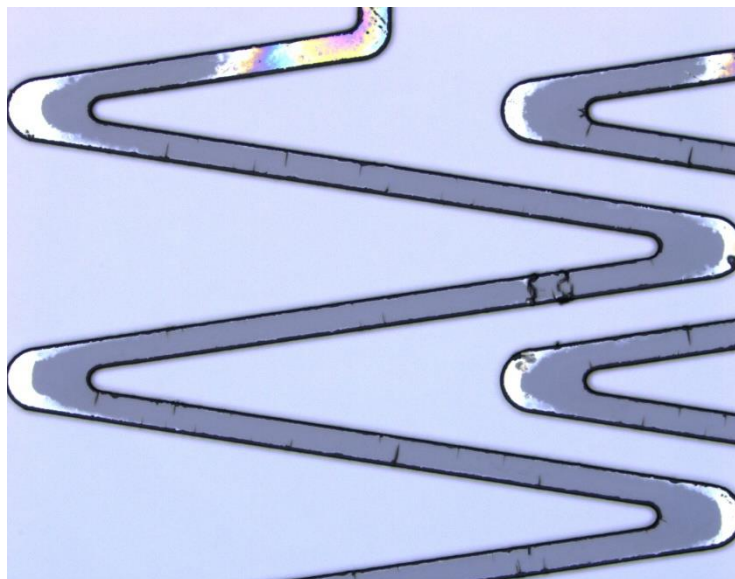


Figure 9 Under-exposed wafer prior to PD bake

After Bake

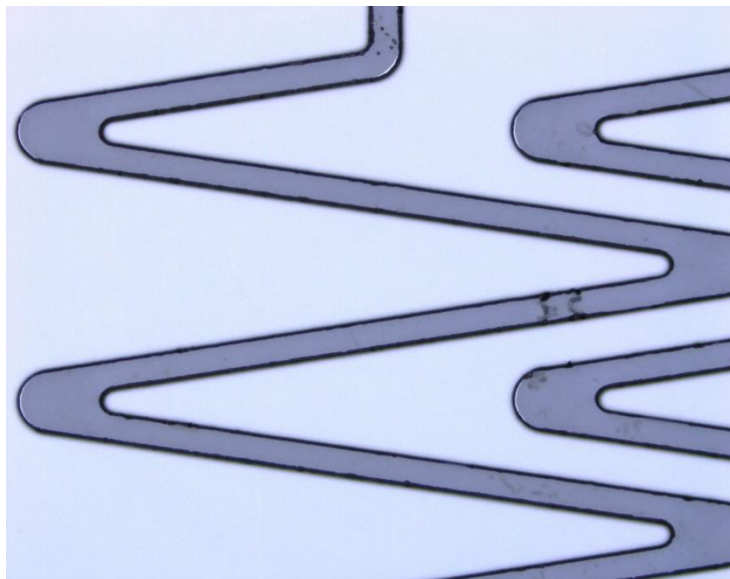


Figure 10 Interference fringes showing areas of weak adhesion vanished after PD bake

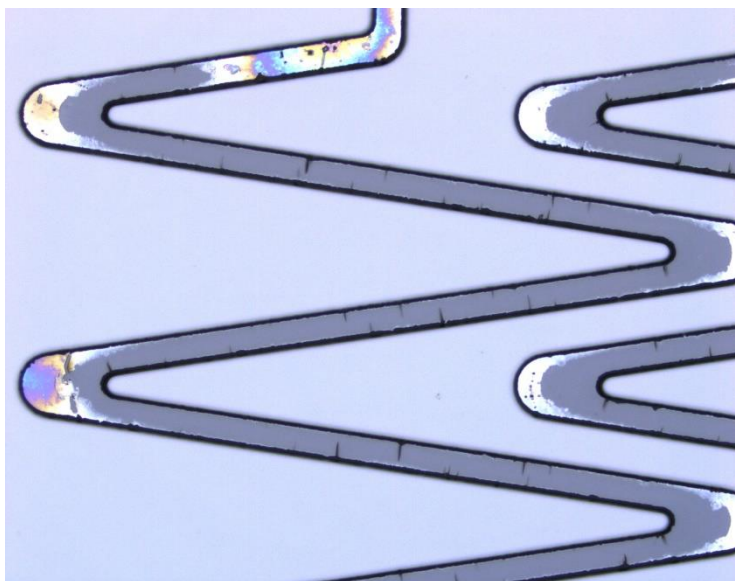


Figure 11 Under-exposed wafer prior to PD bake

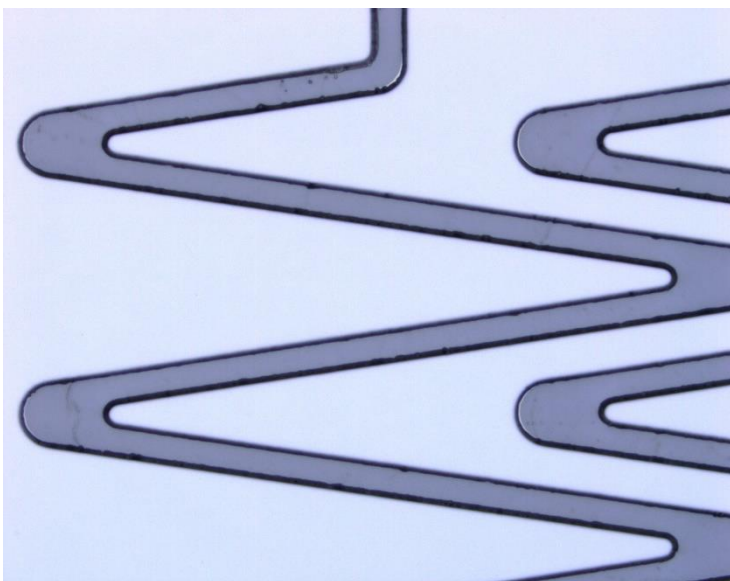
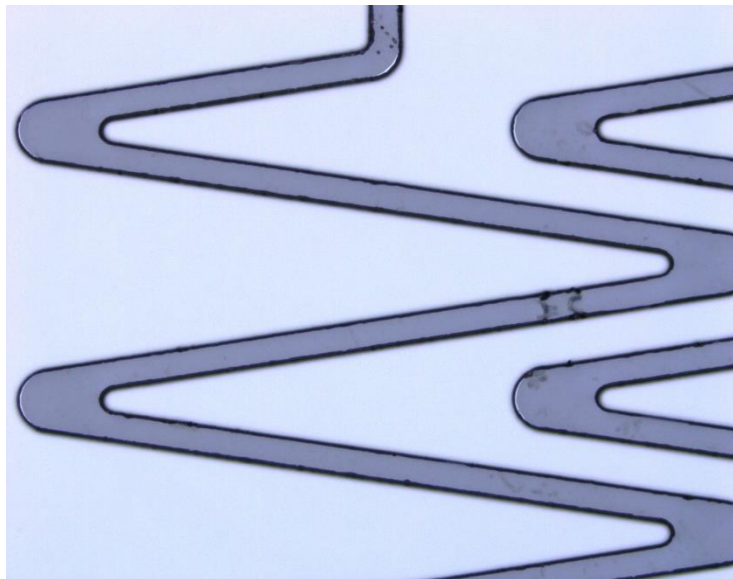
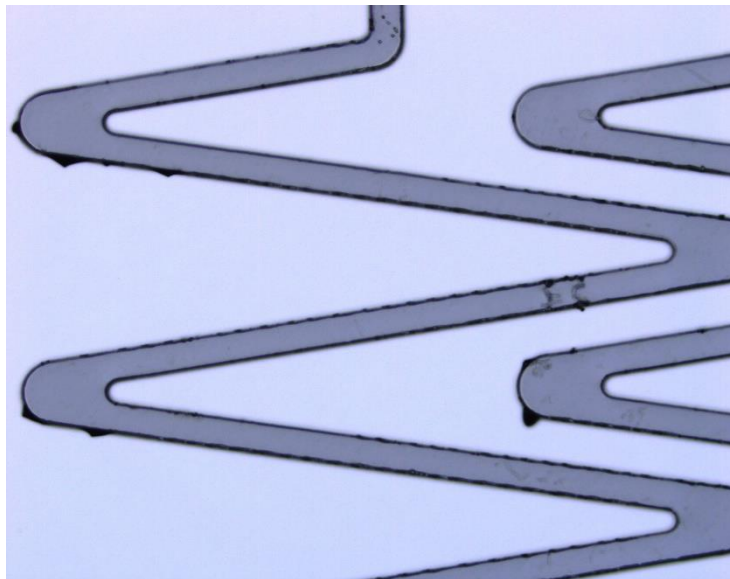
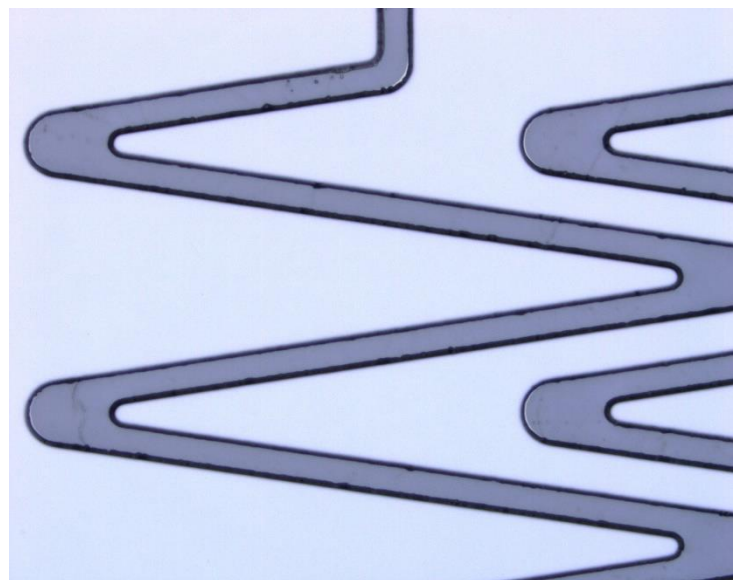
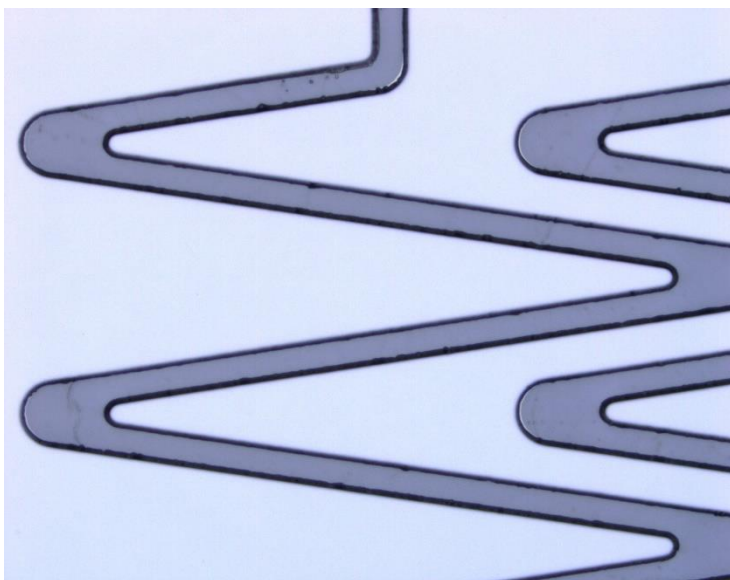


Figure 12 Interference fringes showing areas of weak adhesion vanished after PD bake

30 min PD bake at 150° C followed by PDMS testing***After PD Bake****Figure 13 Channels after PD bake and before PDMS peel test****After PDMS Peel Test****Figure 14 Channels do not delaminate after PDMS peel test**Figure 15 Channels after PD bake and before PDMS peel test**Figure 16 Channels do not delaminate after PDMS peel test*

Materials

- SU-8 2050
- 3-inch diameter Silicon wafer
- Mask with features of width 70 Microns (transparency film)
- SU-8 Developer
- Isopropyl alcohol (IPA)
- PDMS
- PDMS curing agent

Equipment

- Laurell spinner
- Hotplate
- Vacuum chamber
- Oven
- ABM mask aligner
- Zeiss Axio Imager M2m at 5X optical zoom

Protocol

Experiment

- Plain wafer is baked for 15 minutes at 200 degrees
- 100 μm thickness layer is deposited by spin coating 2050 SU-8 at 1700RPM
- It is subjected to soft bake at 65 degrees for 5 min and 95 for 20 min
- After exposing the wafer at specific dose (230 mJ/cm^2) and time, it is subjected to post-exposure bake at 65 degrees for 5 min and 95 for 10 min
- The wafer is developed for 10 min in SU-8 developer, sprayed with IPA and blow dried with Nitrogen gun
- Optical images of fine features are captured

- The wafer is subjected to hard bake at 150 for 5, 30 minutes optical images of the same features are taken for comparison.
- PDMS is cured by below steps and is separated from the wafer to test the adhesion strength between the features and the wafer
- Optical images of the features are taken
- One part of the wafer with no post-development bake is subjected to PDMS adhesion test and optical images are again taken to compare them with treated wafer images

PDMS preparation:

- A 10:1 ratio by weight mixture of PDMS base and curing agent is prepared
- PDMS base-curing agent mixture is adequately mixed
- PDMS base-curing agent mixture is placed in degassing chamber for 15 min
- The mixture is poured on the wafer containing test feature and is cured at 80°C for 20 minutes