



Nanolab Process Manual



Process [4.10]

(ksaligner & quintel resolution)

1.0 Process Summary

1.1 Since Karl Suss ksaligner is heavily used and Quintel contact aligner is not, nanolab decided to compare the 2 micron line resolution from both aligners to show lab members their capabilities.

2.0 Material Controls & Compatibility

2.1 Used 6" bare Si wafers and standard 1.2 μm Fuji Film OiR 906-12 Positive Photoresist.

3.0 Applicable Documents

3.1 Chapter 4.31 to prime wafers with HMDS.

3.2 Chapter 4.21 to coat wafers with standard I-line photoresist on svgcoat1.

3.3 Chapter 4.14 and 4.16 to expose wafers on ksaligner and quintel.

3.4 Chapter 4.25 to do PEB and develop on svgdev1.

3.5 Chapter 8.23 to inspect wafers on uvscope.

4.0 Definitions & Process Terminology

4.1 HMDS: Hexamethyldisilazane is used to improve photoresist adhesion to oxides.

4.2 Fuji Film OiR 906-12 Positive Photoresist: Nanolab standard I-line resist.

4.3 Exposure matrixes: Finding best exposure with various exposure on a wafers.

4.4 Quintel: Quintel Q4000 MA (Mask Aligner) is a top and bottom side contact lithography printer for fine line lithography down to 1 micron or better.

4.5 Ksaligner: Karl Suss MA6 is a top and bottom side contact lithography printer for fine line lithography down to 1 micron or better.

4.6 Svgcoat1: This track has 6" wafer coat modules using 3 different types of photoresist.

4.7 Svgdev1: This is a positive photoresist development track for developing 6" wafers.

5.0 Safety

5.1 Ksaligner vac contact mode: Wrong vacuum seal setting can cause resist on wafer sticks to mask which cause mask vacuum error.

5.2 Quintel vac contact mode: Wrong vacuum chamber setting can cause resist on wafer stick to mask and wafer chuck would not release wafer also.

6.0 Process Data

6.1 Wafer Preparation

Wafer #	Substrate	Photoresist- svgcoat1	PEB- svgdev1	Developer - svgdev1	Mask	Ksaligner Exposure Mode	Exposure Time	Result
#1	6" Bare Si	~ 1.2 um Fuji Film OiR 906-12	Program #1- 120°C 60 sec.	Program #1- OPD 4262 Dev.	M. W. DRIE test mask	Soft contact	6, 8, 10 and 12 sec.	Over exposed
#2	6" Bare Si	~ 1.2 um Fuji Film OiR 906-12	Program #1- 120°C 60 sec.	Program #1- OPD 4262 Dev.	M. W. DRIE test mask	Soft contact	3, 4, 5 and 5.5 sec.	Best exposure at 3 sec. with power at 18 mW/cm2
#3	6" Bare Si	~ 1.2 um Fuji Film OiR 906-12	Program #1- 120°C 60 sec.	Program #1- OPD 4262 Dev.	M. W. DRIE test mask	Soft contact	3 sec.	2 μm horizontal lines are not so good
#4	6" Bare Si	~ 1.2 um Fuji Film OiR 906-12	Program #1- 120°C 60 sec.	Program #1- OPD 4262 Dev.	M. W. DRIE test mask	Vac. contact	3 sec.	Good, but resist pulls off wafer badly.
#5	6" Bare Si	~ 1.2 um Fuji Film OiR 906-12	Program #1- 120°C 60 sec.	Program #1- OPD 4262 Dev.	M. W. DRIE test mask	Vac. contact	3 sec.	Good, but resist pulls off wafer badly even added 3 minutes soft bake.
#6	6" Bare Si	~ 1.2 um Fuji Film OiR 906-12	Program #1- 120°C 60 sec.	Program #1- OPD 4262 Dev.	M. W. DRIE test mask	Lo vac. contact	3.1 sec.	Good, resist pulls off very little on a couple of spots.

#7	6" Bare Si	~ 1.2 um Fuji Film OiR 906-12	Program #1- 120°C 60 sec.	Program #1- OPD 4262 Dev.	M. W. DRIE test mask	Pressure contact	7, 9, 11 and 13 sec.	2 μm lines are slight underexposed at 7 sec. and 9 sec. are good.
#8	6" Bare Si	~ 1.2 um Fuji Film OiR 906-12	Program #1- 120°C 60 sec.	Program #1- OPD 4262 Dev.	M. W. DRIE test mask	Pressure contact	8 sec.	Good.
#9	6" Bare Si	~ 1.2 um Fuji Film OiR 906-12	Program #1- 120°C 60 sec.	Program #1- OPD 4262 Dev.	M. W. DRIE test mask	Vac. contact	3 sec.	Good, but wafer stuck to mask and resist pulls off wafer badly.
#10	6" Bare Si	~ 1.2 um Fuji Film OiR 906-12	Program #1- 120°C 60 sec.	Program #1- OPD 4262 Dev.	M. W. DRIE test mask	Vac. contact	3.1 sec.	Good, but wafer stuck to mask and resist pulls off wafer badly even added 3 minutes soft bake.

7.0 Process Explanation

7.1 First, primed HMDS on 10 bare Si wafers in primeoven, spin coated 1.2 μm standard I-line Fuji Film OiR 906-12 Positive Photoresist, ran lamp intensity tests on ksaligner and quintel aligner, ran exposure matrix tests range from 3 sec. to 12 sec. with ksaligner on 2 bare Si test wafers , ran exposure matrix test range from 7 to 13 seconds with quintel aligner on 1 bare Si test wafer, ran standard PEB program and standard I-line develop program on svgdev1 and inspected 2 μm lines

for best exposure under uvscope microscope. Chose ksaligner best exposure and exposed 1 wafer with soft contact, 1 wafer with lo vac contact, 2 wafers with vac contact mode, yet 1 vac contact wafer was prebaked for 4 minutes trying to solve the resist pulling off issue. Chose quintel best exposure and exposed 1 wafer in pressure contact mode and 2 wafers in vac. Contact mode, yet 1 vac contact wafer was prebaked for 4 minutes trying to resolve the resist pulling off issue. Took 2 μm line pictures with uvscope on all the wafers with various contact mode. Found quintel line resolution is as good ksaligner. Refer to below pictures for photoresist resolution quality images. Even thou resolution lines are both excellent in vacuum mode on both ksaligner and quintel aligner, but need to address resist pulling off issue.

- 7.2** Since quintel aligner photoresist resolution quality is equivalent to ksaligner, it is recommended lab members to make use of the quintel aligner, because quintel is easy to operate and available most of the time as ksaligner is heavily used by lab members most of the time.

8.0 Process Procedure

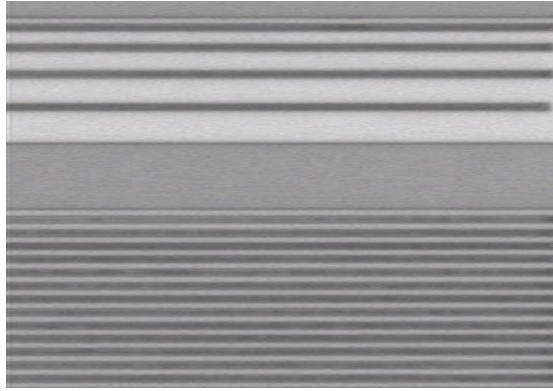
- 8.1** Used 6" bare Si wafers.
- 8.2** Follow the instruction on chapter 4.31 to prime wafers with HMDS in primeoven.
- 8.3** Follow the instruction on chapter 4.21 program #1 on svgcoat track 1 to coat 1.2 μm l-line photoresist.
- 8.4** Follow the instruction on chapter 4.14 and chapter 4.16 to run exposure matrixes on ksaligner and quintel aligner with Matt Wasilik's DRIE test mask which contains 2 μm line patterns.
- 8.5** Follow the instruction on chapter 4.25 to do PEB and develop wafers with program #1 on svgdev1.
- 8.6** Follow the instruction on chapter 8.23 to inspect wafers on uvscope and determine best exposure.
- 8.7** Follow the instruction on chapter 4.14 to expose actual wafers with the same mask with soft contact, lo contact and vac contact mode on ksaligner and chapter 4.16 to expose actual wafers with the same mask with pressure contact and vac contact mode on quintel aligner.
- 8.8** Follow the instruction on chapter 4.25 to do PEB and develop wafers with program #1 on svgdev1.
- 8.9** Follow the instruction on chapter 8.23 to use the uvscope to inspect the photoresist lines on the wafers and took pictures on 2 μm lines.

9.0 Troubleshooting Guidelines

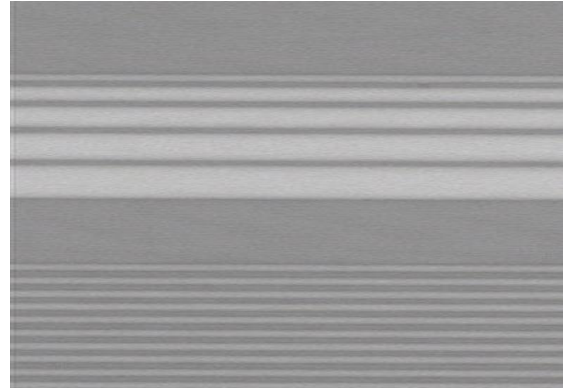
- 9.1** Further testing the aligner performance when the new set of masks are ready by adjusting the aligner vacuum.

10.0 Figures & Schematics

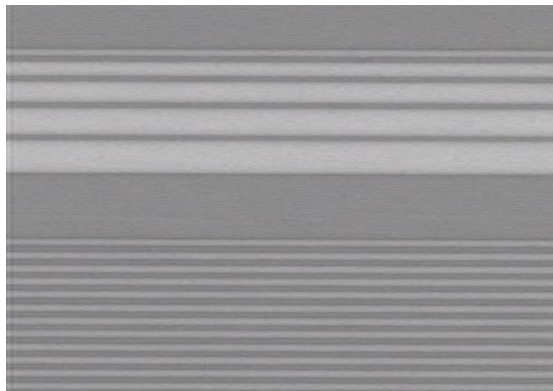
- 10.1** Preliminary test with various contact exposure method- Compare resist images after ksaligner and quintel aligner exposure, PEB and developed with Fuji Film OPD 4262 developer for 60 seconds on svgdev1.



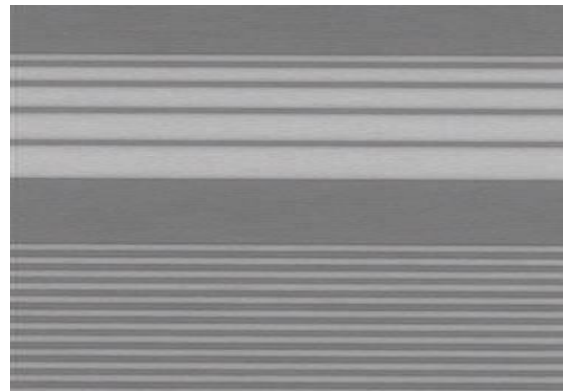
Wafer #3 ksaligner soft contact wafer center



Wafer #6 ksaligner Lo vac contact wafer center

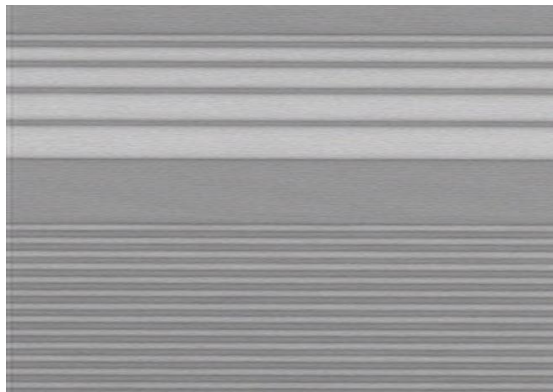


Wafer #4 ksaligner vac contact wafer center

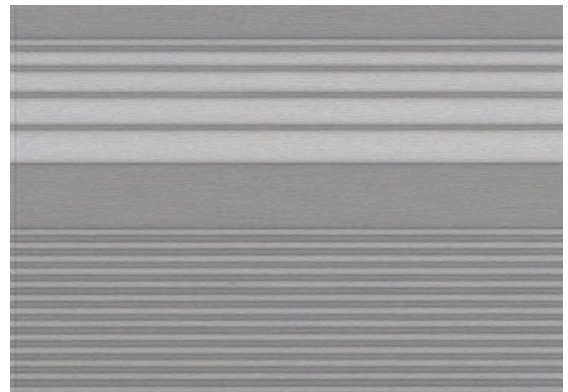


Wafer #5 center ksaligner vac contact 4min prebake

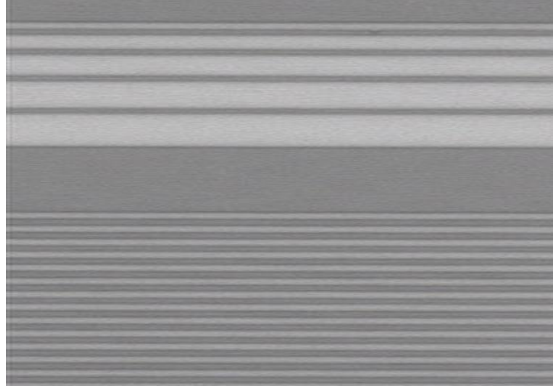
10.2 Preliminary test with various contact exposure methods- Compare resist images after ksaligner and quintel aligner exposure, PEB and developed with Fuji Film OPD 4262 developer for 60 seconds on svgdev1.



Wafer #8 quintel pressure contact wafer center



Wafer #9 quintel vacuum contact wafer center



Wafer #10 center quintel vac contact 4 min prebake

11.0 Appendices

