Photoresist Coat, Expose and Develop Laboratory

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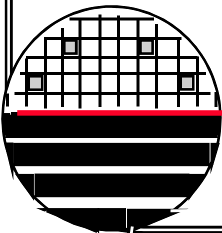

9-27-11 coat_expose_dev.ppt

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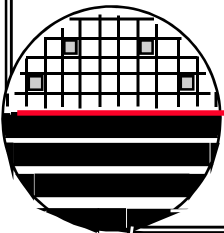
OUTLINE

Photoresist Processing
SSI Coat Develop Track
Spin Coating
Thickness Measurement
Thickness vs Spin Speed
Develop
Hard Bake



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COAT.RCP and DEVELOP.RCP

COAT.RCP

DEHYDRATE BAKE/ HMDS PRIMING
HMDS Vapor Prime
140 °C, 60 sec.

→

SPIN COAT
OIR 620-10 Resist
3250 rpm, 30 sec.

→

SOFT BAKE
90 °C
60 sec.

→

Thickness of 10,000 Å

DEVELOP.RCP

POST EXPOSURE BAKE
110 °C, 60 sec.

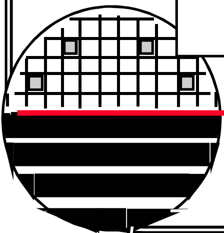
→

DEVELOP
DI Wet
CD-26 Developer
50 sec. Puddle,
30 sec. Rinse,
30 sec., 3750rpm
Spin Dry

→

HARD BAKE
140 °C, 60 sec.

→



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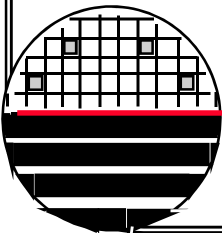
SSI COAT AND DEVELOP TRACK FOR 6" WAFERS

Use Recipe: Coat.rcp and Develop.rcp



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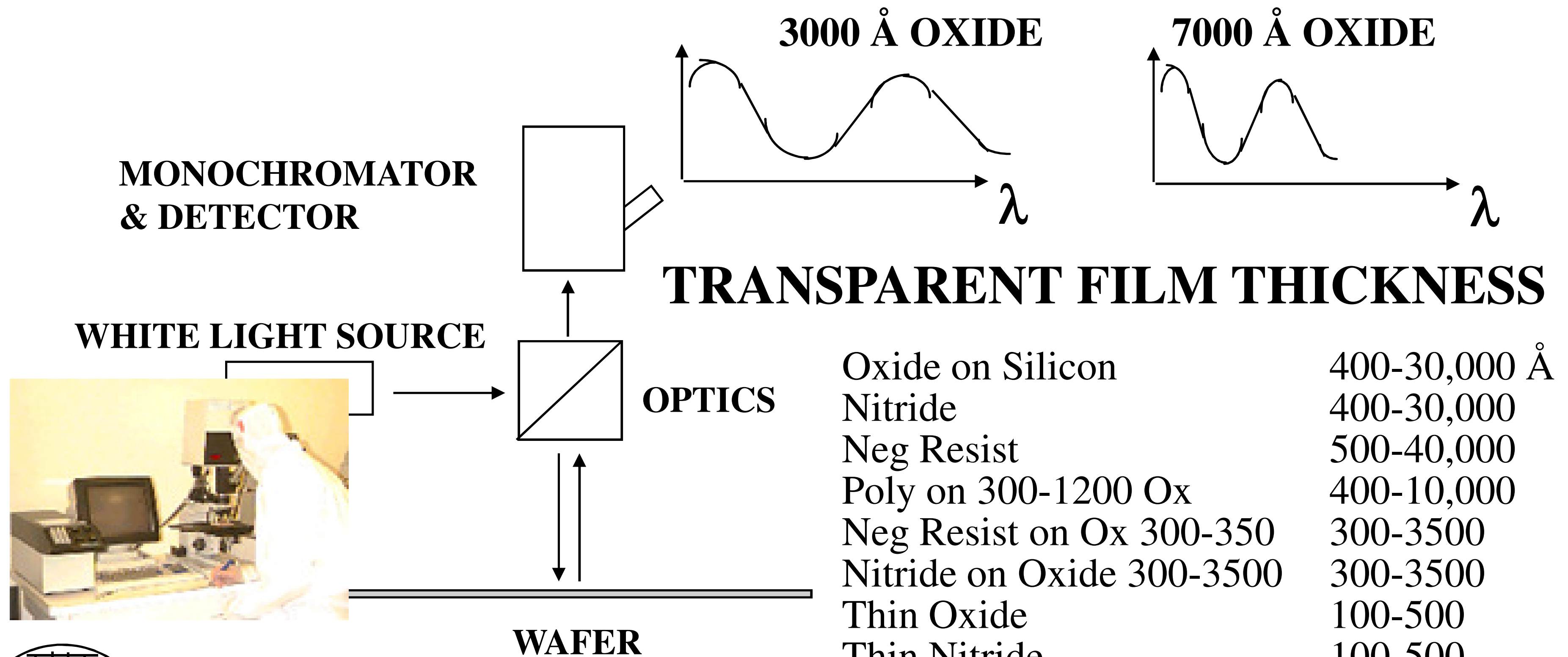
(REFLECTANCE SPECTROMETER) NANOSPEC THICKNESS MEASUREMENT

INCIDENT WHITE LIGHT, THE INTENSITY OF THE REFLECTED LIGHT IS MEASURED VS WAVELENGTH

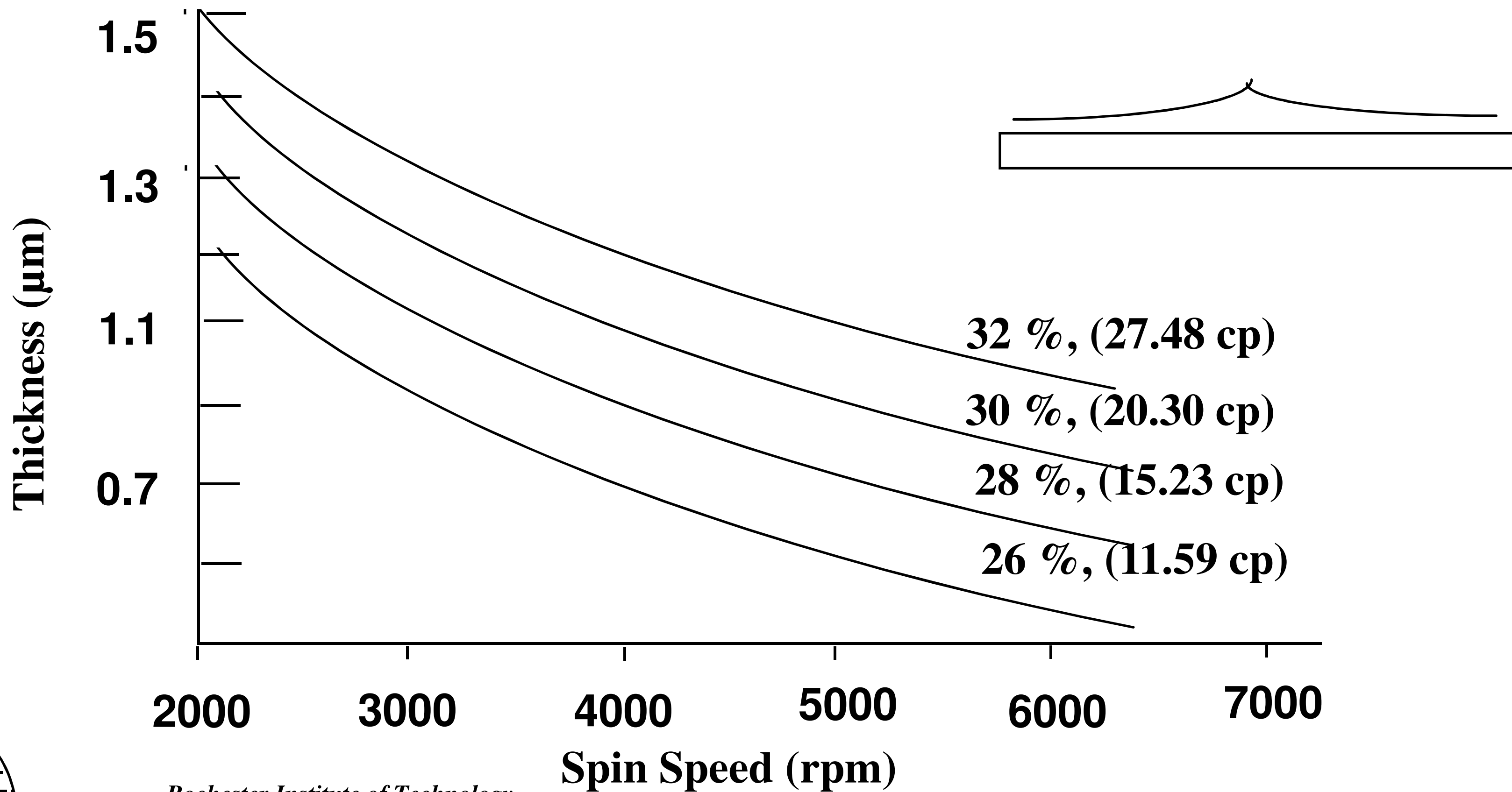


TRANSPARENT FILM THICKNESS

Oxide on Silicon	400-30,000 Å
Nitride	400-30,000
Neg Resist	500-40,000
Poly on 300-1200 Ox	400-10,000
Neg Resist on Ox 300-350	300-3500
Nitride on Oxide 300-3500	300-3500
Thin Oxide	100-500
Thin Nitride	100-500
Polyimide	500-10,000
Positive Resist	500-40,000
Pos Resist on Ox 500-15,000	4,000-30,000

RESIST THICKNESS VS SPIN SPEED

Most spin coating is performed at spin speeds from 3000 to 7000 RPM for 20 to 60 seconds, producing coating uniformities to +/- 100 Å



Example Only

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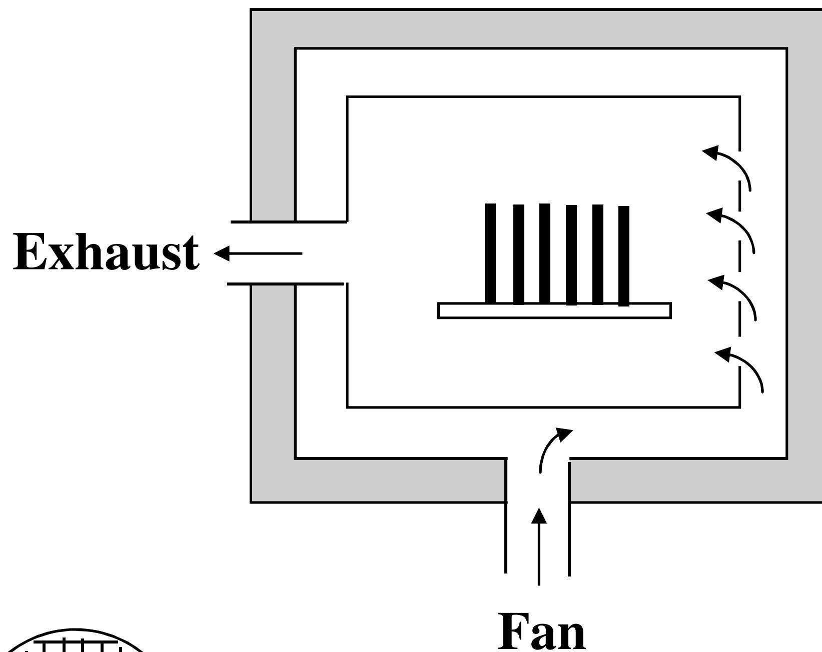
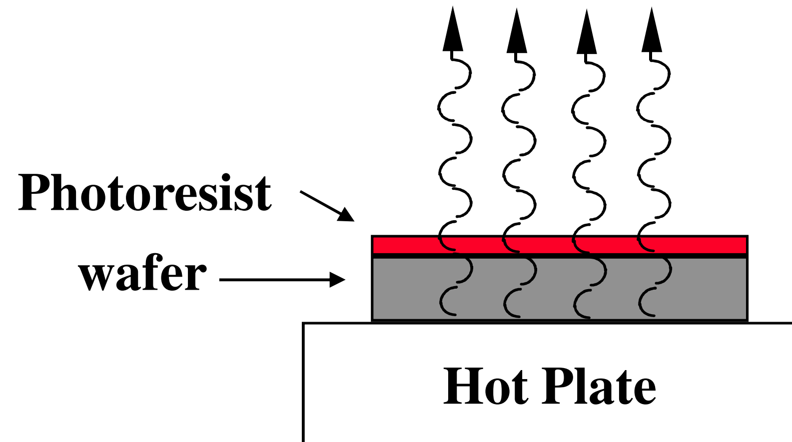
SOFT BAKE

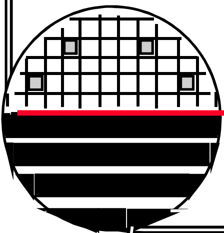
The main purpose is to reduce the solvents from a level of 20 - 30% down to 4 - 7%. Baking in a convection oven about 20 minutes is equivalent to hot plate baking for about 1 minute.

Forced Air Oven





90 TO 100 C



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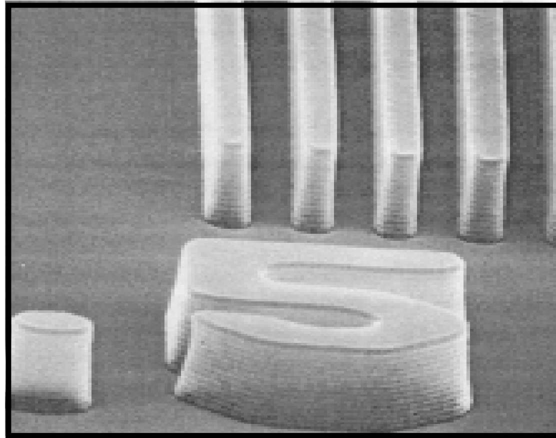
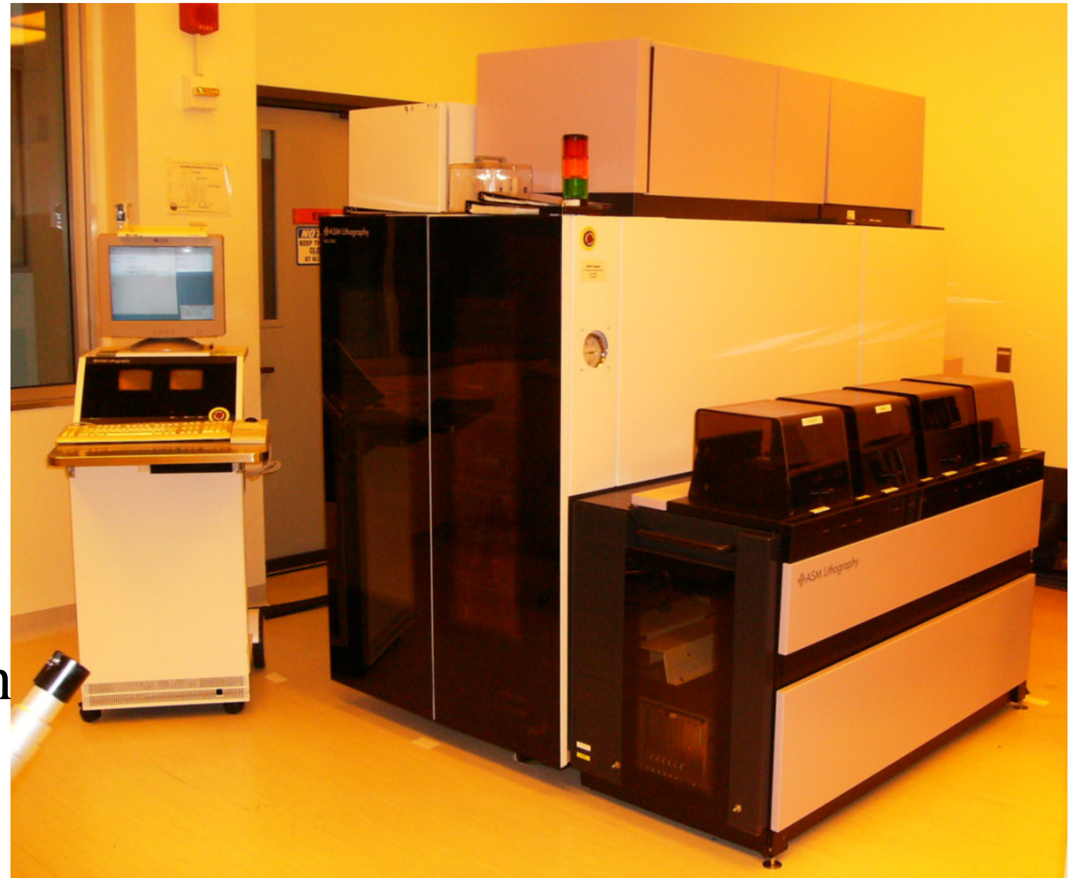
ASML 5500/200



NA = 0.48 to 0.60 variable
σ= 0.35 to 0.85 variable
With Variable Kohler, or
Variable Annular illumination
Resolution = K1 λ/NA
= ~ 0.35µm
for NA=0.6, σ =0.85
Depth of Focus = k_2 $\lambda/(NA)^2$
= > 1.0 µm for NA = 0.6



i-Line Stepper λ = 365 nm
22 x 27 mm Field Size

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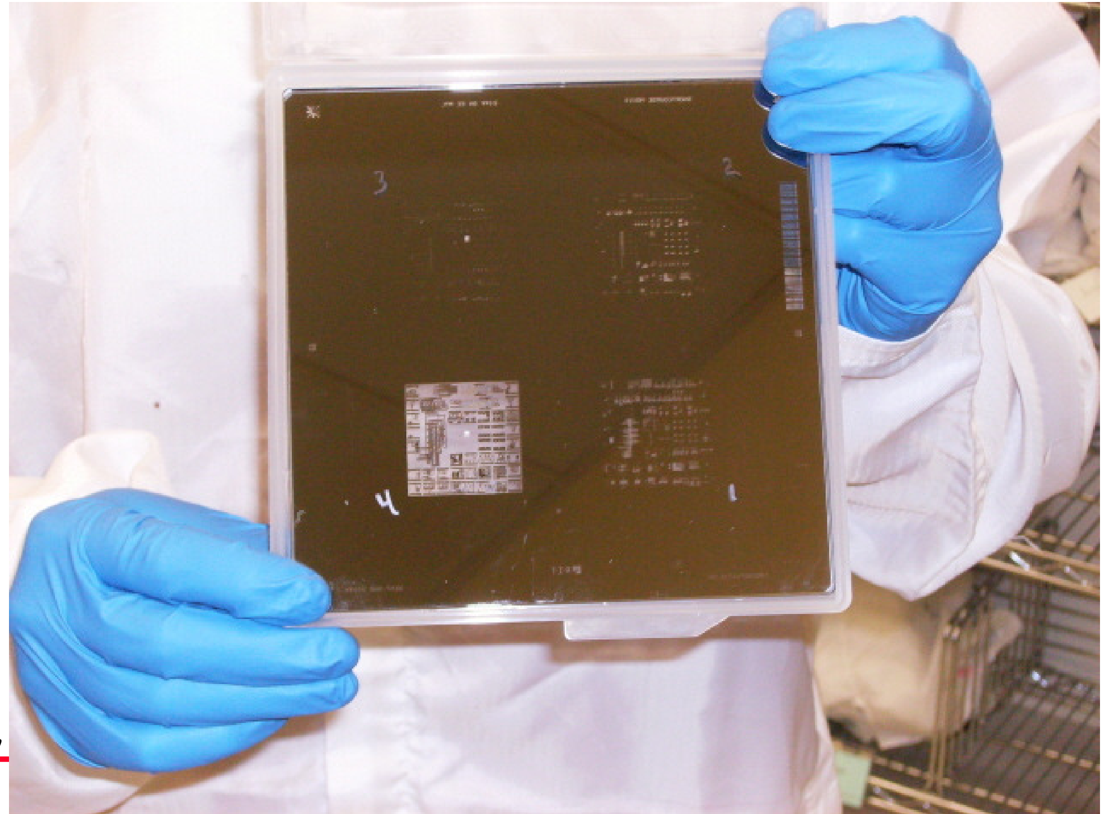
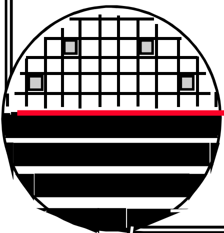
MASKS AND STEPPER JOBS

- Masks with 4 levels
    - Saves money, time, inventory
- Chip size 10mm by 10mm



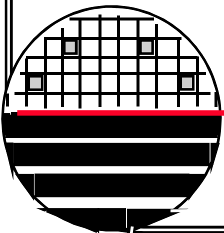


DEVELOP

Develop is done in an alkali solution such as NaOH or KOH (Metal Containing Developers) Trace quantities of these metals can cause transistor threshold voltage shifts.

Metal Ion Free Developers are available, TMAH for example.

Developer Concentration and Temperature of Developer are the most important parameters to control.

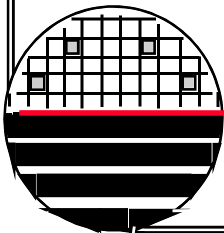


HARD BAKE

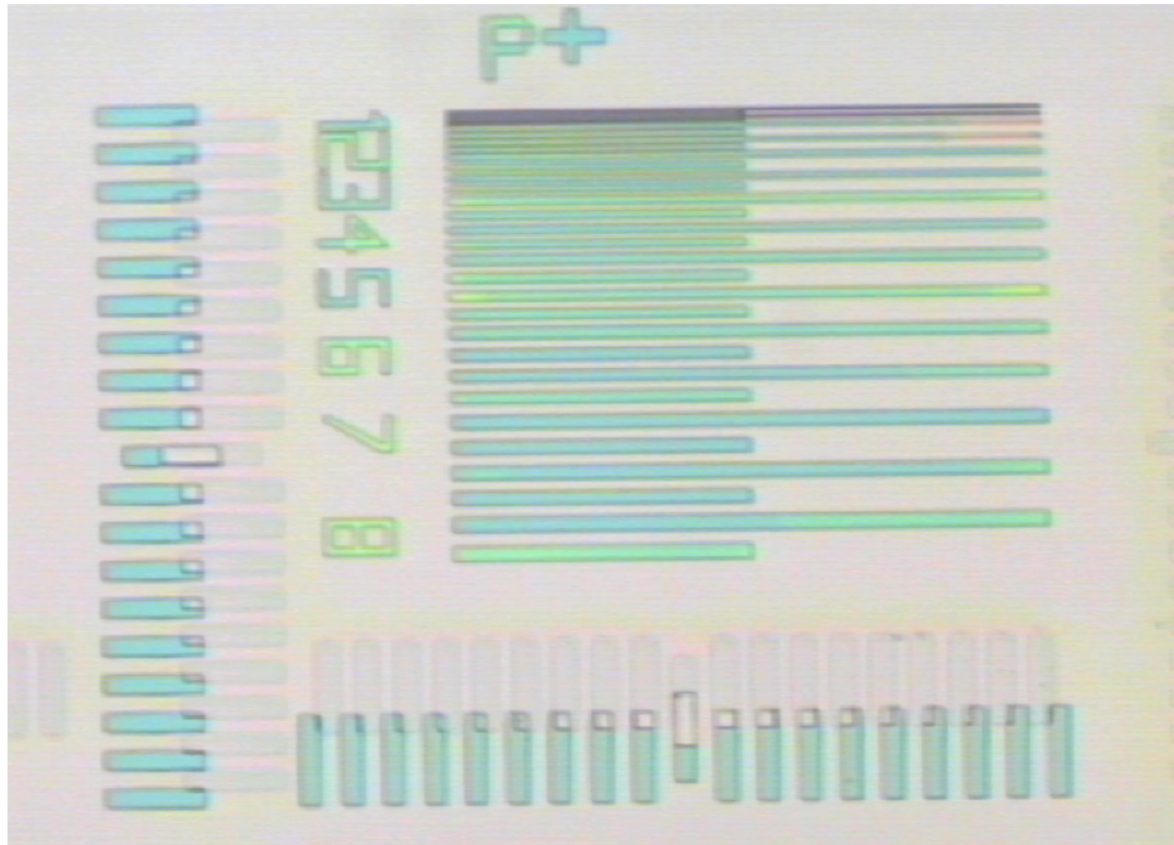
Hard Bake is done at or slightly above the glass transition temperature. The resist is crosslinked (and is toughened prior to plasma etch). The resist flows some as shown below. Pinholes are filled. Improves adhesion also. No flow should occur at the substrate. Photo stabilization involves applying UV radiation and heat at 110C for dose of 1000 mj/cm2 then ramping up the temperature to 150-200 C to complete the photostabilization process.

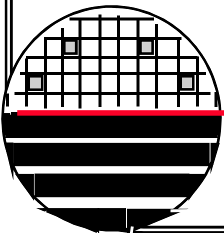
After Develop **After Hard Bake**

125 to 140 C for 1-2 min.



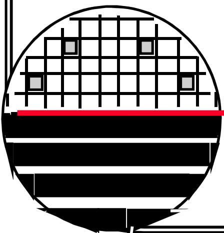
INSPECTION – OVERLAY, RESOLUTION





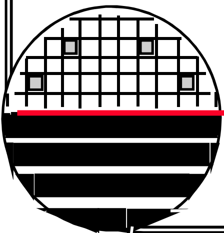
REFERENCES

1. Microlithography, Sheats and Smith



HOMEWORK - LITHOGRAPHY

1. Explain how overlay verniers work.
2. What is the effect of increasing the spin speed in coating photoresist?
3. What is HMDS?
4. What does the post exposure bake do?
5. How is resolution determined?



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