

Lithography, Patterning, Registration

Eng. Lib. / Subject / Lithography, microfabrication,
semiconductor processing

www.cmf.cornell.edu

lith = stone graphic = write

Analogy to photoprinting

light sensitive chemical on paper
negative
light

photoresist - substrate
mask
UV

Photoresist "PR"

positive : $UV + PR^+ \rightarrow \text{damage} \rightarrow \text{remove.}$

Data Sheet \rightarrow spin rate, thickness, UV dose,
developer, applications, ...

Note: "baseline process used as a
starting point"

Substrate Clean

whole Silicon wafer → very clean.
→ scribe, break → particles.

glass → oil, grease, particles, oxides

ultrasonic cleaning, acetone, methanol,
isopropyl alcohol, ultrapure water (UPW),
N₂ spray gun.

Acid clean "Piranha" extreme danger.

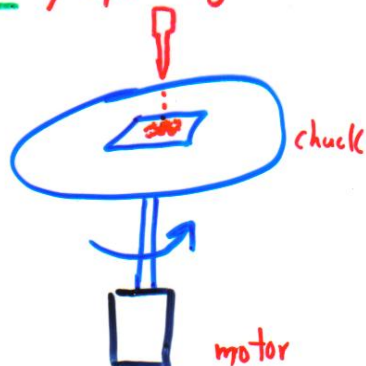
Substrate Pretreatment

dry sample on hotplate.

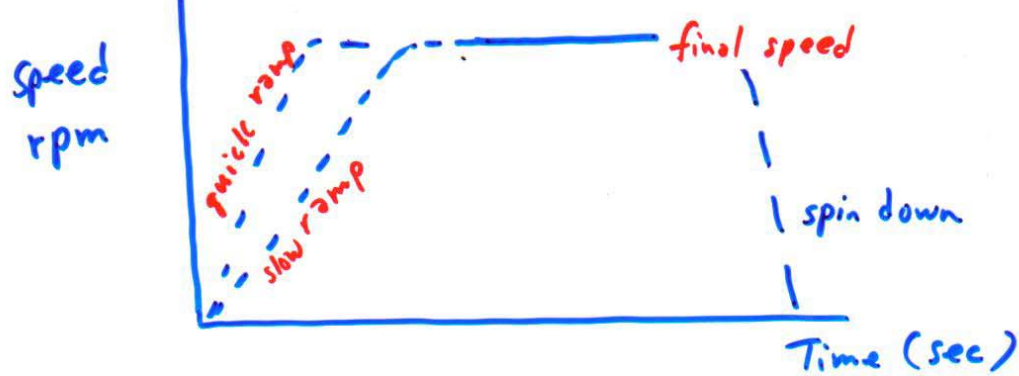
microscopic water film → coat with primer

"P-20" HMDS + adhesion promoter.

Coat / Spinning



Vacuum
N₂ gas flush
program microprocessor



"Acceleration Index" = 1 slow ramp
 = 16 quick ramp

resist edge bead



Tips

center sample, level spinner,
 do test spin to check programming,
 see binder for spinning tips

Clean spinner with lots of acetone, wiper.
 Especially all around the lid.

PR Handling

4

PR = light sensitive organic + solvent



2-5 ml per
substrate



dried photoresist particles on cap
moisture from air
evaporating solvent
heat sensitive.

warm up large bottle before opening
do not bump, shake → air bubbles
look out for dried particulates dropping into
PR.

Review MSDS for PR, P-20 primer, acetone,
developer.

Soft Bake

drives off remaining solvent.

hotplate temperature is not even,
temperature sensing is not in center
or near surface. → use
handheld thermocouple to check
hot plate setting.

Expose / Aligner

UV light + mask + PR coated substrate

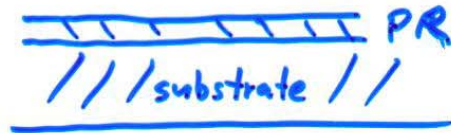
glass mask	2.5"	3.5"	5"
expose area	2" circle	3"	4"

glass mask made with special machine / company \$300
#2000

acetate mask — ink jet printer

mask cleaning — wipes XX
— acetate (do not clean)
— IPA, acetone, ultrasound, Piranha
— handle, store very carefully.

Exposure Modes



hard contact, soft contact,
proximity, flood

Alignment

mask fixed, sample moves
 $\pm 1 \text{ cm. } x, y$ $\theta \pm 5^\circ$

(BSA - look at bottom of substrate
and align to mask.

Wedge Error Correction ("WEC")

chuck not parallel
substrate not flat
mask not parallel

UV Notes

Hg 365 nm
 ↓ 35 $\frac{\text{mW}}{\text{cm}^2}$

405 nm
 ↓ 58 $\frac{\text{mW}}{\text{cm}^2}$

PR⁺ needs 150 $\frac{\text{mJ}}{\text{cm}^2}$ → ~2 sec.

- light scattering, attenuation
- overexposure → affects unexposed PR, widens lines
- High power UV lamp → hot → 20 min cool
 → ozone → N₂ flush
- Heavy spinner, spray gun use → N₂ gas low error → wait for N₂ pressure to recover

Operational Notes

- compressed air → anti-vibration table
 * do not lean, press, bump
- when aligning, do not move chuck more than ±1 cm in x, y!
- after turning off UV lamp, wait 20 min. before shutting N₂ gas.

Develop

agitate gently. more developing?

Rinse - Dry

no acetone, solvents on PR⁺
UPW, N₂ gun

Hard Bake

harden PR.

Imaged Material

etch, deposit, molding

Remove

take PR off chemically, plasma.