

QUANTUM NANOSTRUCTURE FABRICATION

revised 9-December-1996

Main Steps

1. Cleave Sample
2. Mesa etch process (optical lithography)
3. Ohmic contact process (optical lithography)
4. e-Beam gate process
5. Gate pad process (optical lithography)

Standard 3-Solvent Clean:

Use plastic beakers so that chips will not break!

Even better: use small teflon beakers inside glass ones.

- Ultrasound for 5 minutes in boroethane
- Ultrasound for 5 minutes in acetone
- Ultrasound for 5 minutes in methanol

Karl Suss Hints:

Use soft contact mode

If you wafer-bit is off-center, place wafer bits on the other side

Push the exposure button once to test shutter before exposing your sample

Mesa Etch Process (Optical Lithography):

- Standard 3-Solvent Clean
- Singe at 120°C for 15 minutes on digital hot plate
- Spin on Shipley 1813 photoresist at 3500 rpm for 30 second
- Bake at 90°C for 20 minutes on digital hot plate
- Expose using Karl Suss for 24 seconds (power = 16.5) ; (Duncan = 16s)
- Develop 40 sec in 1:1 developer, then 10 sec in clean 1:1 developer
- Rinse in DI for 30 seconds; spritz with DI; blow-dry
- Use test wafer first and measure on Alpha-step*
- Etch for ~ 45 seconds in 1:8:240 H₂SO₄:H₂O₂:DI
- Rinse in DI; blow dry
- Remove photoresist with acetone.

Bondpad Process (Optical Lithography for Ohmics and Gatepads):

- Clean in boiling acetone for 10 minutes. DANGER- EXPLOSIVE.
(Damage to e-beam patterns? Maybe don't do this for gates)
- Standard 3-Solvent Clean
- Singe at 120°C for 15 minutes on digital hot plate
- Spin on Shipley 1813 photoresist at 3500 rpm for 30 seconds
- Bake at 90°C for 20 minutes on digital hot plate

- Soak in chlorobenzene for 20 minutes
- Bake at 90°C for 5 minutes on digital hot plate
- Expose using Karl Suss for 24 seconds (power = 16.6)
- Develop 40 sec in 1:1 developer, then 10 sec in clean 1:1 developer
- Dump in DI for 30 seconds, swish around; blast with DI from squeeze bottle; blow dry
- Plasma etch if desired: 0.08min at 50% power in O₂ .
- BOE 6:1 etch for 60 seconds -- BE CAREFUL handling: BOE = death
- Place in N₂-filled Zip-loc bag; mount sample onto evaporator stage at lab with Carbon paint.
- Metalization for Ohmics: in Edwards evaporator
 - 50 Å Ni
 - 1200 Å AuGe eutectic
 - 250 Å Ni
 - 1500 Å Au
- Metalization for Gatepads: in Edwards evaporator
 - 200 Å Cr (~ 1 Å/s)
 - 2500 Å Au (~ 1-2 Å/s for 1st 200 Å, then ~ 5-6 Å/s)
- Remember to shut off the cooling water to the sample during the initial pump-down to high vacuum
- Lift-off in acetone: *you should not need Ultrasound!*
- For Ohmics: anneal in RTA at 410°C (use anneal time from recipe in wafer data sheet)
 - if desired, test on HP4145B in Leica SEM room (should be < 5 k_Ω)
 - dunk test at 4K to test for contact if anneal time is unknown or changed

e-Beam Gate Process:

- Clean in boiling acetone for 10 minutes
- Standard 3-Solvent Clean
- Spin and bake:

what	rpm	how long	thickness	bake
MAA/MMA	3000	40 seconds	100 nm	3 min at 180°C
495K PMMA	4000	40 seconds	90 nm	3 min at 180°C
495K PMMA	4000	40 seconds	90 nm	5 min at 180°C
- Bakes should be done on the digital hotplate pushed to the back with no cover
- Exposure level is about 210 $\mu\text{C}/\text{cm}^2$, measured beam current ~ 60 pA (set to 100 pA)
- Develop for 15+ seconds in 3:1 IPA:MIBK with 1.3% MEK
 - you should see two and half of the third exposure squares clear out
- Metalization for e-beam gate pads: in Edwards evaporator
 - 20 Å Cr (Duncan = 50 Å Cr)
 - 250 Å Au
- Remember to shut off the cooling water to the sample during the initial pump-down to high vacuum
- Lift-off in acetone: *you should not need Ultrasound!*