| STEP # | PROCESS DESCRIPTION | CHECK-OFF |
|--------|---------------------|-----------|
| 0010   | **OBTAIN SILICON WAFER WITH SiN** |           |
|        | POLISH: SSP         |           |
|        | DIAMETER: 4 INCH    |           |
|        | DOPANT: B           |           |
|        | TYPE: P             |           |
|        | ORIENTATION: <100>  |           |
|        | THICKNESS: 500 µm   |           |
|        | GRADE: PRIME        |           |
|        | **SiN SPECIFICATIONS:** |           |
|        | THICKNESS: 100 nm   |           |
|        | TYPE: LOW-STRESS CVD|           |
|        | VENDOR: UNIVERSITYWAFER.COM |     |

| 0020   | **DEPOSIT HMDS LAYER** |           |
|        | EQUIPMENT: KARL SUSS RC8 SPINNER (MARCUS INORGANIC CLEANROOM) |     |
|        | RECIPE: STEP 1: 3000 rpm 1000 rpm/s 10 s |     |
|        | NOTES FOR KARL-SUSS RC8 SPINNER: |           |
|        | • PRESS ‘ENTER’ TO CLEAR ERRORS | |     |
|        | • PRESS ‘ST/STOP’ TO CLEAR ERRORS UNTIL YOU SEE ‘0000’ | |     |
|        | • ‘DEVICES’ SHOULD ALL BE ‘READY’ | |     |
|        | • RIGHT-CLICK TO RESET IF THERE ARE STILL ERRORS | |     |
|        | • IF YOU NEED TO, POWER CYCLE THE MACHINE | |     |
|        | • SELECT THE OPEN FOLDER ICON TO ADD A RECIPE | |     |
|        | • SELECT THE NEW PAGE ICON TO EDIT A RECIPE | |     |
- To run your recipe, use the drop-down menu to select your recipe, then select run.
- Be sure to run the auto-clean recipe with the cleanroom wafer.
- For the hot-plate, do not change ‘calibration’ or ‘PID’ loops values.

| Time  | Description                        | Equipment                                      | Recipe Details                                      |
|-------|------------------------------------|------------------------------------------------|----------------------------------------------------|
| 0030  | **Deposit Photoresist**            | Karl Suss RC8 Spinner (Marcus Inorganic Cleanroom) | STEP 1: 500 rpm 100 rpm/s 10 s  
                     |         |                                                | STEP 2: 3000 rpm 1000 rpm/s 40 s  
                     |         |                                                | STEP 3: 0 rpm 500 rpm/s 0 s  |
| 0040  | **Bake Photoresist**               | Karl Suss RC8 Spinner (Marcus Inorganic Cleanroom) | Temperature: 115 °C  
                     |         |                                                | Time: 60 seconds  |
| 0050  | **Align Mask / Expose Photoresist**| Karl Suss TSA MA-6 (Marcus Inorganic Cleanroom)  |                                                    |
PARAMETERS:

CONTACT TYPE: HARD CONTACT
ALIGNMENT GAP: 30 µm

NOTES FOR KARL-SUSS TSA MA-6:

- BE SURE TO CHECK LAMP INTENSITY WITH UV SENSOR, IN BLACK CASE UNDERNEATH MACHINE
- BE SURE 365 nm WAVELENGTH IS SELECTED
- CH 1 IS 365 nm
- IF ‘CHANGE MASK’ SCREEN IS ON, PRESS ‘CHANGE MASK’ TO GO BACK TO MAIN SCREEN
- PLACE SENSOR ON CHUCK AND PRESS ‘LAMP TEST’ TO COMMENCE UV INTENSITY TEST
- FOR SPR-220, APPROXIMATELY 500 mJ/cm² IS REQUIRED

- USE ‘EDIT PARAMETER’ BUTTON TO ADJUST EXPOSURE TIME AND THE ALIGNMENT GAP
- HARD CONTACT IS OK
- ONCE MASK IS ALIGNED, PRESS ‘ALIGN CONT/EXP’ TO BRING WAFER INTO CONTACT WITH MASK. IF ALIGNMENT IS NOT GOOD, PRESS ‘ALIGN CONT/EXP’ TO RELEASE MASK AND WAFER PROCEED WITH ALIGNMENT
- PRESS EXPOSE TO BEGIN EXPOSURE.

- BE SURE TO REMOVE THE MASK, RETURN SUBSTRATE KNOBS TO X10 AND Y10, AND ROTATE CHUCK HOLDER SO THAT THE WHITE LINES MATCH.

DEVELOP PHOTORESIST

DEVELOPER: MF-319 for SPR-220 photoresist

DEVELOP FOR 3 MINUTES, THEN PLACE WAFER IN WATER BATH FOR AT LEAST 3 MINUTES. AFTERWARDS, THOROUGHLY DRY THE WAFER.
ETCH SILICON NITRIDE LAYER THRU TO SILICON

EQUIPMENT: OXFORD END-POINT RIE (MARCUS INORGANIC CLEANROOM)

NOTES FOR OXFORD END-POINT RIE:

- VISION RIE IS FINICKY. IT MIGHT BE FASTER, BUT IT IS INCONSISTENT. BEST TO USE OXFORD.
- SELECT THE ‘SYSTEM’ BUTTON
- PRESS ‘STOP’ TO BEGIN VENTING PROCESS
  o SELECT ‘VENT’ TO VENT CHAMBER
- WHEN TIME IS <100s, SWITCH ‘CHAMBER DOWN’ TO ‘CHAMBER UP’
  o THEN PRESS BOTH GREEN BUTTONS SIMULTANEOUSLY TO OPEN CHAMBER
  o YOU WILL ALSO HEAR WHEN IT IS OK TO OPEN THE CHAMBER
- MAKE SURE O-RING IS SEATED EVENLY
- THERE ARE 2 PLATTENS: Al & Graphite
  o Al if etch depth is < 2 µm
  o Graphite is etch depth is > 2 µm
- SWITCH TO ‘CHAMBER DOWN’ AND PRESS BOTH GREEN BUTTONS SIMULTANEOUSLY TO LOWER LID
  o MAKE SURE LID IS ALIGNED CORRECTLY. MAY NEED TO ADJUST MANUALLY
- PRESS ‘STOP’, THEN ‘EVACUATE’
  o BE SURE TO READ PROMPT CLOSELY. IT WILL TELL YOU TO PRESS ‘CANCEL’ IF YOU ARE EVAUCATING AN EMPTY CHAMBER.
- TO SELECT YOUR PROCESS, GO SELECT THE PROCESS BUTTON
  o RECIPES -> LOAD -> OK

- STANDARD OXIDE ETCH: (OK for etching 100 nm of SiN)
  o PRESSURE: 50 mTorr
  o O₂: 4
  o CHF₃: 35
  o RF power: 250
  o Step time: 3 min

- AFTER DONE, SELECT CHAMBER CLEAN
  o MAKE SURE Al PLATTEN IS IN CHAMBER
ETCH (DRIE) SILICON

EQUIPMENT: STS HRM ICP (MARCUS INORGANIC CLEANROOM)

RUN RECIPE ‘HC_GENM’ FOR 350 CYCLES. THIS SHOULD ETCH 400 µm OF Si.

NOTES FOR STS HRM ICP:

- 'VENT' LOAD LOCK TO LOAD SAMPLE; LID WILL OPEN ONCE BY ITSELF
- PLACE SAMPLE ON SHUTTLE, CLOSE LID, AND PRESS 'PUMP & MAP'
- SELECT WAFER POSITION (1 OR 2) AND PRESS 'LOAD' TO LOAD SAMPLE INTO ETCHING CHAMBER
- GO TO 'RECIPE'
  - OPEN AND EDIT THE RECIPE YOU WANT TO RUN.
  - IT IS OK TO OVERWRITE RECIPES
  - USE ‘HC_GENM’ RECIPE
  - WE WILL ONLY EDIT THE NUMBER OF CYCLES
    - 350 CYCLES ≈ 400 µm
  - SAVE RECIPE AND CLOSE RECIPE EDITING WINDOW
- PRESS ‘SELECT’ (NOT ‘PROCESS’)
  - SELECT DESIRED RECIPE, LET IT LOAD. ONCE LOADED, PRESS ‘PROCESS’ TO BEGIN ETCH.

SUBMIT WAFERS TO DICING SERVICE WITH CHARLIE SUH. <suh@gatech.edu>

PLACE WAFERS IN STAFF ROOM CABINET LABELED ‘DICING SAMPLES’

BE SURE TO SUBMIT DICING INSTRUCTIONS TO ENSURE CORRECT DICING

PEEL INDIVIDUAL DICED SUBSTRATES FROM DICING TAPE

SUBSTRATES ARE VERY FRAGILE; USE CARE WHEN PEELING SUBSTRATES OFF OF DICING TAPE.

USING ACETONE TO REMOVE ADHESIVE CAN HELP BUT CAUSES ADHESIVE LAYER TO COME OFF OF THE TAPE BACKING. CAN BE MESSY.
| Time | Description |
|------|-------------|
| 0110 | **RINSE SUBSTRATES OFF WITH ACETONE THEN ISOPROPYL ALCOHOL AND THEN DI WATER**  
BE SURE TO REMOVE ALL RESIDUAL PHOTORESIST PRIOR TO KOH ETCH. |
| 0120 | **LET SUBSTRATES AIR DRY THOROUGHLY**  
SUBSTRATES CAN BE PLACED ON HOTPLATE TO ACCELERATE DRYING. |
| 0130 | **KOH ETCH SILICON THRU TO SILICON NITRIDE AT 85°C FOR 1 HOUR OR UNTIL APERTURES ARE CLEAR.**  
**EQUIPMENT:** KOH 45% AQUEOUS SOLUTION  
TEFLON ETCHING FIXTURE  
DO NOT DILUTE KOH; IT SHOULD BE AT CORRECT CONCENTRATION.  
PLACE SUBSTRATES IN TEFLON ETCHING FIXTURE. EXPOSED SILICON SHOULD BE FACING UP TO ALLOW HYDROGEN BUBBLE TO FREELY PERCOLATE. FIXTURE HOLDS UP TO 9 SUBSTRATES  
PLACE FIXTURE WITH SUBSTRATES IN SHALLOW BEAKER AND FILL WITH KOH TO FULLY COVER FIXTURE  
DO NOT OVER ETCH SUBSTRATES. SILICON FRAME MAY TO DETERIORATE |