

Bimorph Cantilever								
TPFab								
Responsible: chenxiang.zhang								
Project: Practical Training for Bachelor students								
Created: 1999-11-01 Last revision : 2024-02-5 (Arnaud Bertsch)								
Substrates: Si Test wafer, <100>, 4", 525um, single sided								
Masks: Layer 1 Metal, Layer 2 Oxide								
Step No.	Description	Wafers	Equipment	Parameter	Target	Remarks	Duration	Q's
1 WAFER PREPARATION								05:20
1.1	Stock out					Done by CMI	00:10	
1.2	Check					Done by CMI	00:10	
1.3	Clean RCA					Done by CMI	02:00	
1.4	Oxidation		Centrotherm	1100°C, Wet	1.5um	Done by CMI. Cr deposition needs to be performed immediately after taking the wafers out of the oxidation tubes.	03:00	
2 METAL DEPOSITION								02:20
2.1	Cr deposition		Alcatel EVA 760, Z4	Parameters for EVA 600: 5A/s, target thickness 500nm	500nm	Done by CMI. Cr deposition needs to be performed immediately after taking the wafers out of the oxidation tubes.	02:20	
TP A2: definition of the Cr tracks								
Prepare beforehand the wet bench for Cr etch + switch on the Hg lamp on the MJB4 + check temperature of the softbake hotplate (100°C)								
3 Photolithography 1						Intro: show the students the process flow and the CMI website for the different steps of photoresist processing. General materials: tweezers, wafer box, paper, tissue	01:05	
3.1	NO HMDS ON CHROME!!!		HMDS hotplate, Z13	T=135°C ; 15min from RT; 1min cooling at RT		selection-Dehydrate TP A-automatic-(put wafer on chuck)-init-start; clean chuck at the end	00:15	Q1
3.2	Coating AZ1512		Sawatec SM-200 coater line, Z13	Coat for 1.5um @ 2800rpm for 45s	1.5um	Materials: AZ1512 bottle, plastic pipette Take enough resist (use at least 3mL resist), avoid bubbles; If it fails, use a new wafer + clean the bad one at the end with acetone -> IPA -> DI water Place cooled down wafer on biggest chuck Test vacuum should be around -0.8 select-TPFAB-automatic-init-start	00:10	Q2
3.3	Softbake		Hotplate next to spin coater/Ceram Hotplate, Z13	100°C for 75 sec (values for automatic coaters:112°C, 90sec)		Materials: timer Use 2 tweezers to manipulate the wafer without pinching it	00:05	
3.4	Expo AZ1512 UV		MJB4, Z13	20mW/cm2, for 50mJ/cm2-> 2.5s can use 2.6s to be safe depending on design		Materials: mask LAYER 1 METAL Use 'align and expose' with 'hard contact' mode Check WEC pressure to be at 0.1MPa Before pressing WEC settings put circular height knob on 0.0 then follow instructions on CMI help sheet (1 graduation =1um)	00:15	Q3 Q4 Q5
3.5	Development AZ1512		Base wet bench, Z13	CD26=AZ726 MIF, 1min20sec-1min30sec. ; 1min Rinse with DIW ; Dry with N gun		Materials: 1 glass beaker of CD26 or AZ726 MIF (Careful TMAH!!!), 1 glass beaker of DIW, timer	00:10	Q6 Q7
3.6	Check		Microscopes Z13				00:10	Q8
Safety advice (chemicals, unknown liquids, cleaning, eye wash, shower, alarm)								
4 Cr wet etching								01:15
4.1	Etch Cr		Acid wet bench, Z14	~10min (needs to be checked after 5min) Rinse 2x 3 min with the DIW Rinse directly wafer under DIW gun Dry with N2 gun		Materials: papers, tissue, timer, tweezers, white nitrile gloves, long chemical gloves, apron, face shield, 2 glass beakers of 2L for the rinsing with DIW, Cr etch waste bottles are below the fume hood, use funnel to fill the waste bottle; A) use single wafer plastic container for the CR etch (orange solution in the top left cupboard), 2x single wafer holder (arrows) : etch the two wafers separately or B) use common CR etch bath (orange bath to the left side), 2x single wafer carrier (arrows): etch the two wafers at the same time with a few minutes delay between them. Visual detection of end of CR etching: Dark blue spread from border to center (12-13 min) ; Add 30s when green of oxide (SiO2) seen everywhere	00:25	Q9 Q10 Q11
4.2	Check		Microscope, Z13 or stereoscope Z14				00:10	
4.3	Remove AZ1512		Lift-off bench Z13	TechniStrip P1316 ; agitate at room temperature for 6 min ; Rinse in DI water (2 beakers) ; Dry N2 gun		Materials: paper, tissue, Technistrip bottle, 3 glass beakers, 1 waste bottle, spider (two wafers can be stripped simultaneously, maybe increase slightly the time)	00:10	
4.4	Check and take images		Microscope, Z13 + Z15				00:10	Q12 Q13
4.5	Measure resistance of Cr tracks		MPI TS150 Prober station, Z11	4 points vs 2 points measurements			00:20	Q14 Q15
TP A3: definition of the SiO2 beams								
Prepare beforehand the wet bench for SiO2 etch + switch on the Hg lamp on the MJB4 + check temperature of the softbake hotplate (100°C)								
5 Photolithography 2								01:10
5.1	Vapor HMDS on mix SiO2&Cr		SB20 HMDS hotplate, Z13	Standard 135°C; 1min cooling at RT Check whether wafer is hydrophobic		selection-HMDS standard-automatic-init-start	00:15	Q16
5.2	Coating AZ1512		Sawatec SM-200 coater line, Z13	Coat for 1.5um @ 2800rpm for 45s	1.5um	Materials: AZ1512 bottle, plastic pipette Take enough resist (use at least 3mL resist), avoid bubbles; If it fails, use a new wafer + clean the bad one at the end with acetone -> IPA -> DI water Place cooled down wafer on biggest chuck Test vacuum should be around -0.8 select-TPFAB-automatic-init-start	00:10	Q17
5.3	Softbake		Ceram Hotplate, Z13	100°C for 75 sec (values for automatic coaters:112°C, 90sec)		Materials: timer Use 2 tweezers to manipulate the wafer without pinching it	00:05	

5.4	Expo AZ1512 UV		MJB4, Z13	20mW/cm2, for 50mj/cm2--> 2.5s can use 2.6s to be safe depending on design		Materials: mask LAYER 2 OXIDE Use 'align and expose' with 'hard contact' mode Check WEC pressure to be at 0.1MPa Before pressing WEC settings put circular height knob on 0.0 then follow instructions on CMI help sheet for the alignment procedure on the Layer 1 (1 graduation =1um)	00:20	Q18 Q19 Q20
5.5	Development AZ1512		Base wet bench, Z13	CD26=AZ726 MIF, 1min20sec -1min30sec. ; 1min Rinse with DIW ; Dry with N gun		Materials: 1 glass beaker of CD26 or AZ726 MIF (Careful TMAH!!!!), 1 glass beaker of DIW, timer	00:10	Q21 Q22
5.6	Check and take images		Microscope Z13				00:10	Q23
Safety advice (chemicals, unknown liquids, cleaning, eye wash, shower, alarm)								
6 SiO2 wet etching								01:25
6.1	Etch SiO2		Acid wet bench, Z14	BOE (=BHF = NH4F:HF @ 7:1 ratio) etch rate 72-77 nm/min ~ 17-21min Rinse 2x 3min Rinse directly wafer under DIW gun Dry N2 gun		Materials: papers, tissue, timer, tweezers, white nitrile gloves, long chemical gloves, apron, face shield, 2 large plastic beakers for the rinsing with DIW, HF waste bottles are in the bottom left cupboard + use funnel to fill the waste bottle; Use single wafer plastic container for the BOE (BOE solution in the bottom left cupboard) with 2 big plastic beakers for the rinsing with DIW Use single wafer holder (triangular shape). Plastic containers ONLY! End of SiO2 etching detection: add 30s when Si squares seen (SiO2 = hydrophilic, Si = hydrophobic)	00:30	Q24 Q25 Q26
6.2	Check		Microscope, Z13 or stereoscope Z14				00:10	
6.3	Remove AZ1512		Lift-off bench Z13	TechniStrip P1316 ; agitate at room temperature for 6 min ; Rinse in DI water (2 beakers) ; Dry N2 gun		Materials: paper, tissue, Technistrip bottle, 3 glass beakers, 1 waste bottle, spider (two wafers can be stripped simultaneously, maybe increase slightly the time)	00:10	
6.4	Check and take images		Microscope, Z13				00:15	Q27 Q28 Q29
6.5	Measure thickness of features		Tencor Alpha-step, Z15	Mechanical measurement of the features			00:20	Q30
Release and KOH etching at CMI+1 or CMI-1								
Start warming up the KOH solution 1h before								
7 Si ETCH KOH @ CMI+1, Z14 or @ CMI-1, Z5								02:20
7.1	Etch Si		Base wet bench, Z14 / Plade Six Sigma, Z5	23%KOH @64°C for around 1h30 min (or use alternative recipe 23%KOH @80°C (etch rate 76um/h) put for around 50 min)	40um	Check SPC for etch rate on the side of the wet bench or on the CMI website Info for KOH etching at CMI+1: !!! first dilution is 1:1 to have 23% KOH solution with DIW but after will reuse this solution. --> add the KOH in the DIW !!!!!! every time before using the KOH solution check the concentration using the densitometer by using a 500mL column the density value should be around 21 otherwise need to dilute/ concentrate more. Always do the measures of density at room temperature and check again the concentration after the dilution operation For KOH use 2L glass beaker for the KOH (KOH solution previously tested for the concentration found in the top right cupboard with TP name) with 2 glass beakers (2L or 5 L) for the DIW rinse. The KOH glass beaker should be on a hotplate set at 80°C with a stirrer set between 200-300rpm After use leave KOH cool down before disposing the waste. Leave setup with glass lens cover	02:00	
7.2	Rinse		Base wet bench, Z14 / Plade Six Sigma, Z5	Rinse 2x 3min with DIW (Z14) Rinse in FFR DIW bath (Z5)		Careful Fragile!!! no DIW gun!! Be very gentle and slow (about 1-2cm/s) when moving the wafer out of the bath as going too fast could break the cantilevers.	00:10	
7.3	Rinse		Solvent wet bench, Z14 / Plade Six Sigma, Z5	Rinse 1x with alcohol (IPA) for 1min Do not dry with N2 gun		While still wet with water (don't let it dry out), place the cantilever in a dish with IPA (cantilevers facing up, wafer horizontal), add IPA and let the IPA cover the full wafer to prevent stress on cantilevers and to prevent the collapse to the surface. Wait about 30s, then take out the wafer on a paper and let it dry (no N2 gun!), inspect to see if the release is complete.		
7.4	Check		Microscope, Z13/Z1/Z6				00:10	
Alternative dry etching release at CMI-1								
7 Si isotropic ETCH @ Cmi-1, Z2								00:20
7.1	Etch Si		Alcatel AMS 200/ Z2	Recipe Si_release		Si – continuous process isotropic etch - about 10min @ 2µm/min lateral	00:20	
END								