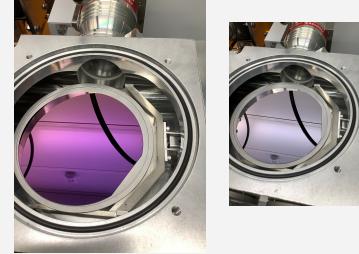
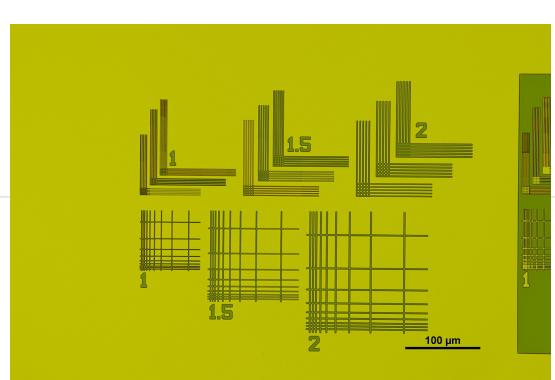
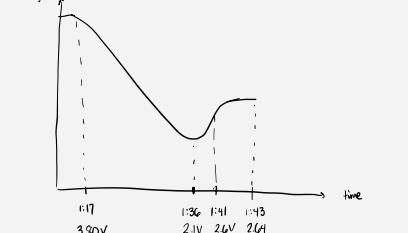
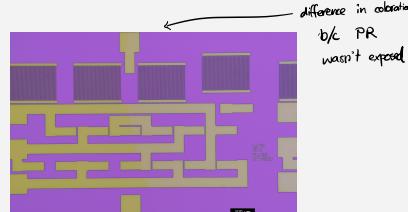
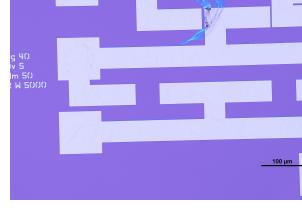
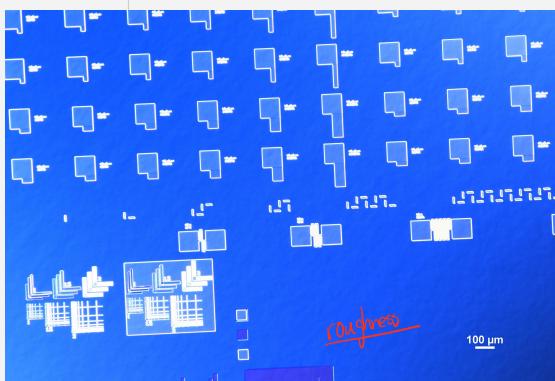
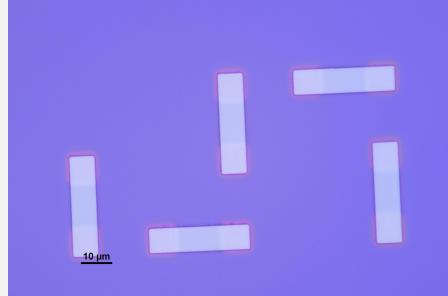


#	Steps	Process steps	Tool	Date/Time	Checklist															
Process revision notes	Reintroduced oxygen plasma descum after NMP resist strip post-RIE																			
<b>Part 0: wafer prep</b> Prepare wafer for oxide deposition, deposit insulating dielectric to isolate device from wafer																				
0.1 Start	6-inch prime (100)-Si wafers.																			
0.2 RCA Clean	10 min SC1, 5 min HF, 15 min SC2	Nano/RCA-Diffusion-L02																		
0.3 Deposit SiO2	300nm SiO2. Tube-oxidation(-Clean or -Flex)	Tube-Oxidation(-Clean or -Flex)																		
<b>Part 1: Metal gate contacts</b> Sputter W and dry etch to form source and drain contacts																				
1.1 Sputter W	W 10nm (Ar 20sccm, 3mTorr, DC 100W, deposition time 133s, rotation ON, shutter delay 60s).  5 min 200 W presputter to clean target	Nano/Sputter-AJA-LL		2025/03/22 PM	<ul style="list-style-type: none"> <li>[ ] Take picture of wafer pre-deposition</li> <li>[ ] Record chamber base pressure before loading wafer</li> <li>[ ] Measure dep rate with QCM (#8 for W) - optional</li> <li>[ ] Record P,V,I for spark, presputter, and sputter</li> <li>[ ] Take picture post-deposition</li> <li>[ ] Measure Rsheet with 4-point probe</li> </ul> <p>base pressure : 2.6 e-6 Torr 133s</p> <table border="1"> <thead> <tr> <th>strike</th> <th>presp</th> <th>dep</th> </tr> </thead> <tbody> <tr> <td>w</td> <td>204</td> <td>101</td> <td>102</td> </tr> <tr> <td>v</td> <td>297</td> <td>295</td> <td>290</td> </tr> <tr> <td>I</td> <td>690</td> <td>352</td> <td>355</td> </tr> </tbody> </table> <p>R<sub>sheet</sub> 138 Ω/□</p> 	strike	presp	dep	w	204	101	102	v	297	295	290	I	690	352	355
strike	presp	dep																		
w	204	101	102																	
v	297	295	290																	
I	690	352	355																	
1.2 Photolithography [Layer 1]	AZ3312 1 um recipe (bypass VPO1); MLA: 405 nm, 130 mJ/cm <sup>2</sup> , 0 defocus. INVERT DESIGN Develop in picoTrack: AZ726_SPRAY_60sec.  Design rules: Min metal width = 1.5 um Min spacing = 1.5 um	Nano/CoatDevelop-picoTrack, MLA150-AirAF or OptAF or WaferOnly		2025/03/24 PM	<ul style="list-style-type: none"> <li>[ ] Record layer # from GDS file</li> <li>[ ] Double check layer is inverted</li> <li>[ ] Record dose, defocus, exposure wavelength, focus method (opt/air)</li> <li>[ ] Take picture of lithography structure with microscope</li> </ul> <p>layer 1 , consolidated w/3 qts optical focus, 405 nm, 130 mJ/cm<sup>2</sup>, 0 defocus substrate angle: 3.12 mRad</p> 															

#	Steps	Process steps	Tool	Date/Time	Checklist
1.3	Dry etch W	Etch 10 nm W with Tung-sel 20nm/min. 35 s. Etch will probably complete at ~27 s. Overetch fine	Plasmatherm-A-L06	2025/03/24 PM	<ul style="list-style-type: none"> <li>[ ] Take picture (in microscope) before etch without color filter.</li> <li>[ ] Sketch laser interferometer signal as a function of time, noting the point when the etching starts, when the interferometer signal is minimized, and when it flattens out</li> <li>[ ] Take picture (in microscope) after etch. Make sure color is uniform everywhere, especially that SiO<sub>2</sub> surface is smooth and visible.</li> </ul>  <p>253</p> 
1.4	Solvent resist strip	Soak in hot NMP (70C) for 20 minutes. Rinse with acetone, IPA. Blow dry N2	Nano/Solvent-L06	2025/03/24 PM	<ul style="list-style-type: none"> <li>[ ] Take pictures in microscope (particularly around litho test structures) after clean</li> <li>[ ] Rsheet with 4-point probe</li> </ul> <p>20 min hot NMP, 2x (acetone, IPA, N2 dry) still resist</p> 
1.5	O plasma descum	Remove residual resist with oxygen plasma. SlowstripHP5 (5 min, high-pressure O plasma strip, 120 A/s)	Nano/Asher-Barrel-Thierry	03/28/2025 AM	<ul style="list-style-type: none"> <li>[ ] Take pictures in microscope (particularly around litho test structures) after clean</li> <li>[ ] Rsheet with 4-point probe</li> </ul>
1.6	Electrical testing	Measure resistance of W resistors on bottom metal layer. Check for linearity and consistency with step 1.1	Nano/Probestation-Summit-11000	2025/03/24 PM	<ul style="list-style-type: none"> <li>[ ] Compare resistance of meandered resistors with measurement of 4-point probe</li> <li>[ ] Measure Van der Pauw structure (before slowstrip HP5)</li> </ul> <p>W VDP  <math>31.2 \rightarrow 141 \Omega/\square</math> vs. <math>138 \Omega/\square</math> (from step 1.1)</p>

#	Steps	Process steps	Tool	Date/Time	Checklist
2.1	Deposit ALD Al2O3	Rinse sample with acetone, IPA, blow dry N2 before loading into ALD chamber  15nm Al2O3. Recipe: Al-TMA-H2O-200C (25 ms pulse, 10 s purge for TMA and H2O precursors). At least 20 preconditioning cycles. 150 deposition cycles. Place dummy Si pieces on top of wafer at 4 corners. Place dummy piece with 280 nm thermal oxide on top of wafer. Measure thickness of (native oxide + Al2O3) dummy pieces with Filmetrics-F20, Ellipsometer-Semilab-SE2000, or FilmSense Ellipsometer. Save dummy piece with thermal oxide for later.	Nano/ALD-Ozone or ALD-AllPurpose	3/28/2025 PM	[ ] Take picture of chamber before deposition (with Palacios tablet) [ ] Record thickness of SiO2 on dummy chip before [ ] Place dummy chips around wafer edge [ ] Take picture of wafer before deposition [ ] Take picture of wafer after deposition [ ] Take picture of chamber after deposition (with Palacios tablet) [ ] Record thickness of SiO2+Al2O3 on dummy chips after
<b>Part 2b: Optional via opening</b> Etch vias in Al2O3 gate oxide to allow connections between metal layers					
2.2	Photolithography [Layer 2]	AZ3312 1 um recipe; MLA: 405 nm, 130 mJ/cm2, 0 defocus. develop picoTrack: AZ726_SPRAY_60S  Design rules: Allow 1 um overetch on each side. Min spacing 5 um Min via width 2 um	Nano/CoatDevelop-picoTrack, MLA150-AirAF or OptAF or WaferOnly	2025/01/03 PM	<p>Dummy pieces before ALD</p> <p>before</p> <p>after</p> <p>Valve / Pulse [ms] / Purge [s] / Pmax [Torr] 3 / 25 / 10 / 0.8 1 / 25 / 10 / 0.8</p>

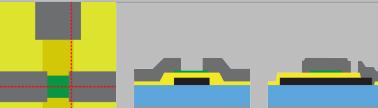
#	Steps	Process steps	Tool	Date/Time	Checklist
2.3	Etch Al2O3	AZ435 MIF, 690 s (slight overetch for 150 Å at 0.23 A/s). dip in DI 3 times, rinse under flowing DI. Dry with N2 gun.	Nano/Develop-L08	2025/04/03 pm	[ ] Take picture (in microscope) after etch. [ ] Time permitting, measure resist thickness with Filmetrics-F50 or Filmetrics-F20 (with wafer O2)
2.4	Solvent resist strip	Soak in hot NMP (70 C) for 20 minutes. Rinse with acetone, IPA. Blow dry N2	Nano/Solvent-L06 or Solvent-Clean-U06	2025/04/03 pm	[ ] Take pictures in microscope of lithographic resolution and alignment tests after clean 25 min in hot NMP (with wafer O2) exposed W looks much smoother than for wafer O2   

**Part 3: Semiconducting channel**  
Sputter ITO and wet etch to form semiconducting mesa



#	Steps	Process steps	Tool	Date/Time	Checklist
3.1	Sputter channel	Change target 3 to ITO Sputter 3nm of ITO. RF 100W: Ar 31.5sccm, O2 3.5sccm, 3mTorr, 120s. Heated deposition at 200°C R.T. 5 min 200 W presputter to clean target Note: Gun #3 angle at 0.5, 14	Nano/Sputter-AJA-LL	Friday April 4 <sup>th</sup> 9:15	<ul style="list-style-type: none"> <li>[ ] Take picture of wafer pre-deposition</li> <li>[ ] Record chamber base pressure <math>2.2 \cdot 10^{-6}</math> Torr</li> <li>[ ] Measure dep rate with QCM (#20 for ITO). done last lab</li> <li>[ ] Place a piece of thermal oxide on silicon on the chuck next to the wafer</li> <li>[ ] Record P,V for spark, presputter, and sputter</li> <li>[ ] Take picture post-deposition</li> </ul>
3.2	Photolithography [Layer 4]	AZ3312 1um recipe; MLA: <del>120nm</del> 405nm. INVERT DESIGN Develop in picoTrack: AZ726_spry_60sec.  Min ITO width = 1.5 um Min spacing = 1.5 um  ↓ 140 mJ , defoc +1 , opt focus	Nano/CoatDevelop-picoTrack, MLA150-AirAF or OptAF or WaferOnly	4/7 AM	<ul style="list-style-type: none"> <li>[ ] Record layer # from GDS file</li> <li>[ ] Double check layer is inverted</li> <li>[ ] Record dose, defocus, exposure wavelength, focus method (opt/air)</li> <li>[ ] Record rotation, scaling, shearing</li> <li>[ ] Take picture of lithography structure with microscope</li> <li>[ ] Take picture of alignment calipers with microscope</li> </ul> <p>layer 4, s25, consolidated, v3, inverted. 405 nm, 140 mJ, +1 defoc optical focus angle: -89.5 mRad ?? ~5° rotation: 3.216 mRad ✓ scaling: 0.999998 / 1.000000 ✓</p>
3.3	Wet etch ITO	Prepare 1:10 HCl:H2O by mixing 120mL 36% HCl and 1.2L DI water. Dip cassette with wafers into diluted HCl for 24 seconds (19 s timer) or until color change completes. No agitation. Rinse in DI water. N2 dry  - double check etch rate using piece from deposition	Nano/Acid-Extended-U07 (IGZO) or Nano/Acid-Etch-General-U10/L06 (ITO)	4/7 AM	<ul style="list-style-type: none"> <li>[ ] Time permitting, check etch rate with dummy piece from step 3.1</li> <li>[ ] Take picture (in microscope, without color filter) before etch</li> <li>[ ] Take picture (in microscope, without color filter) after etch</li> </ul>
3.4	Solvent resist strip	Soak in hot NMP (70°C) for 20 minutes. Rinse with acetone, IPA. Blow dry N2	Nano/Solvent-L06	4/7 AM	<ul style="list-style-type: none"> <li>[ ] Inspect in microscope after strip, checking for residual resist with O2, O5</li> </ul> <p>11:35 into NMP heater was off lots of droplets, needs 12p out to be cleaned again → same w/ 2 and 5 cleaned again, looks okay (acetone, IPA)</p>

**Part 4: Metal source/drain contacts**  
Liftoff evaporated Ni to form source and drain contacts



#	Steps	Process steps	Tool	Date/Time	Checklist
4.1	Photolithography [Layer 3]	nLOF2020 2um recipe MLA: 340mJ <b>375nm</b> , 0 defocus. INVERT DESIGN Develop in picoTrack: AZ726_spry_60sec_NOHB.	Nano/CoatDevelop-picoTrack, MLA150-AirAF or OptAF	4/11 am	<ul style="list-style-type: none"> <li>[ ] Record layer # from GDS file</li> <li>[ ] Double check layer is inverted</li> <li>[ ] Record dose, defocus, exposure wavelength, focus method (opt/air)</li> <li>[ ] Record rotation, scaling, shearing</li> <li>[ ] Take picture of lithography structure with microscope</li> <li>[ ] Take picture of alignment calipers with microscope</li> </ul> <p>4, v3_cons., inv</p> <p>340mJ, 0 def, 375 nm, opt focus</p> <p>rotation : 0.407 mRad ✓</p> <p>scaling : 1.000021 / 1.000023 ✓</p> <p>Shear : 0.004 mRad</p>
4.2	Evaporate NiAu	10 nm Ni, 30 nm Au	Nano/EBeam-Temescal-FC2800 or EBeam-Temescal-LL	4/11 pm	<ul style="list-style-type: none"> <li>[ ] Take picture of wafer pre-deposition</li> <li>[ ] Record chamber base pressure</li> <li>[ ] Take picture of wafer post-deposition</li> </ul>
4.3	Liftoff resist	Soak in hot NMP (70 C) for 45 minutes. Ensure bowl is sufficiently full of NMP that resist won't redeposit when taking the wafer out. Rinse with acetone, IPA. Blow dry N2	Nano/Liftoff-L08	4/11 pm	<ul style="list-style-type: none"> <li>[ ] Take picture in microscope (particularly around litho test structures) after liftoff</li> </ul>
4.4	Electrical testing	Measure leakage, breakdown voltage of MIM capacitors. Measure resistance of NiAu resistors on top metal layer. Measure ITO resistivity with VDP structures. Measure TLMs (ITO TLMs and W TLMs)	Nano/Probestation-Summit-11000		

Remarks/measurement results