

Process Flow for Micro-Electrode Array Fabrication

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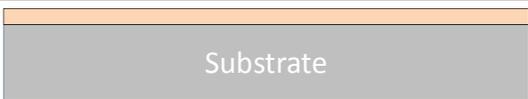
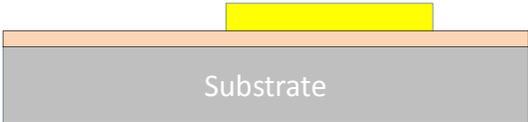
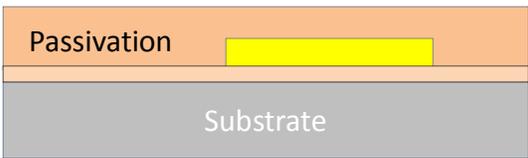
Introduction

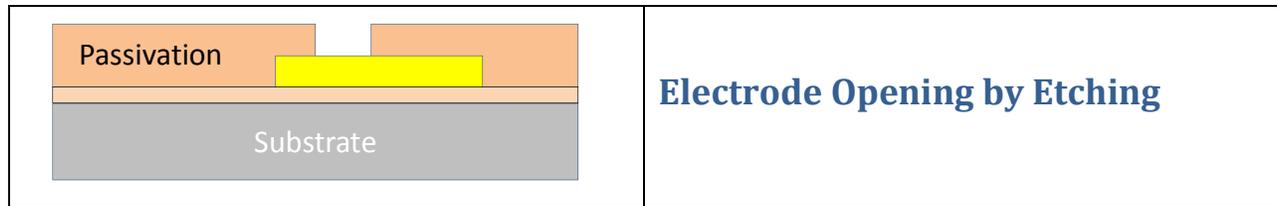
To fabricate 1cm x 1cm Platinum Micro-Electrode Array (4x4) on fused silica substrate. The critical dimension of the device is 30 μm , and the passivation layer should have least pin-holes. The fabricated device will be used for DNA and protein sensor application.

Project Description

Substrate material: Fused Silica
Substrate size: 4 in
Metal material: Gold
Metal Layer: 1
Device Type: MEMS
Critical Dimension: 30 μm
Die size: 1 cm x 1 cm

Process Flow Diagram

	Substrate Cleaning
	Deposition of PECVD Oxide Layer
	Deposition of Metal Patter
	Deposition of Passivation Layer



Process Flow

1. Metal Deposition (Mask #1)

A. Substrate Solvent Clean

Purpose	Clean substrate, removal residues, make it ready for later fabrication steps
Equipment	Fume Hood (Marcus)
Chemicals	Acetone/Methanol or IPA/DI Water
Labware	Glass beaker
Tools	Tweezers
Operation	<p>(1). Locate the fume hood you want to use. Make sure there is no Piranha solution or hotplate being used in the fume hood and that there is a solvent waste jar/drain available. Fill out a chemical warning label, and place it in your work area.</p> <p>(2). Put the glass beaker, texwipes and solvent bottles in your work area. Clean the beaker with solvent if necessary.</p> <p>(3). Grip the substrate with the tweezers at the edge, and hold it firmly above the beaker. Gently rinse the substrate surface with acetone for 1 min.</p> <p>(4). While still holding the substrate, rinse the substrate with methanol or IPA for 1 min.</p> <p>(5). While still holding the substrate, rinse the substrate with DI water for 1 min over the sink.</p> <p>(6). Move substrate above a texwipes, blow dry it with a nitrogen gun, and put it back into its box.</p> <p>(7). Pour solvent contained in the beaker into the solvent waste jug/drain, rinse it with IPA, and blow dry it with a nitrogen gun.</p> <p>(8). Clean up the work area, and remove the texwipes and the chemical warning label.</p> <p>(9). Return all the solvent bottles to the storage shelf.</p>

B. Deposition of PECVD Oxide

Purpose	Increase adhesion between metal layer and substrate
Equipment	Oxford PECVD Right (Marcus)
Recipe	Standard Oxide
Time	8 min (expected thickness 480nm)
Tools	Tweezers

Operation	(1). Login equipment. Check the log if previous user has run "clean" recipe after usage. Run "clean" recipe for 30 min if necessary
	(2). Vent the chamber. Wait until the vent cycles complete, open the chamber. Check the status of chamber: blow any dust or residue off the platen. Blow substrate with a nitrogen gun. Load substrate onto the platen, and position it in center.
	(3). Close the chamber. Start pumping down.
	(4). Load recipe "standard oxide". Calculate deposition time based on deposition rate (8 min). Type in deposition time into recipe, start recipe.
	(5). Watch over the window to see if plasma is striking normally. Wait until the process stops.
	(6). Vent the chamber. Wait until the vent cycles complete, open the lid and take substrate out. Wait until it cools down before put it into storage box.
	(7). Close the chamber. Start pumping down.
	(8). Load the recipe "clean" and start recipe
	(9). Logout equipment.

C. Deposition of Metal Layer

Purpose	Deposition of metal layer
Equipment	Unifilm Sputterer (Marcus)
Target	Gold, Titanium
Tools	Tweezers
Operation	(1). Login equipment. Check if the Pt, and Ti targets are install in the equipment. Install the targets if needed.
	(2). Vent the Loadlock, blow the load plate and substrate before load them into Loadlock. Load the substrate into Loadlock and start pumping.
	(3). Following the instruction on screen, load the substrate into chamber.
	(4). Load recipe for Ti deposition, set thickness = 300A; rate = 200A/min. Then start he recipe.
	(5). When Ti deposition is done, load the recipe for Au deposition, set thickness = 3000A; rate = 200A/min. Then start the recipe.
	(6). When Au deposition is done, load the recipe for Ti deposition, set thickness = 300A; rate = 200A/min. Then start the recipe.
	(7). When the Ti deposition is done, load the substrate back into Loadlock.
	(8). Vent the Loadlock, take substrate out. Close the lid and start pumping.
	(9). Logout the equipment and clean up the area.

D. Photolithography with Mask #1

Purpose	Prepare photoresist mask for metal deposition and lift-off process
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Equipment	K&S RC8 Spinner, K&S MA-6 Mask Aligner (Marcus)
Chemicals	Megaposit SPR220-7.0, MF-319 developer, HMDS, Hotplate
Labware	Pipette, Beaker, timer
Tools	Tweezers
Operation	<p>(1). Set spin speed = 4000rpm, ramp rate = 1000rpm/sec, spin time = 40 sec on spinner</p> <p>(2). Blow substrate with a nitrogen gun, mount it onto spinner chuck.</p> <p>(3). Cast HMDS on substrate surface with a pipette. Wait until HMDS spread all over the substrate surface, close the lid and start the spinner.</p> <p>(4). Set hotplate temperature to 105C, and set baking time to 5min. Set spin speed = 3000rpm, ramp rate = 500rpm/sec, spin time = 40 sec on spinner</p> <p>(5). Open the lid and cast SPR220 on substrate surface with a pipette. Wait until resist spread and over 2/3 of the substrate surface. Remove any bubbles as possible. Close the lid and start the spinner.</p> <p>(6). Wait until spinner fully stops, substrate will be transferred to hotplate, substrate will be baked for 5 min at 105C</p> <p>(7). Wait until the substrate is transferred to Loadlock, open the lid and take substrate out.</p> <p>(8). Run "clean" recipe on RC8 to clean the spinner.</p> <p>(9). Remove all the solvent waste and put in "solvent trash can"</p> <p>(10). Login K&S MA-6 Mask aligner, set UV lamp to channel 1. Measure the light intensity with the intensity meter. Calculate the exposure time based on exposure dose and intensity.</p> <p>(11). Load the correct mask holder (4") into the mask aligner, set contact mode to "hard contact", set alignment gap to 30um, set exposure time to calculated value.</p> <p>(12). Load the mask into mask aligner and then load the substrate into mask aligner. Align the substrate the mask, expose the substrate</p> <p>(13). Remove substrate and mask from mask aligner. Logout the equipment</p> <p>(14). Set up a work area in a fume hood, fill out a chemical warning label, and put it in the work area</p> <p>(15). Rinse a clean beaker with DI water, pour MF-319 in it</p> <p>(16). Set the timer to 30 sec</p> <p>(17). Put the substrate into the beaker and start the timer. Shake the beaker gently to let the photoresist fully developed.</p> <p>(18). Take the substrate out and rinse it with DI water, blow dry it with a nitrogen gun.</p> <p>(19). Clean up the work area, rinse the beaker with DI water. Return all the chemicals to storage area.</p>

E. Resist Thickness Measurement

Purpose	Characterize photoresist thickness
Equipment	Dektak Profilometer (Marcus)

Tools	Tweezers
Operation	(1). Login profilometer.
	(2). Open front door, and load substrate onto stage, switch stage vacuum on.
	(3). Move stage to starting position, lower tower and stylus. Setup scan parameters: distance = 500um; time = 20 sec; stylus force = 1mg
	(4). Locate the position for scan, setup scan rout then start the scan
	(5). When scan is done, level the scan result and record the average step height.
	(6). Repeat the scan on 3 other different locations on substrate.
	(7). Unload the substrate, and take the substrate out. Close the front door
	(8). Logout the equipment and clean up the work area

F. Metal Pattern Etching

Purpose	Removal extra metal off the substrate
Equipment	Fume Hood (Marcus)
Chemicals	Gold Etchant 8184, BOE
Labware	Glass beaker, Teflon container
Tools	Tweezers
Operation	(1). Locate the fume hood you want to use. Fill out a chemical warning label, and place it in your work area.
	(2). Put the glass beaker, texwipes, ultrasonic bath and solvent bottles in your work area. Clean the beaker with solvent if necessary.
	(3). Wear personal protective equipment
	(4). Pour BOE into the Teflon container, and then put substrate in the container.
	(5). Watch carefully for the color change, take wafer out and rinse it thoroughly.
	(6). Pour Gold Etchant into the glass beaker, and then put substrate in the beaker.
	(7). Watch carefully for the color change, take wafer out and rinse it thoroughly.
	(8). Put the substrate in BOE container again.
(6). Watch carefully for the color change and then take the substrate out, rinse it thoroughly and blows dry it.	
(7). Pour BOE in the drain, gold etchant in a storage container, and clean the baker/container. Clean up the work area.	

G. Photoresist Removal/Substrate Clean

Purpose	Remove the photoresist, make sure the device is ready for testing
Equipment	Fume Hood (Marcus)
Chemicals	Acetone/Methanol or IPA/DI Water
Labware	Glass beaker
Tools	Tweezers

Operation	(1). Locate the fume hood you want to use. Make sure there is no Piranha solution or hotplate being used in the fume hood and that there is a solvent waste jar/drain available. Fill out a chemical warning label, and place it in your work area.
	(2). Put the glass beaker, texwipes and solvent bottles in your work area. Clean the beaker with solvent if necessary.
	(3). Grip the substrate with the tweezers at the edge, and hold it firmly above the beaker. Gently rinse the substrate surface with acetone for 1 min.
	(4). While still holding the substrate, rinse the substrate with methanol or IPA for 1 min.
	(5). While still holding the substrate, rinse the substrate with DI water for 1 min.
	(6). Move substrate above a texwipes, blow dry it with a nitrogen gun, and put it back into its box.
	(7). Pour solvent contained in the beaker into the solvent waste jar/drain, rinse it with IPA, and blow dry it with a nitrogen gun.
	(8). Clean up the work area, and remove the texwipes and the chemical warning label.
	(9). Return all the solvent bottles to the storage shelf.

H. Metal Thickness Measurement

Purpose	Characterize metal layer thickness
Equipment	Dektak Profilometer (Marcus)
Tools	Tweezers
Operation	(1). Login profilometer.
	(2). Open front door, and load substrate onto stage, switch stage vacuum on.
	(3). Move stage to starting position, lower tower and stylus. Setup scan parameters: distance = 500um; time = 20 sec; stylus force = 1mg
	(4). Locate the position for scan, setup scan rout then start the scan
	(5). When scan is done, level the scan result and record the average step height.
	(6). Repeat the scan on 3 other different locations on substrate.
	(7). Unload the substrate, and take the substrate out. Close the front door
	(8). Logout the equipment and clean up the work area

2. Electrode Opening (Mask #2)

A. Deposition of Passivation Layer

Purpose	Passivation of substrate surface to protect metal layer
Equipment	Oxford PECVD Right (Marcus)
Recipe	Standard Oxide
Time	25 min (expected thickness 1.5 um)

Tools	Tweezers
Operation	(1). Login equipment. Check the log if previous user has run "clean" recipe after usage. Run "clean" recipe for 30 min if necessary
	(2). Vent the chamber. Wait until the vent cycles complete, open the chamber. Check the status of chamber: blow any dust or residue off the platen. Blow substrate with a nitrogen gun. Load substrate onto the platen, and position it in center.
	(3). Close the chamber. Start pumping down.
	(4). Load recipe "standard oxide". Calculate deposition time based on deposition rate (25 min). Type in deposition time into recipe, start recipe.
	(5). Watch over the window to see if plasma is striking normally. Wait until the process stops.
	(6). Vent the chamber. Wait until the vent cycles complete, open the lid and take substrate out. Wait until it cools down before put it into storage box.
	(7). Close the chamber. Start pumping down.
	(8). Load the recipe "clean" and start recipe
	(9). Logout equipment.

B. Photolithography with Mask #2

Purpose	Prepare photoresist mask for metal deposition and lift-off process
Equipment	K&S RC8 Spinner, K&S MA-6 Mask Aligner (Marcus)
Chemicals	Megaposit SPR220-7.0, MF-319 developer, HMDS, Hotplate
Labware	Pipette, Beaker, timer
Tools	Tweezers
Operation	(1). Set spin speed = 4000rpm, ramp rate = 1000rpm/sec, spin time = 40 sec on spinner
	(2). Blow substrate with a nitrogen gun, mount it onto spinner chuck.
	(3). Cast HMDS on substrate surface with a pipette. Wait until HMDS spread all over the substrate surface, close the lid and start the spinner.
	(4). Set hotplate temperature to 105C, and set baking time to 5min. Set spin speed = 3000rpm, ramp rate = 500rpm/sec, spin time = 40 sec on spinner
	(5). Open the lid and cast SPR220 on substrate surface with a pipette. Wait until resist spread and over 2/3 of the substrate surface. Remove any bubbles as possible. Close the lid and start the spinner.
	(6). Wait until spinner fully stops, substrate will be transferred to hotplate, substrate will be baked for 5 min at 105C
	(7). Wait until the substrate is transferred to Loadlock, open the lid and take substrate out.
	(8). Run "clean" recipe on RC8 to clean the spinner.
	(9). Remove all the solvent waste and put in "solvent trash can"
	(10). Login K&S MA-6 Mask aligner, set UV lamp to channel 1. Measure the light intensity with the intensity meter. Calculate the

	exposure time based on exposure dose and intensity.
	(11). Load the correct mask holder (4") into the mask aligner, set contact mode to "hard contact", set alignment gap to 30um, set exposure time to calculated value.
	(12). Load the mask into mask aligner and then load the substrate into mask aligner. Align the substrate the mask, expose the substrate
	(13). Remove substrate and mask from mask aligner. Logout the equipment
	(14). Set up a work area in a fume hood, fill out a chemical warning label, and put it in the work area
	(15). Rinse a clean beaker with DI water, pour MF-319 in it
	(16). Set the timer to 30 sec
	(17). Put the substrate into the beaker and start the timer. Shake the beaker gently to let the photoresist fully developed.
	(18). Take the substrate out and rinse it with DI water, blow dry it with a nitrogen gun.
	(19). Clean up the work area, rinse the beaker with DI water. Return all the chemicals to storage area.

C. Resist Thickness Measurement

Purpose	Characterize photoresist thickness
Equipment	Dektak Profilometer (Marcus)
Tools	Tweezers
Operation	(1). Login profilometer.
	(2). Open front door, and load substrate onto stage, switch stage vacuum on.
	(3). Move stage to starting position, lower tower and stylus. Setup scan parameters: distance = 500um; time = 20 sec; stylus force = 1mg
	(4). Locate the position for scan, setup scan rout then start the scan
	(5). When scan is done, level the scan result and record the average step height.
	(6). Repeat the scan on 3 other different locations on substrate.
	(7). Unload the substrate, and take the substrate out. Close the front door
	(8). Logout the equipment and clean up the work area

D. Electrode Opening by Etching

Purpose	Open Metal Electrode to make electrode array
Equipment	Vision RIE (Marcus)
Recipe	Standard Oxide
Time	60 min (expected etch depth 1.5 um)
Tools	Tweezers
Operation	(1). Login equipment. Check the log if previous user has run "clean" recipe after usage. Run "clean" recipe for 30 min if necessary
	(2). Vent the chamber. Wait until the vent cycles complete, open the

	chamber. Check the status of chamber: blow any dust or residue off the platen. Blow substrate with a nitrogen gun. Load substrate onto the platen, and position it in center.
	(3). Close the chamber. Start pumping down.
	(4). Load recipe "standard oxide". Calculate deposition time based on deposition rate (60 min). Type in etch time into recipe, start recipe.
	(5). Watch over the window to see if plasma is striking normally. Wait until the process stops.
	(6). Vent the chamber. Wait until the vent cycles complete, open the lid and take substrate out. Wait until it cools down before put it into storage box.
	(7). Close the chamber. Start pumping down.
	(8). Load the recipe "O2 clean" and start recipe
	(9). Logout equipment.

E. Etch Depth Measurement

Purpose	To measure etch depth, make sure passivation layer is completely etched
Equipment	Dektak Profilometer (Marcus)
Tools	Tweezers
Operation	(1). Login profilometer.
	(2). Open front door, and load substrate onto stage, switch stage vacuum on.
	(3). Move stage to starting position, lower tower and stylus. Setup scan parameters: distance = 500um; time = 20 sec; stylus force = 1mg
	(4). Locate the position for scan, setup scan rout then start the scan
	(5). When scan is done, level the scan result and record the average step height.
	(6). Repeat the scan on 3 other different locations on substrate.
	(7). Unload the substrate, and take the substrate out. Close the front door
	(8). Logout the equipment and clean up the work area

F. Photoresist Removal/Substrate Clean

Purpose	Remove the photoresist, make sure the device is ready for testing
Equipment	Fume Hood (Marcus)
Chemicals	Acetone/Methanol or IPA/DI Water
Labware	Glass beaker
Tools	Tweezers
Operation	(1). Locate the fume hood you want to use. Make sure there is no Piranha solution or hotplate being used in the fume hood and that there is a solvent waste jar/drain available. Fill out a chemical warning label, and place it in your work area.
	(2). Put the glass beaker, texwipes and solvent bottles in your work area. Clean the beaker with solvent if necessary.

	(3). Grip the substrate with the tweezers at the edge, and hold it firmly above the beaker. Gently rinse the substrate surface with acetone for 1 min.
	(4). While still holding the substrate, rinse the substrate with methanol or IPA for 1 min.
	(5). While still holding the substrate, rinse the substrate with DI water for 1 min.
	(6). Move substrate above a texwipes, blow dry it with a nitrogen gun, and put it back into its box.
	(7). Pour solvent contained in the beaker into the solvent waste jar/drain, rinse it with IPA, and blow dry it with a nitrogen gun.
	(8). Clean up the work area, and remove the texwipes and the chemical warning label.
	(9). Return all the solvent bottles to the storage shelf.

3. Substrate Dicing

A. Spin Coating Protection Layer

Purpose	To apply a photoresist layer for protection during dicing
Equipment	K&S RC8 Spinner (Marcus)
Chemicals	Megaposit SPR220-7.0, HMDS, Hotplate
Labware	Pipette, timer
Tools	Tweezers
Operation	(1). Set spin speed = 4000rpm, ramp rate = 1000rpm/sec, spin time = 40 sec on spinner
	(2). Blow substrate with a nitrogen gun, mount it onto spinner chuck.
	(3). Cast HMDS on substrate surface with a pipette. Wait until HMDS spread all over the substrate surface, close the lid and start the spinner.
	(4). Set hotplate temperature to 105C, and set baking time to 5min. Set spin speed = 3000rpm, ramp rate = 500rpm/sec, spin time = 40 sec on spinner
	(5). Open the lid and cast SPR220 on substrate surface with a pipette. Wait until resist spread and over 2/3 of the substrate surface. Remove any bubbles as possible. Close the lid and start the spinner.
	(6). Wait until spinner fully stops, substrate will be transferred to hotplate, substrate will be baked for 5 min at 105C
	(7). Wait until the substrate is transferred to Loadlock, open the lid and take substrate out.
	(8). Run "clean" recipe on RC8 to clean the spinner.
	(9). Remove all the solvent waste and put in "solvent trash can"

B. Request Dicing Service through cleanroom website

C. Photoresist Removal/Substrate Clean

Purpose	Remove the photoresist, make sure the device is ready to use
Equipment	Fume Hood (Marcus)
Chemicals	Acetone/Methanol or IPA/DI Water
Labware	Glass beaker
Tools	Tweezers
Operation	<p>(1). Locate the fume hood you want to use. Make sure there is no Piranha solution or hotplate being used in the fume hood and that there is a solvent waste jar/drain available. Fill out a chemical warning label, and place it in your work area.</p> <p>(2). Put the glass beaker, texwipes and solvent bottles in your work area. Clean the beaker with solvent if necessary.</p> <p>(3). Grip the substrate with the tweezers at the edge, and hold it firmly above the beaker. Gently rinse the substrate surface with acetone for 1 min.</p> <p>(4). While still holding the substrate, rinse the substrate with methanol or IPA for 1 min.</p> <p>(5). While still holding the substrate, rinse the substrate with DI water for 1 min.</p> <p>(6). Move substrate above a texwipes, blow dry it with a nitrogen gun, and put it back into its box.</p> <p>(7). Pour solvent contained in the beaker into the solvent waste jar/drain, rinse it with IPA, and blow dry it with a nitrogen gun.</p> <p>(8). Clean up the work area, and remove the texwipes and the chemical warning label.</p> <p>(9). Return all the solvent bottles to the storage shelf.</p>