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SCIENCE MISSION SQUID CARRIER SUBSTRATE (Part# 25019-201) FABRICATION[1]

Document Revision Record

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1.0 WAFER COATING

1.1. CLEANING.

1.1.1 SCOPE: This section of the procedure covers the cleaning of sapphire wafers for SQUID carriers prior to coating with thin films of niobium, gold and copper. It covers both virgin wafers, as received from the manufacturer, as well as wafers to be re-worked.

1.1.2 EQUIPMENT:

Exhausted Wet Bench,
Rotor Cleaning Wet Bench, Interlab MRS/1351
Loop Coating System Laminar Flow Assembly Bench
Chemical safety goggles or face shield
Chemical Apron
Chemical Gloves
Arm Guards
Hotplate, Corning, Model 351 (built into Exhausted Wet Bench)
Dump Rinser
Beaker, 1000 ml, Pyrex
Reflux Condenser made from Pyrex round bottom boiling flask, 500 ml.
Teflon basket
Teflon wafer boat, Fluoroware A82M-0215 or equilivalent
Lab Stand

1.1.3 MATERIALS:

Sulfuric acid, concentrated 18.0M
MICRO Detergent

1.1.4 PROCEDURE:

[1] The SQUID carrier substrate is not ESD sensitive.

Safety precautions:

Note that sulfuric acid is very hazardous. Always wear chemical goggles or face shield, chemical apron, arm guards, and chemical gloves over clean room gloves. Hot sulfuric acid is very reactive, keep away from flammable materials, metals, and water. All containers should be clearly labeled before placing sulfuric acid solutions in them. Any spills or droplets should be immediately cleaned up.

1.1.4.1 Preparation, Sulfuric Acid Etch/Clean:

1.1.4.1.1 Attach reflux condenser to water lines in general purpose acid wet bench. Mount condenser to stand over hotplate. Start a low flow (approx. 100 ml/min) of water through condenser. Verify flow exists and be sure condenser does not leak.

1.1.4.1.2 Place sapphire wafer to be cleaned in teflon holder or basket, whichever is appropiate and will permit covering the part with the minimum amount of acid.

1.1.4.1.3 Place holder or basket in 600 ml beaker. **Don full protective gear**. Pour sufficient sulfuric acid into beaker to cover part. Return sulfuric acid bottle to storage.

1.1.4.1.4 Place beaker with part on hotplate and lower condenser against top of beaker.

1.1.4.2 Sulfuric acid pre-clean:

1.1.4.2.1 Turn on hotplate to about 3-4. Allow acid to heat until white fumes are observed, this takes about 25-30 minutes. Once fumes are observed, allow 15 minutes at this temperature.

1.1.4.2.2 After part has soaked at high temperature, turn off hotplate and allow sulfuric acid to cool. Allow a minimum of 1 hour for acid to cool.

1.1.4.2.3 Fill second beaker with DI water to a level high enough to cover the part and basket or holder.

1.1.4.2.4 Once acid has cooled to less than 30 °C the part can be removed from the acid. **Be sure to wear full safety gear whenever approaching or handling acid.** Remove beaker with acid and part from hotplate and place on wet bench surface. Slowly lift basket from acid, allowing acid to drain from part back into beaker. Place basket in second beaker and place this beaker in the sink.

1.1.4.2.5 Verify that acid is below 30 °C. When acid is cool, pour into used sulfuric acid container. Allow as much acid to drain from the beaker as is possible. Return used sulfuric acid container to storage. Be sure container is properly labeled.

1.1.4.2.6 Remove part in holder or basket from beaker with DI water and place in dump rinser. Pour DI water into beaker from which acid was drained and place the empty beaker into the dump rinser. Run dump rinser.

1.1.4.2.7 When dump rinser has finished its cycle, remove part. Dry part or proceed to aqueous clean as appropiate.

1.1.4.3 Shutdown, Sulfuric Acid Etch/Pre-Clean:

1.1.4.3.1 Pour contaminated rinse water from beaker into waste container labeled DILUTE SULFURIC ACID WASTE. Place this beaker into the dump rinser and run dump rinser. Return waste container to storage.

1.1.4.3.2 Shut off cooling water to condenser, remove condenser and rinse. Return condenser to storage.

1.1.4.3.3 Verify hotplate is off. Wipe down hotplate surface, hotplate well and lab stand with lint free paper wetted with DI water.

1.1.4.4 Aqueous Clean:

1.1.4.4.1 Set up INTERLAB Model RMS/1351 Spherical Substrate Cleaning System per its operating procedure, document P319.

1.1.4.4.2 Place teflon wafer holder with sapphire wafers into ultrasonic tank. Start ultrasonics and clean for 60±5 seconds, stop ultrasonics and allow cleaning solution to circulate for 60±5 seconds, repeat ultrasonic and circulation cycles for a total of 3 cycles.

1.1.4.4.3 Transfer wafer holder with sapphire wafers into DUMP RINSER and run dump rinse cycle per equipment operating procedure.

1.1.4.4.4 Transfer wafer holder with sapphire wafers into hot overflow rinse. Perform hot overflow rinse for a minimum of 5 minutes per equipment operating procedure 6.3.

1.1.4.4.5 Transfer wafer holder with sapphire wafers into hot air drier and operate drier per equipment operating procedure 6.4, for a minimum of 20 minutes to assure complete drying of teflon wafer holder. After complete drying remove wafer holder slowly and transfer to Loop Coating System Laminar Flow Assembly Bench.

1.2. Nb/Au DEPOSITION

1.2.1 SCOPE: This section of the procedure covers deposition of niobium and gold thin films for SQUID carriers.

1.2.2 EQUIPMENT:

MICROSCIENCE DC MAGNETRON SPUTTERING SYSTEM.
Loop Coating System Laminar Flow Bench
Wafer Holder adaptor, titanium, drawing number: wafhld.dwg.

1.2.3 MATERIALS:

Niobium Target, per drawing looptarg.dwg
Gold Target, 99.999% pure or better.
Dish, Petri square, 100x15 mm, polystryene, Falcon 1029 or equivalent.

1.2.4 PROCEDURE:
See Loop Coating System operating procedure dkg00956.doc, GP-B P#0114.
1.2.4.1 Mount wafer in titanium wafer holder adaptor. Adaptor previously mounted to molybdenum fixture with titanium fasteners. Use stainless steel tweezers to handle wafer, taking care to touch wafer only on outer rim which will be removed when substrates are diced from the wafer.
1.2.4.2 Install in system loadlock and pump down. Allow loadlock to pump to a base pressure below 5×10^{-6} Torr.
1.2.4.3 Transfer to main chamber and position over niobium target. Allow system to re-establish base pressure. Throttle system and verify pressure 1 minute after throttling is below 2.0×10^{-7} Torr. Record base pressure and throttled pressure in depositon record sheet.
1.2.4.4 Deposit niobium film at 0.50 nm/second.
Verify that the crystal monitor is programmed for the required film thickness specified on the traveler and the operating parameters currently recorded in the system operating manual. Set the argon backfill pressure to the value currently recorded in the system operating manual to achieve minimum film stress. Immediately after niobium deposition, shutdown power supply and start gold target pre-sputter. Record argon flow, pressure, target current, target voltage and indicated rate on the deposition record sheet. Also record time and power information on target utilization log.
1.2.4.5 Position over gold target. During the 60 second gold target pre-sputter period, rotate the substrate manipulator to position the substrate over the gold target. This requires 10 turns counterclockwise as viewed from above the system.
1.2.4.6 Deposit gold film, 1.0 nm/second, 50 seconds. Press the shutter #1 manual control switch to open the gold target shutter and manually time the depositon. Immediately upon completion of the 50 second deposition, close the shutter and turn off the power supply. Turn off argon flow and open the throttle.
1.2.4.7 Position for unload. Turn manipulator approximately 6 turns clockwise. Raise substrate holder to 3.0 " on z-axis manipulator scale.
1.2.4.8 Transfer to loadlock. Open manual transfer valve and transfer substrate to loadlock. Close manual transfer valve.
1.2.4.9 Isolate loadlock, vent and remove sample.
1.2.4.10 Store wafer in plastic dish, label dish with date and time of deposition, which become the I.D. number for the wafer.
1.2.4.11 Fill out traveler, dkg01000.doc.

1.3. Cu DEPOSITION

1.3.1 SCOPE: This section of the procedure covers the deposition of copper thin films for SQUID carriers to form patterned copper pads.

1.3.2 EQUIPMENT: MRC 8806 RF SPUTTERING SYSTEM.
UVOCs UV Ozone cleaner.
Exhausted Wet Bench
Chemical safety goggles or face shield
Chemical Apron
Chemical Gloves
Arm Guards
Hotplate
Dump Rinser
Beaker, 1000 ml, Pyrex

1.3.3 MATERIALS: copper sputtering target, 99.999% pure or existing target supplied with system.
1/2" thick, single position copper mounting block
molybdenum shadow mask, per traveler.
copper mask hold down cover, matched to molybdenum shadow mask, SQDMOSM.DWG[2]
niobium centering ring, sqdcrmsk.dwg.
Sulfuric acid, concentrated 18.0M

1.3.4 PROCEDURE: See Rotor Coating Procedure, P0079 for basic system operating procedures. Follow procedures in DKG00178 unless directed otherwise below.

1.3.4.1 Verify that mask, mounting block, etc. are clean for vacuum use. If necessary clean per GP-B P0317.
1.3.4.2 If sapphire wafer with niobium/gold films has been stored in plastic Petri dish for more than 24 hours, clean using UV Ozone cleaner to remove plastizers and other organic contaminants from the gold film. Set up UV Ozone cleaner inside General Wet bench to provide fume exhaust. Operate UV Ozone cleaner for 30 minutes to clean chamber and fixture. Be sure fixture is set so that wafer will be within 1/4 " of top of chamber opening. Also verify that fixture has niobium sheet cover for back side wafer contact to prevent magnetic contamination. After cleaner has operated for 30 minutes, install coated sapphire wafer and clean for 2.00 minutes.
1.3.4.3 Mount wafer to 1/2" thick copper block, place inside 3" opening in niobium centering ring, place molybdenum shadowmask over wafer and place copper hold down cover over mask. Install 2 each copper alignment pins and 4 each retention screws. Be sure retention screws are loosely tightened so as not to cause mask to bow up in center.
1.3.4.4 Vent MRC sputtering system and place mounted wafer over rotor manipulator fixturing. Record date, time, and base pressure. Install mounted wafer over rotor manipulator. Allow system to pump down, typically overnight.

1.3.4.5 Base pressure is typically around 3 X 10^{-7} torr (must be less than 1 X 10^{-6} Torr), foreline GP-307 Convectron B reads around 5.3 micron. Record base pressure, throttle system and record throttled pressure 1 minute after throttling. Throttled pressure should be below 5.0 x 10^{-6} Torr.

[2] Archival computer copy of SQDMOSM.DWG is on file at the documentation center.

1.3.4.6 Set copper target up and SPUTTER/PRE-SPUTTER switch to pre-sputter. Pre-sputter copper target for 30 minutes at 200 watts.
1.3.4.7 Switch copper target to sputter down and deposit copper for 45 minutes at 600 watts.
1.3.4.8 Immediately after copper deposition ends, switch niobium target #1 to pre-sputter up position and pre-sputter nioboum for 30 minutes at 200 watts. This step provides a fresh niobium film to getter reactive background gases during substrate cooling.
1.3.4.9 After niobium getter film deposition, turn off argon flow, open throttle and pump system to base pressure. Allow substrate to cool for at least 4 hours before venting system and removing mounted substrate.
1.3.4.10 Un-mount mask and substrate and examine color of copper film. If copper film is grey or black, indicating oxidation. Proceed to step 1.3.4.11, otherwise store proceed to INSPECTION per 1.4.
1.3.4.11 Bright dip coated wafer to remove excess oxidation from copper film.
1.3.4.11.1 Heat copper bright dip solution, 5% sulfuric acid in DI water, to a temperature of 50±5 C, using the hotplate in the Acid General Wet Bench. Follow all safety precautions, see section 1.1.4. Fill a second beaker with DI water.
1.3.4.11.2 Immerse wafer in bright dip for 60±5 seconds, then transfer to beaker containing DI water.
1.3.4.11.3 Transfer wafer to dump rinser and run for a programmed rinse, 4 spray, fill, dump cycles.
1.3.4.11.4 Remove wafer from dump rinser, blow dry with nitrogen gun and proceed to INSPECTION per 1.4

1.4. INSPECTION

1.4.1 SCOPE: This section of the procedure covers the inspection of sapphire wafers after blanket niobium and gold deposition and patterned copper depositon.

1.4.2 EQUIPMENT: Microscope, Olympus SZH
DekTak Model 3030th

1.4.3 MATERIALS: None

1.4.4 PROCEDURE:

1.4.4.1 Inspect coated wafer in transmitted light using Olympus SZH microscope. Note any pinholes greater than 0.002".
1.4.4.2 Inspect coated wafer in reflected light at 20x using Olympus SZH microscope. Note any defects larger than 0.002".
1.4.4.3 Using DekTak 3030TH, measure and record copper thickness along pads at warm and cold ends of all three SQUID carriers on the wafer. Copper shall be greater than 700 nm on all pads.

2.0 METAL PATTERNING

2.1. PHOTORESIST APPLICATION

2.1.1 SCOPE: This section of the procedure covers the application of photoresist to the sapphire wafers following the deposition of niobium, gold and copper that was covered in section 1.0

2.1.2 EQUIPMENT:

A.C.E. Photoresist Spinner
Vacuum chuck for 3" wafers
30 ml Beaker
Fluroware teflon cassette for 3" wafers
Wafer tweezers

2.1.3 MATERIALS:

Shipley 1400-27 Positive Photoresist
Acetone
Texwipe Tx 4009 Miracle Wipes

2.1.4 PROCEDURE:

Install the vacuum chuck for 3" wafers on the spinner if it is not already in place. This is accomplished by removing the Allen head screw at the center of the chuck, pulling the existing chuck off of the shaft, replacing it with the desired chuck, then securing the new chuck with the screw.

Pour 25 ml of photoresist into the beaker. Wipe the neck of the resist bottle and the inside of the cap with a Miracle Wipe. (This will prevent the cap from sticking the next time it is removed. It will also prevent gel slugs from accumulating and contaminating the resist.) Place wafer to be coated, metalized side up on the vacuum chuck then activate the vacuum by turning the vacuum switch on.

Pour 5-10 ml of resist from the beaker onto the center of the wafer. Press the start button twice, pausing at least one second between the first and second press. The wafer will spin for 5 seconds at 500 R.P.M. followed by 30 seconds at 3000 R.P.M. When spinning stops turn the vacuum switch off, remove the wafer and place it in the teflon cassette.

When finished coating wafers clean the spinner bowel with Miracle Wipes moistened with acetone.

2.2. SOFT BAKE PHOTORESIST

2.2.1 SCOPE: This section of the procedure covers the baking of photoresist following application of resist to the sapphire wafers.

2.2.2 EQUIPMENT:

Blue M Cleanroom Oven, Catalog No. 146
Fluroware teflon cassette for 3" wafers

2.2.4 PROCEDURE:

Turn on power to the oven. Set the temperature to 90°C. Allow a minimum of 5 minutes for the temperature to stabilize.

Place the teflon cassette containing the resist coated wafers in the oven for 30 to 35 minutes. After removing the cassette of wafers turn off the oven.

2.3. EXPOSE PHOTORESIST

2.3.1 SCOPE: This section of the procedure covers the exposure of photoresist on the sapphire wafers following soft baking of the resist.

2.3.2 EQUIPMENT:
Quintel Aligner/Exposure System Model Q-2001 CT
1-1/4" Thick x 3" Diameter Spacer for Aligner Vacuum Chuck
"SQDCAR6AM" Photomask[3].
Model 100 Optical Power Meter, Hybrid Technology Group
Fluroware teflon cassette for 3" wafers
Wafer tweezers

2.3.3 PROCEDURE:

Turn on house vacuum to the aligner via the valve on wall under the aligner table. Turn on the power switch on the exposure lamp power supply and press the **START LAMP** button. Set power to 150 watts. Allow exposure lamp at least 15 minutes to warm up before using.

Place the intensity meter probe on the wafer chuck and Press **WAFER LOAD** to bring the chuck into the expose position. Turn on the intensity meter and press the **SHUTTER** switch on the aligner.

The exposure time should be set to give an energy dose of 130 millijoules/cm^2 at a wavelength of 400 nanometers. (Divide 130 by the uv intensity in milliwatts/cm^2 to get the exposure time in seconds. At the time this document was written a 10 second exposure was used with an intensity of 13 milliwatts/ cm^2)

Inspect the photomask for dirt and defects. Loose particles may be blown off with a filtered air gun. Resist residue and adherent particles should be cleaned off with R-10 resist stripper, after which the mask should be thoroughly rinsed in DI, blown dry with filtered air, then oven dried at 50 - 90°C. If scratches or voids are found in the chrome pattern the mask should be discarded and replaced.

Press **VISUAL ALIGN** to raise the optical head. Press **MASK LOAD** (this will turn off vacuum to the mask chuck). Place the photomask on the chuck, chrome side down Press **MASK LOAD** again to secure the mask to the vacuum hold down.

[3] An archival copy of SQDCAR6AM.DWG is held in the document center.

Pull out the tray load and place the spacer centered on the vacuum chuck. Place the wafer to be exposed on the spacer with the copper pads roughly oriented with the corresponding pads on the photomask. Push the tray load back in.

Press **WAFER LOAD** to bring the substrate into close proximity to the mask. Perform a final alignment of the copper pads on the substrate to the corresponding openings on the mask by translating with the X-Y Alignment (right hand) Disk and rotating with the Wafer Rotation Adjustment Knob.

Press **VISUAL ALIGN** to lower optical head. Press **CONTACT**. Do not touch the X-Y Alignment Disk when the substrate and mask are in contact or damage to the instrument may result.

Rotate the optical turret to the **EXPOSE** position. Press **MANUAL EXPOSE**.

The substrate should automatically drop to the position it was in before **WAFER LOAD** was pressed after completion of exposure. Check to see that this has indeed happened then pull the tray out and remove the wafer. Replace the wafer in the Fluroware cassette.

When finished exposing wafers press **VISUAL ALIGN** to raise the optical head. Press **MASK LOAD** to turn off vacuum to the mask chuck. Remove the photomask and return it to its box. Press **VISUAL ALIGN** again to lower the optical head.

Turn off power to the aligner and the UV lamp power supply and turn off the valve to the house vacuum.

2.4 DEVELOP PHOTORESIST

2.4.1 SCOPE: This section of the procedure covers development of the exposed photoresist on the sapphire wafers following exposure.

2.4.2 EQUIPMENT:

Dump rinse
Rinser/Dryer set up for 3" wafers
2 - 400 ml beakers
Timer
2 - Fluroware teflon cassettes for 3" wafers
Wafer tweezers

2.4.3 MATERIALS:

Shipley Microposit Positive Photoresist Developer 351 Concentrate
De ionized Water
Texwipe Tx 4009 Miracle Wipes

. 24.4 SAFETY CONSIDERATIONS:
wear safety glasses. photoresist developer contains sodium hydroxide which can cause serious damage to the eyes and skin.

2.4.4 PROCEDURE:
Put 200 ml of deionized water in a beaker and add 50 ml of developer (dilute 4:1). Fill the second beaker with DI water. Using wafer tweezers, immerse the wafer in the developer solution. After one minute remove the wafer from the developer and rinse in the beaker of DI for 5 seconds, place the wafer in the second cassette and the cassette in the dump rinse. Start the dump rinse and allow it to run for 5 fill and dump cycles.

After the dump rinse is complete place the cassette containing the developed and rinsed wafers in the rinser/dryer and allow the dry cycle to run for 5 minutes.

2.5. HARD BAKE PHOTORESIST

2.5.1 SCOPE: This section of the procedure covers the baking of photoresist following development of resist to the sapphire wafers.

2.5.2 EQUIPMENT:
Blue M Cleanroom Oven, Catalog No. 146
Fluroware teflon cassette for 3" wafers

2.5.4 PROCEDURE:

Turn on power to the oven. Set the temperature to 120°C. Allow a minimum of 5 minutes for the temperature to stabilize.

Place the teflon cassette containing the resist coated wafers in the oven for 30 to 35 minutes. After removing the cassette of wafers turn off the oven.

2.6 INSPECT RESIST

2.6.1 SCOPE: This section of the procedure covers inspection of the developed resist prior to etching the metals.

2.6.2 EQUIPMENT

Zeiss Flourescence Microscope
Wafer Tweezers

2.6.3 PROCEDURE

Turn on the incandescent microscope light and place the wafer to be inspected housing on the stage.
Using the 5X objective inspect the resist pattern. The maximum tolerable size for resist voids on the lines is 1/3 of the line width. The maximum tolerable size for stray resist spots between the lines is 1/3 of

the space between lines. There shall be no stray resist spots in the field larger than 1 line width and no more than 5 stray resist spots larger than 1/2 the line width.

If the resist pattern does not meet the above criteria strip the resist in R-10 stripper and repeat the patterning process.

2.7 SCRIBE IDENTIFICATION

2.7.1 SCOPE: This section of the procedure covers the scribing of identification mark on the SQUID carrier die.

2.7.2 EQUIPMENT:
Phosphor Bronze Scribe

2.7.2 PROCEDURE:
Using the phosphor bronze scribe scratch a unique alphanumeric identification mark in the photoresist on the ID pad of each of the three die on the wafer. This mark will be etched into the underlying metal in subsequent steps.

2.8 PLASMA DE-SCUM

2.8.1 SCOPE: This section of the procedure covers the removal of any photoresist scum that may otherwise prevent complete etching of copper and gold during subsequent processing.

2.8.2 EQUIPMENT:
Timer
Wafer tweezers
March Plasma Etcher

2.8.3 MATERIALS:
Oxygen

2.8.3 PROCEDURE:
Open the cylinder and regulator valves for the O_2 and SF_6. Both regulators should be set for 15 ±5 PSI. Turn on the main power switch located on the back of the process control module. Turn on the power to the RF generator. Set the mode select switch to **AUTO** to backfill the chamber.

When the chamber has backfilled open the chamber, place the wafer to be processed near the center of the electrode. Close the chamber and set the mode select switch to **MANUAL** which will cause the system to pump down to
10 - 20 mTorr ("001 -002"). Turn on the O_2 and set the flow to read 235. This flow should result in pressure reading of 025 (0.25 torr). Turn on the RF at 50 watts for 12 seconds to ash any photoresist scum remaining in the developed areas. After completion of the 12 second ash, turn off the O_2 and wait until the pressure reads 001-002, then set the mode switch to **AUTO** to backfill.

After the chamber has backfilled, open and remove the wafer. Then close the chamber and set the mode switch to **MANUAL** to pump back down.

2.9. ETCH COPPER.

2.9.1 SCOPE:
This section of the procedure covers the removal of any stray copper that may have found its way under the shadow mask used to delineate the copper pads during the copper deposition

2.9.2 EQUIPMENT:
Petri dish
400 ml beakers
Timer
Fluroware teflon cassettes for 3" wafers
Wafer tweezers
Air gun

2.9.3 MATERIALS:
Kaypro ferric chloride etchant for printed circuit boards
DI water

2.9.4 PROCEDURE:
Pour 50 ml of ferric chloride diluted with 500 ml DI water into a Petri dish. Using the wafer tweezers immerse the wafer for 10 seconds in the ferric chloride solution. Immediately rinse the wafer in DI water for 10 seconds after removing from the ferric chloride. Blow off the water with the air gun and proceed to step 2.10, ETCH GOLD.

2.10. ETCH GOLD.

2.10.1 SCOPE:
This section of the procedure covers the etching of gold from the field area of the SQUID carrier.

2.10.2 EQUIPMENT:
Dump rinse
Rinser/Dryer set up for 3" wafers
Petri dish
400 ml beakers
Timer
2 - Fluroware teflon cassettes for 3" wafers
Wafer tweezers

2.10.3 MATERIALS:
Transene Type TFA Gold Etch
DI water

2.10.4 PROCEDURE:
Pour 50 ml of Transene TFA gold etch into a Petri dish. Fill a 400 ml beaker with DI water. Using the wafer tweezers immerse the wafer for 200 seconds in the

gold etch. Immediately rinse the wafer in DI water for 10 seconds after removing from the gold etch.

Place the wafer in the cassette and the cassette in the dump rinse. Start the dump rinse and allow it to run for 5 fill and dump cycles.

After the dump rinse is complete place the cassette containing the developed and rinsed wafers in the rinser/dryer and allow the dry cycle to run for 5 minutes.

2.11. ETCH NIOBIUM.

2.11.1 SCOPE:

This section of the procedure covers plasma etching of the niobium from the field area of the SQUID carrier.

2.11.2 EQUIPMENT:

Timer
Wafer tweezers
March Plasma Etcher

2.11.3 MATERIALS:

Oxygen
SF_6

2.11.4 PROCEDURE:

Open the cylinder and regulator valves for the O_2 and SF_6. Both regulators should be set for
15 ±5 PSI. Turn on the main power switch located on the back of the process control module. Turn on the power to the RF generator. Set the mode select switch to **AUTO** to backfill the chamber.

Open the chamber and set the wafer at the center of the RF electrode. Close the chamber and set the mode select switch to **MANUAL** which will cause the system to pump down to
10 - 20 mTorr ("001 -002")

Turn on the O_2 and set the flow to read 235. This flow should result in pressure reading of 025 (0.25 torr). Turn on the RF at 50 watts for 5 seconds to ash any photoresist scum remaining in the developed areas. After completion of the 5 second ash, turn off the O_2 and wait until the pressure reads 001-002.

Turn on the SF_6 and set the flow to read 184. This flow should result in a pressure reading of 015 (0.15 torr). Turn on the RF at 50 watts for 4.5 minutes to etch the exposed niobium. After completion of the etch turn off the SF_6 and wait until the pressure reads 001-002, then set the mode switch to **AUTO** to backfill.

After the chamber has backfilled, open and remove the wafer. Then close the chamber and set the mode switch to **MANUAL** to pump back down.

Inspect the etched niobium pattern under the microscope using the 5X objective. If any metal remains in the etched area repeat the above SF_6 etch for an additional 45 seconds.

CLEANUP:
Turn off the power switch on the RF generator and the main power switch.
Shut off the O_2 and SF_6 cylinder and regulator valves.
Turn off the microscope light.

2.12. STRIP PHOTORESIST.

2.12.1 SCOPE:
This section of the procedure covers removal of the photoresist following completion of etching of the metals.

2.12.2 EQUIPMENT:
Timer
Wafer tweezers
Heated Water Bath
Dump Rinse
Rinser/Dryer
Fluroware teflon cassette for 3" wafers
2-4" dia. Crystallizing Dishes

2.12.3 MATERIALS:
E400 Positive Photoresist Stripper from Brent America, EMT Division

2.12.4 PROCEDURE:
Fill the heated water bath with water. Set the temperature to 80-90°C and turn on the heat. Allow at least 30 minutes for temperature to stabilize.

Fill each of the crystallizing dishes to a depth of 1/2 to 1 inch with stripper. Set the dishes of stripper in the water bath, allowing them to float.

Immerse the wafer to be stripped in one of the dishes of stripper for 5 to 10 minutes. Remove the wafer from the first dish of stripper and rinse in the second dish of fresh stripper for at least 10 seconds.

Place the wafer in the teflon cassette and process through the dump rinse for 5 fill dump cycles.

Remove from the dump rinse and spin dry in the rinser/dryer for 5 minutes.

2.13 REMOVE GOLD FROM INPUT PADS.

2.13.1 SCOPE:
This section of the procedure covers removal of gold from the input pads of the SQUID carrier substrates.

2.13.2 EQUIPMENT:

Air Gun
50 ml beaker
Timer

2.13.3 MATERIALS:
Transene Type TFA Gold Etch
Kapton Tape 1/2" wide
DI Water
Methanol
Crew Clean Wipes
Cotton Swabs

2.13.4 PROCEDURE:
Wrap end of substrate above the input pads with Kapton tape (leave the input pads bare, but cover all nearby bond pads).

Pour Gold Etchant into the 50 ml beaker to a depth of 3/16 - 1/4" depth or enough to cover the input pads when the substrate in placed in the beaker.

Immerse the cold end of the substrate into the beaker containing the gold etchant for 20-30 seconds taking care not to get any of the etchant on to the unprotected area of the substrate above the Kapton tape.

Remove the substrate from the etchant and rinse for a minimum of 10 seconds in running DI water then blow dry with air gun. Place the substrate on a Crew Wipe to further dry while stripping the gold from the input pads of rest of the batch of substrates.

Remove the Kapton Tape. Rinse the substrate with methanol then swab surface of substrate with cotton swab soaked with methanol. Rinse again with methanol. (This will remove any adhesive residue from the Kapton tape.) Blow dry.

2.14. DICE WAFER.

2.14.1 SCOPE:
This section of the procedure covers dicing of the wafer following completion of the patterning of the metal.

2.14.4 PROCEDURE:
The wafers are diced American Precision Dicing per drawing 25019-201. The die dimensions are 2.51" X 0.50"

2.15. CLEANING.

2.15.1 SCOPE:
This section of the procedure covers cleaning of the diced substrates. The main function of this cleaning step is to remove any wax or other contaminants introduced during the dicing operation.

2.15.2 EQUIPMENT:
Air gun
Petri Dish

2.15.3 MATERIALS:
Heptane
Methanol
Cotton Swabs

1.15.4 PROCEDURE:
Pour 50 - 70 c.c. of Heptane into the Petri dish. Place the diced substrates in the dish of Heptane for at least 20 seconds. Remove the substrates from the dish of HEPTANE Then scrub both top and bottom surfaces of the substrates with a cotton swab dipped in HEPTANE. Rinse with methanol. Blow dry.

2.16. FINAL INSPECTION AND ELECTRICAL TEST.

2.16.1 SCOPE:
This section of the procedure covers inspection and test for electrical continuity following completion of fabrication of the SQUID carrier substrate.

2.16.2 EQUIPMENT:
Microscope, Olympus SZH
Ohm Meter, Fluke Model 77 with current calibration.

2.16.3 MATERIALS:
SQUID Carrier Substrate, Part No. 25019-201
SQUID Carrier Substrate Electrical Test Form

2.16.4 PROCEDURE:
Inspect the substrate under the microscope, looking for any defects in the metal pattern.

Measure the length and width of the substrate. Confirm dimensions per drawing 25019-201

Turn on the incandescent microscope light and place the wafer to be inspected housing on the stage.

Using the .5X objective inspect the metal pattern. The maximum tolerable size for voids on the lines is 1/3 of the line width. The maximum tolerable size for stray metal spots between the lines is 1/3 of the space between lines. There

shall be no stray metal spots in the field larger than 1 line width and no more than 5 stray metal spots larger than 1/2 the line width.

Confirm location of metal pattern on substrate per drawing 25019-201

If the metal pattern does not meet the above criteria the substrate should be rejected.

Using the ohm meter in the auto range mode, measure the resistance between opposite ends of all interconnect traces, being particularly careful not to scrape the gold surfaces on the bond pads. Record the resistance values on the SQUID Carrier Substrate Electrical Test Form.

If any discontinuous traces are found the substrate should be rejected.

2.1.7 SCREEN FOR CRACKS

2.17.1 PROCEDURE:
All Substrates are screened for cracks by Acustic Micro Imaging by:

Sonoscan
530 East Green Street
Bensenville, Illinois 60106
(630)766-7088

2.1.8 DELIVERABLES

The following documentation should be delivered with the completed SQUID carrier substrate:

- Acustic Micro Imaging report from Sonoscan
- Carrier Substrate Electrical Test Form
- Certificate of Compliance