PREPARED BY:	***Multiband Imaging Photometer*** ***for SIRTF***	NUMBER M11P10	
C. DAVIDSON		TYPE PROCEDURE	
APPROVALS			
ENGINEERING	University of Arizona Steward Observatory, IR Group	DATE 07/10/97	
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TITLE

GOLD ETCH DETECTOR PATTERN IN Ge : Ga WAFER, PROCEDURE FOR

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4.0 PROCEDURE

1.0 SCOPE

This specification defines the equipment, materials and procedures for delineating the pattern and etching gold from a Ge: Ga wafer in preparation for sawing the wafer into individual die of 1x32 detectors for use in the fabrication of the MIPS 32x32 Focal Plane Assembly.

2.0 APPLICABLE DOCUMENTS

Unless otherwise specified, the most recent revision of the following documents form a part of this processing procedure to the extent specified herein. In the event of conflict between the requirements of this procedure and the documents calling out this procedure, the requirements of this procedure shall take precedence.

<u>Non-Government Documents</u> – <u>Drawings</u>

- Drawing Number MIPSD-065, Detector Wafer
- Drawing Number MIPSD-067, 1x32 Detector

3.0 REQUIREMENTS

3.1 Equipment

Acceptable results are contingent upon the use the recommended equipment listed below or equivalent equipment. Equivalent equipment may be substituted for the recommended equipment if and only if effectiveness and accuracy are not decreased by its use.

Item	Quantity	Description
1	1 ea.	Microscope, binocular, 1X to 7X magnification range, with 10X eyepiece,. Bausch and Lomb
2	1 ea.	Photo mask, Mylar film, ID No. XXX, dark field, emulsion
3	1 ea.	Photo resist spinner, Hamlin Model No. 5701 with Headway Research, Inc. spin meter
4	1 ea.	Wafer spin chuck, 4 inch diameter
5	1 ea.	UV exposure system, Oriel Corp., Model 82320 UV source, with Model 770 Intensity Control System and OAI 150 exposure timer
6	2 ea.	Oven, laboratory, Cole Palmer Model 5015-50
7	1 ea.	Balance, Ohaus Dial-o-gram
8	1 ea.	Hot plate, 4-inch diameter surface
9	1 ea.	Timer, digital
10	1 ea.	Thermometer, surface, temperature range 0^0 to 250^0F
11	2 ea.	Blow gun

3.2 Materials

Item	Quantity	Description
1	1 ea.	Ge:Ga detector wafer, PIN MIPSD-065
2	as required	Photo resist, positive, KTI 820 or AZ1512, viscosity: 27 centistokes at 77F
3	as required	Developer, positive photo resist, KTI 809 or AZ351
4	as required	Trichloroethylene
5	as required	Deionized water supply
6	as required	Potassium iodide (KI), granular
7	as required	Iodine (I_2), crystals
8	1 ea.	Silicon wafer, three-inch diameter, scrap
9	1 ea.	Wax, Doping, ('black' wax)
10	1 ea.	Aluminum block, approx. 5in. x 3.5in. x 2in.
11	as required	Swab, cotton
12	as required	Kim wipes
13	as required	Razor blade
14	as required	Ink, black. water/detergent insoluble
15	3 ea.	Petri dish, glass, 3-inch diameter
16	2 ea.	Petri dish, glass, 5-inch diameter
17	as required	Weigh dish, aluminum, or filter paper
18	1 ea.	Beaker, glass, 250 ml
19	as required	Pipette, transfer, disposable, 7.5 ml total capacity
20	as required	Gloves, PVC, clean room, or finger cots
21	as required	Gloves, rubber
22	as required	Nitrogen gas supply
23	as required	Air supply

4.0 PROCEDURE

4.1 Mount Wafer In Preparation for Photo Resist Application

Note: This work is to performed in a class 10,000 or better clean room.

4.1.1 Place surface thermometer onto hot plate. Turn hot plate on and let stabilize at 205^0F to 210^0F. Place scrap silicon wafer onto hot plate. Place piece of wax in center of wafer. Allow wax to melt.

4.1.2 Center detector wafer in wax. With gloved hand, or using tweezers, carefully remove Si wafer from hot plate and place onto Al block covered with piece of clean room wipe. With swab stick, gently press detector wafer into wax.

4.1.3 Carefully lift Si wafer from block and remove wipe. Set wafer back down on block and again gently press detector wafer into wax. Allow wax to solidify.

4.1.4 Notes:

1. Detector wafer must be firmly attached to the Si wafer with sufficient wax under the detector wafer and along its perimeter to encapsulate it. This will protect the detector wafer back surface from subsequent etch operations.
2. No wax should flow onto the detector wafer surface.

Inspect mounted wafer for continuous wax coverage along its perimeter and for absence of wax on its surface. Remove wax from detector wafer surface by gently swabbing with a cotton swab dampened with trichloroethylene (TCE).

4.1.5 Place mounted wafer into a clean petri dish, cover with properly labeled cover and transport to clean room for photo resist application. If resist application is not to take place immediately, store wafer in desiccator.

4.2 Prepare Area and Equipment for Detector Delineation

Note: Photo resist is sensitive to ultraviolet light. To reduce uncontrolled exposure to UV, this work is to be performed under yellow lighting and in a class 10,000 or better clean room.

4.2.1 Turn on the yellow safety lights and turn off all white lighting in the clean room.

4.2.2 Inspect the photo mask for scratches, chips and defects in the emulsion pattern.

Important: Do not expose mask to acetone or any other solvent. Solvents may degrade or wash off the emulsion film.

4.2.3 Blow mask off with dry nitrogen or air to remove loose particulates. Inspect to verify mask is free of particulates.

4.2.4 Place the clean photo mask in a clean container. Cover the container.

4.2.5 **Caution**: UV light can damage the eye. Do not stare directly into the lamp.

Turn the UV lamp on by pushing the power switch then the starter button. Turn on the lamp timer. Check the lamp operation by dialing in a short (1 second) exposure time and verifying that the lamp does come on. Allow the lamp to warm up and stabilize for a minimum of 30 minutes before use.

4.2.6 Turn on the ovens. Allow clean room oven to stabilize at $92^0 \pm 5^0$C for a minimum of 15 minutes. Allow second oven to stabilize at 100^0C ± 5^0C.

4.2.7 Clean the spin chuck by flushing it with acetone then blow dry.

4.2.8 Center the chuck on the spinner.

4.3 Apply Photo Resist to Wafer Surface

4.3.1 Center the silicon wafer on which the detector wafer is mounted onto the chuck. Turn the vacuum on. Set the spinner for 3500 rpm.

4.3.2. Fill a clean pipette with photo resist and apply the entire volume of photo resist to the wafer, i.e. flood the wafer surface with photo resist. Spin wafer at 3500 ± 200 rpm for 20 ± 3 seconds.

4.3.3 Turn of vacuum. Insert a razor blade between the spin chuck and silicon wafer, then gently pry wafer up from the chuck. With a gloved hand, remove the wafer from the chuck.

4.3.4 Set wafer onto back surface of an inverted petri dish in the 90^0C bake oven. Allow resist to bake at 92^0C ± 5^0C oven for 35 ± 5 minutes.

4.3.5 Remove wafer from oven and center it on UV exposure system stage. Turn on the vacuum.

4.4 Expose Photo Resist.4 Expose Photo Resist.

4.4.1 Place the photo mask over the wafer, emulsion side down, fitting it into the grooves of the mask holder. Place aluminum bars at opposite side edges of the mask to secure mask in place.

4.4.2 Using the x-axis, y-axis and theta micrometers, align the wafer under the mask.

4.4.3 Using the z-axis micrometer, carefully bring the wafer up and into contact with the mask. Once contact is made back wafer off slightly from the mask.

Note: As the wafer is brought in very close proximity of the mask, a shadow of the mask can be seen on the wafer. Contact is presumed once the mask shadow is no longer apparent.

4.4.4 By turning the black hand crank at the base of the wafer/mask stage, carefully move the stage under the UV lamp. Dial in an exposure time of 30 seconds. Push the exposure button and expose the wafer to the UV light.

4.4.5 Carefully turn the black crank to move the stage out from under the lamp. Using the z-axis micrometer, lower the wafer away from the mask. Turn off the vacuum.

4.4.6 Using a gloved hand to grip the silicon wafer, remove the mounted wafer from the stage and place it a clean, glass petri dish. Place a labeled cover over the dish.

4.5 Develop the Photo Resist

Note: Photo resist development must be done in yellow light, but the subsequent metal etch operations may be performed outside the clean room and in white light.

Caution: Developer can cause burns and is harmful if inhaled. Safety glasses, rubber gloves and protective clothing are to be worn when handling developer, concentrated or diluted. Developer is only to be used within a fume hood.

Carefully add developer to the 50 milliliters (ml) demarcation line of a clean, graduated 250 ml glass beaker. Add 150 ml deionized water to the beaker, making a 1:3, by volume, developer-to-water solution. If developer comes pre-mixed (e.g. AZ351), this step shall be deleted.

4.5.1 Into a five-inch diameter glass petri dish, pour sufficient developer to allow wafer to be submerged in the developer. Using a gloved hand to hold the silicon substrate, submerge the detector wafer into the developer and gently agitate the wafer for 35 ± 5 seconds. Rinse the mounted wafer under flowing deionized water for a minimum of one (1) minute. Blow the wafer dry with dry nitrogen or air.

4.5.2 Under 20X magnification, inspect the photo resist pattern to verify that it extends all the way to the perimeter of the wafer.

If the resist pattern is not fully developed, spin and flush the wafer with acetone to remove the photo resist, and spin until dry. Repeat steps 4.3.1 through 4.5.2.

Notes:
1. If the pattern is not been fully developed, increase the exposure time.
2. If the pattern is over etched, reduce the exposure time.

If the photo resist pattern is fully developed, place the wafer in a clean, glass petri dish. Cover the dish with a properly labeled cover.

Place the petri dish into an oven stabilized at a temperature of $100^{o}C \pm 5^{o}C$ for 15 to 20 minutes to bake the resist. Place a petri dish cover over the petri dish, tilting the cover to allow the hot air to flow across the wafer.

4.5.3 Remove the petri dish/wafer from the oven to the flow bench. Place cover over petri dish and allow wafer to cool to room temperature.

4.6 Etch Gold from Wafer Surface

Notes:
1. The detector wafer has on its surfaces a deposited layer of approximately 200A palladium followed by a layer of approximately 4000A gold. Only the gold is etched at this step. The relatively thin layer of palladium is chemically etched with the etchant used post dicing to remove saw damage.
2. This operation may be performed under white light.

4.6.1 Using weigh dishes and a balance, weigh out 4 grams potassium iodide and add to 40ml deionized water in a clean, glass beaker. Weigh out 1 gram iodine and add to beaker. With clean glass stirring rod, stir to dissolve solutes in the water. Record weighed amounts on the manufacturing traveler.

Note: If unused, previously made etch solution is available, it is not necessary to make up fresh solution.

4.6.2 Note: The potassium iodide etchant will remove gold at a rate of 0.5 to 1.0 microns per minute (5000 – 10,000 A per minute).

Pour etchant into 5-inch diameter petri dish. Submerge mounted detector wafer in etchant. Gently agitate the wafer in the etchant for 65 ± 5 seconds. Rinse wafer under flowing deionized water for 30 to 60 seconds. Blow wafer dry with dry nitrogen or air.

4.6.3 Inspect wafer to verify all gold has been removed from exposed areas.

If residual gold remains, etch in gold etchant for an additional 30 to 35 seconds. Rinse wafer under flowing deionized water for 30 to 60 seconds. Blow wafer dry with dry nitrogen or air.

4.7 Mark Wafer in Preparation for Sawing

Using a water/detergent insoluble black ink or a razor blade, delineate on/in the photo resist areas of wafer not to be sawn into detector strips due to missing detector wafer metallization or other wafer defects.

Place wafer in petri dish, cover dish with properly labeled cover and store in desiccator until ready to saw wafer into discrete 1x32 detector die. Sign and date traveler.