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P5000 CVD Process procedure

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SPECIFICATION FORMAT:

EQUIPMENT MANUFACTURER:

Applied Materials Equipment

EQUIPMENT MODEL:

P5000

FDC ASSIGNED TOOL ID NUMBER:

Applied Serial #5559

APPLICATION PROGRAM(S) AND REVISION:

Microsoft Word 2003

SIGNATURES FOR RELEASE OR
HISTORY ON FILE IN PRODUCT
SPECIFICATIONS

Confidential Proprietary

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1.0 Purpose

1.1 To define the operating procedures for the P5000 CVD processes.

2.0 Scope

2.1 Outline the process qualification requirements for the CVD process chambers.

2.2 Define all CVD process recipe parameters.

2.3 Describe documentation for Process control and Lot Records.

3.0 Associated Materials and Equipment

3.1 AMAT Heat exchanger - Heated Galden, 4gal volume.

3.2 Exhaust - MFC enclosure.

3.3 Vacuum pump oil – Fomblin

3.4 H₂-Hydrogen.

3.5 N₂-Nitrogen.

3.6 PH₃:H₂-Phosphine.

3.7 NF₃-Nitrogen Trifluoride.

3.8 He-Helium.

3.9 N₂std-Nitrous Oxide.

3.10 SiH₄-Silane.

3.11 Deionized water.

3.12 Isopropyl alcohol.

3.13 150mm silicon wafers.

3.14 Nilfisk vacuum cleaner.

3.15 Clean room wipes.

3.16 Wafer cassette – Fluoroware PA182-39M or equivalent.

4.0 Safety

4.1 The P5000 system uses reactive gases that require careful handling. These gases are toxic, poisonous, flammable or caustic and provide inhalation or exposure risks, see MSDS.

4.2 The P5000 system uses high voltage electrical power and presents lethal risks if protective covers are removed.

4.3 The P5000 system uses RF energy, presenting electrical and radiation hazards if safety interlocks are defeated or covers are removed.

4.4 The P5000 system produces hazardous byproducts in the process chambers, always wear clean room gloves when cleaning the chamber, and dispose of used wipes and gloves in the solvent waste can.

4.5 The P5000 has moving mechanical parts, keep fingers clear when robot, cassette elevator, load lock elevator, slit valves, or susceptor might be in motion.

4.6 The P5000 system uses high magnetic fields which may disrupt pacemakers.

5.0 Procedures

- 5.1 The system will automatically logoff the current user after 8 hours. Go to the Login/Logout page located under the “System” header menu and Logout the last user, then Login using “AMAT” as the user name and “5458” as the password.
- 5.2 As the system processes wafers, warnings or indicators may show on the screen. There will also be an alarm. The following colors give indications to the systems status.
- 5.3 Red – is a fault, it will stop all processes and maintenance must be notified. Touch red line at top of screen to silence and clear the alarm
- 5.4 Yellow – is a warning. Often times the system will self correct this and will continue running. Either way, notify maintenance. Touch the yellow line at top of screen to silence and clear the warning.
- 5.5 Blue or Green – are always good. These are normal operating indicators and no notification is necessary. These indicators may be silenced by touching the blue or green line at the top of the screen.
- 5.6 Wafers may be loaded in either cassette A or B position on the handler. A is on the left and B is on the right. When loaded, insure the H-Bar on the cassette is aligned with the H-Bar on the cassette handler. If the cassette desired on the cassette handler is unavailable press “shuttle cassettes.
- 5.7 Press the “Load” button on the operator control panel on the front of the P5000. The front panel will open and the cassette clamp will release.
- 5.8 If the clamp does not release press “Clamp” at the bottom right, of the System Control Screen, press “Cassette” clamped and “Release” to unlock.
- 5.9 Load wafer(s) into cassette, place on flat finder, and rotate wafer(s) to flats UP position.
- 5.10 Verify that wafers are ready for the operation listed on the flowsheet by verifying prior step has been signed off.
- 5.11 From the “Wafer” header menu, select the “Monitor Wafer” screen. Load cassette into P5000 and clamp the cassette, deleting any unused wafer slots.
- 5.12 To delete press the first slot of unused wafers. A pop-up screen appears press “Start delete sequence”. Press wand on the last wafer to delete. Press “Finish delete sequence”.

- 5.13 From the “Control” header menu, select the correct recipe in the “Sequence selection”, and set system state to “Automatic”.
- 5.14 Verify that the tools actual software recipe parameters match the documentation, and the values indicated on the Lot Flow sheet.
- 5.15 Select “Run (Go) Button” from the “Wafer” header to start processing.
- 5.16 Check that all requested wafer(s) are transferred to the loadlock (8 maximum).
- 5.17 Monitor and record the following information during the processing of the first wafer.
- 5.18 Verify that all wafers have changed from white (unprocessed) to green (completed process) when the “All processing of wafers is complete” appears above the header menu.
- 5.19 Once the wafers have completed the process run press the **UNLOAD** button on the front of the operator control panel on the front of the P5000. The front panel will open and the cassette clamp will release. The cassette can now be removed.
- 5.20 Date and initial the flowsheet, and send to the next operation.

6.0 Daily SPC/Leak-up

- 6.1 Daily Leak up rates must be performed before running any material.
- 6.2 Press “Vacuum Service” with the pen. The screen will display Chambers A, B, C, and Loadlock. Ensure that all three chambers are “Offline for Maintenance”.
- 6.3 Press the “Offline for Maintenance”.
- 6.4 Press “Leak-up”.
- 6.5 Press “Enter Leak-up parameters”.
- 6.6 Press “Start leak up program”. The system will begin leak-up. Perform leak-up on all three process chambers and the loadlock. Record readings in the MES system. Press “Non Lot Data Collection” located on the first menu page. Use the pull down menu to choose “AMATP5000-607B”. Use the second pull down menu to choose “P5000 Daily Leak Rates”.
- 6.7 Vent the Load lock by pressing “loadlock” and “Chamber vent
- 6.8 Repeat the leak up for chambers A,B,C.
- 6.9 Pump down the loadlock and repeat the leak up. Record readings in the MES system. Press “Non Lot Data Collection” located on the first menu page. Use the pull down menu to choose “AMATP5000-607B”. Use the second pull down menu to choose “P5000 Daily Leak Rates”.

6.10 The Leak Up rate specification for the process chambers is <10mt/min and the loadlock is <20mt/min. If the Leak Up rates do not meet the specification, contact maintenance. Material may be run if all chambers and the loadlock pass Leak Up.

7.0 Daily SPC/Gas Flow Checks and Heat Exchanger

7.1 Check all gas flow pressure daily.

7.2 Gauges are located on the floor in the maintenance area. There are three locations with Plexiglas viewing windows.

7.3 Read the pressure gauges on each of the gas flow lines. Compare with “P5000 Gas Flow” document. If readings are not within the specified range notify engineering. Do not run the machine.

7.4 Verify the Heat Exchanger is set to 40 degrees. Press “System Facilities”. Press “Heat exchanger” at the bottom of the screen. A pop-up window will appear at the top and the heat exchanger should read 40 degrees.

8.0 Weekly SPC/particles

8.1 Obtain 3 virgin prime silicon wafers.

8.2 Measure three wafers on the Tencor Surfscan 6100 (Refer to Tencor Surfscan 6100 specification).

8.3 Load wafers in slots 1-3.

8.4 Run wafers in slot 1 and 2 through “Cycle A” serial sequence program. Slot 3 is used for a witness wafer.

8.5 When wafers have completed processing measure the 3 wafers on the Tencor Surfscan 6100. Record readings in the MES system. Press “Non Lot Data Collection” located on the first menu page. Use the pull down menu to choose “AMATP5000A-607B”. Use the second pull down menu to choose “P5000A CH A Particles”.

8.6 Repeat these steps for Chamber B using “Cycle B” and Chamber C using “Cycle C” serial sequence programs.

8.7 If particulate count exceeds 100 place wafers in monitor box and obtain and measure a virgin silicon wafer.

8.8 Repeat test.

8.9 If the chamber fails particles a second time, notify engineering/maintenance.

9.0 Weekly SPC/MFC Flow Verify

- 9.1 Press “OFFLINE for Maintenance” under Chamber A.
- 9.2 Press “MFC FLOW VER”.
- 9.3 Verify that all gases are set at 50%.
- 9.4 Press “Start Flow Verify”. The chamber will start flowing gases.
- 9.5 When the system has completed the flow, record readings in the MES system. Press “Non Lot Data Collection” located on the first menu page. Use the pull down menu to choose “AMATP5000A-607B”. Use the second pull down menu to choose “P5000 SPC Machine Parameters”.
- 9.6 Repeat for Chambers B and C.
- 9.7 MFC Flow Verify can be run on all chambers simultaneously.

10.0 Weekly SPC/ Process monitors

- 10.1 Obtain two wafers from the virgin prime silicon wafer box for Chamber C SiN SPC.
- 10.2 Measure wafers on the Tencor FLX-2350FP stress tool. (Refer to Tencor FLX-2350FP specification located in the Metals folder on the Q drive). Double click on the “Winflex” icon. Select “barry”, Click “OK”. Pull down the “Measure” icon. Choose “First (no film)”. Use “sin-chc.dat”. Identify wafers by date and slot number, i.e. “10-02-s1”.
- 10.3 Load wafers on the P5000. Press “1K SIN B” on the system control screen.
- 10.4 When wafers have been processed clear the alarm. Measure wafers on the Tencor FLX-2350FP stress tool. Pull down the “Measure” icon. Choose “Single”. Use “sin-chc-dat”. Pull down the correct wafer id. Enter the stress reading into the MES system.
- 10.5 Press “Non Lot Data Collection” located on the first menu page. Use the pull down menu to choose “AMATP5000C-607B”. Use the second pull down menu to choose “SiN Stress”.
- 10.6 Measure the wafers on the Woollam ellipsometer located in the Photo area. Choose Project “Kay”, choose Recipe “SiN on Si 9pt Rudolph pattern”. Identify wafers by date, chamber and slot number, i.e. “071003-c1”. Use the Woollam Process Procedure to retrieve data with your thumb drive when both wafers have completed the measurement routine. (Refer to Woollam ellipsometer specification).
- 10.7 An excel Macro has been created that will download the Woollam data and record this data in the MES system. Load the thumb drive into the MES computer across from the P5000. Open “ Copy of Upload Chamber SPC” located on the desk top. Another window will appear, press “Enable

Macros”. A pop-up screen will appear, log-in, and press “Open file for Parameter Upload”.

Highlight the Woollam files for upload, the program will prompt for the deposit time to be inserted in the pop-up screen for each file. The data is then transferred to the MES system.

- 10.8 When all the data for the chamber has been entered review the files, if trends are noticed notify engineering.
- 10.9 Obtain two wafers from the virgin prime silicon wafer box for Chamber C a-Si SPC.
- 10.10 Measure wafers on the Tencor FLX-2350FP stress tool. (Refer to Tencor FLX-2350FP specification located in the Metals folder on the Q drive).). Double click on the “Winflex” icon. Select “barry”, Click “OK”. Pull down the “Measure” icon. Choose “First (no film)”. Use “a-si-chc.dat”. Identify wafers by date and slot number, i.e. “10-02-s1”.
- 10.11 Load wafers on the P5000. Press “1K SIN B” on the wafer process screen.
- 10.12 When wafers have been processed clear the alarm. Measure wafers on the Tencor FLX-2350FP stress tool. Pull down the “Measure” icon. Choose “Single”. Use “a-si-chc-dat” file. Pull down the correct wafer id. Measure both wafers.
- 10.13 Pull down “Edit”, choose “Data Files”, click on “a-si-chc.dat”, press “Okay”. Highlight the SiN readings, Click on “Edit”, choose “Create No film rec”. Delete all other readings except for these two points.
- 10.14 Load the same wafers on the P5000. Press “Amorphous-Si” on the wafer process screen.
- 10.15 When wafers have been processed clear the alarm. Measure wafers on the Tencor FLX-2350FP stress tool. Pull down the “Measure” icon. Choose “Single”. Use “a-si-chc.dat”, Pull down the correct wafer id. Enter the stress reading into the MES system.
- 10.16 Press “Non Lot Data Collection” located on the first menu page. Use the pull down menu to choose “AMATP5000C-607B”. Use the second pull down menu to choose “a-Si Stress”.
- 10.17 Measure the wafers on the Woollam ellipsometer located in the Photo area. Choose Project “Kay”, choose Recipe “aSi on 1KA SiN 9pt Rudolph pattern”. Identify wafers by date, chamber and slot number, i.e. “071003-ca1”. Use the Woollam Process Procedure to retrieve data with your thumb drive when both wafers have completed the measurement routine. Refer to section 10.7 in this specification for instructions on transferring data to the MES system. (Refer to Woollam ellipsometer specification).
- 10.18 Obtain two wafers from the virgin prime silicon wafer box for Chamber B nc n+ SPC.
- 10.19 Measure wafers on the Tencor FLX-2350FP stress tool. (Refer to Tencor FLX-2350FP specification located in the Metals folder on the Q drive).). Double click on the “Winflex” icon.

Select “barry”, Click “OK”. Pull down the “Measure” icon. Choose “First (no film)”. Use “nc-2-chb.dat”. Identify wafers by date and slot number, i.e. “10-02-s1”.

- 10.20 Load wafers on the P5000. Press “1K SIN B” on the wafer process screen.
- 10.21 When wafers have been processed clear the alarm. Measure wafers on the Tencor FLX-2350FP stress tool. Pull down the “Measure” icon. Choose “Single”. Use “nc-2-chb.dat” file. Pull down the correct wafer id. Measure both wafers.
- 10.22 Pull down “Edit”, choose “Data Files”, click on “nc-2-chb.dat”, press “Okay”. Highlight the SiN readings, Click on “Edit”, choose “Create No film rec”. Delete all other readings except for these two points.
- 10.23 Load the same wafers on the P5000. Press “NC N PLUS SI” on the wafer process screen.
- 10.24 When wafers have been processed clear the alarm. Measure wafers on the Tencor FLX-2350FP stress tool. Pull down the “Measure” icon. Choose “Single”. Use “nc-2-chb.dat”, Pull down the correct wafer id. Enter the stress reading into the MES system.
- 10.25 Press “Non Lot Data Collection” located on the first menu page. Use the pull down menu to choose “AMATP5000B-607B”. Use the second pull down menu to choose “P5000B n+Si Stress”.
- 10.26 Measure the wafers on the Woollam ellipsometer located in the Photo area. Choose Project “Kay”, choose Recipe “NC n+ on 1KA SiN 9pt Rudolph pattern”. Identify wafers by date, chamber and slot number, i.e. “071003-b1”. Use the Woollam Process Procedure to retrieve data with your thumb drive when both wafers have completed the measurement routine. Refer to section 10.7 in this specification for instructions on transferring data to the MES system. (Refer to Woollam ellipsometer specification).
- 10.27 Measure these two wafers on the four point probe. Change the probe to the “n” head. Use the measurement “Micro_5pt_N_PLUS”. Change the probe back to the “a” head. After both wafers have been read download the Sheet Resistance readings into the MES system. To download Sheet Resistance data press “Non Lot Data Collection” located on the first menu page. Use the pull down menu to choose “AMATP5000B-607B”. Use the second pull down menu to choose “P5000B n+Si Sheet Resistance”. (Refer to Woollam ellipsometer specification). (Refer to Tencor FLX-2350FP specification). (Refer to four-point probe specification).
- 10.28 When all the data for the chamber has been entered review the files, if trends are noticed notify engineering.
- 10.29 Place used wafers in the labeled boxes on the P5000 bottom shelf.

11.0 Maintenance/ Engineering

- 11.1 Engineering will monitor SPC charts.
- 11.2 Notify engineering of misprocessed wafers.
- 11.3 Notify engineering/maintenance of “red” alarms.
- 11.4 Maintenance will perform wet cleans.
- 11.5 Do not operate machine while maintenance is being performed.
- 11.6 Leak up and MFC flow verify will be performed after maintenance has returned machine to engineering.
- 11.7 Notify engineering/maintenance if the P5000 does not meet specifications.
- 11.8 Engineering will review results of SPC tests before returning machine to production status.