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Standard Operating Procedure
for

Safe Handling of Arsenic Doped Wafers

REVISION

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2	DCN0992	Update Logo; Remove Authorized Users List for Arsenic Glove Box	10-16-13	B. Borden	R. Segura

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1. PURPOSE

1.1 To provide a written procedure governing the requirements for the safe handling, storage and post process transport off-site of arsenic doped wafers at the College of Nanoscale Science and Engineering (CNSE) facility.

1.2 To prevent employee exposure to arsine and inorganic arsenic at the CNSE facility or off-site.

2. ACTION LEVEL

2.1 Arsine at 1.25 ppb (TLV 5 ppb; alarm and warning limits at CNSE facility are 2 ppb and 4 ppb, respectively).

3. RESPONSIBILITIES

3.1 Environmental, Health and Safety (EHS) Department

3.1.1 The EHS department is responsible for ensuring that all the equipment described below is installed in accordance with NYS Fire and Building Code, and according to Occupational Safety and Health Administration (OSHA) regulations, in order to minimize employee exposure to Arsine and inorganic Arsenic.

3.1.2 The EHS department is responsible for verifying that the process outlined in this procedure is complied with at all times.

3.1.3 The EHS department is responsible for verifying that the Honeywell continuous-monitor chemical tapes are changed out by the cleanroom employees on a quarterly basis.

3.1.4 The EHS department is responsible for providing training on this procedure and maintaining training records on the training class provided.

3.2 CNSE, Applied Materials (AMAT) and IBM Management Teams

3.2.1 CNSE, Applied Materials (AMAT) and IBM Management teams are responsible for ensuring that all employees working under their direction comply with the process outlined in this procedure.

3.3 **Cleanroom Employees** (Dedicated IBM and AMAT Process Engineers, CNSE Work Station Operators as selected by CNSE, AMAT and IBM management teams)

3.3.1 Cleanroom employees are responsible for complying with the process outlined in this procedure.

3.3.2 Cleanroom employees are responsible for changing out the Honeywell chemical-monitoring tapes on a quarterly, or as needed, basis.

3.3.3 Cleanroom employees are responsible for attending training provided on this procedure.

3.3.4 Only those employees trained on this procedure and the EHS-00052 Arsenic Protection Program are permitted to use the Arsenic Glove Box.

4. EQUIPMENT

4.1 **Glove Box/Fume Hood** - An enclosed environment capable of containing the Arsine off-gassing from the FOUP and shall meet the following requirements:

4.1.1 Glove box (fume hood) must bear the following label: “Danger -Contains Inorganic Arsenic - Cancer Hazard - Harmful If Inhaled or Swallowed - Use Only with Adequate Ventilation or Respiratory Protection”.

4.1.2 Exhaust from the glove box (fume hood) must be connected to the facility’s abated acid exhaust.

4.1.3 Glove box shall be situated on a standard workbench, 30” x 84”.

4.1.4 Glove box shall be equipped with flame retardant, acid resistant gloves.

4.2 **Arsine Gas Detector** – Honeywell Continuous Gas Monitor (CM4) Model Number Part Number (P/N) 1874-1000 or similar.

4.2.1 The Arsine gas detector will have a lower detectable limit of 0.3 ppb, detectable range is 0.3 - 25 ppb.

4.3 The Arsine gas detector will utilize a three-month, extended-play, hydride monitoring tape, P/N 1874-9300, with a minimum of three tapes being on hand at all times.

4.3.1 The Arsine gas detector will be set-up outside the glove box with the sample hose run from the detector through a dedicated hole in the glove box. Sufficient hose will be provided so that the sampler can move the sample tube to various parts of the FOUP being measured.

4.3.2 The Arsine gas detector sample exhaust line will be routed into the glove box’s acid abated exhaust duct.

4.4 **Vacuum Cleaner** – A Nilfisk GM 80CR, P/N 01790150 equipped with a HEPA filter, P/N 11730410 will be utilized.

4.4.1 The vacuum cleaner shall be specifically dedicated for use on the P3i chamber and be equipped with the following sign: “Danger -Contains Inorganic Arsenic - Cancer Hazard - Harmful If Inhaled or Swallowed - Use Only with Adequate Ventilation or Respiratory Protection”.

4.5 **FOUP** – Dedicated 300mm Entegris A300G3 *orange* FOUPs will be utilized.

4.5.1 Dedicated 300mm Entegris A300G3 FOUP opener.

4.5.2 The FOUPs utilized shall be specifically dedicated for use on the P3i chamber, and be labeled with the following label: “Danger -Contains Inorganic Arsenic - Cancer Hazard - Harmful If Inhaled or Swallowed - Use Only with Adequate Ventilation or Respiratory Protection”.

5. PROCESSING ARSENIC DOPED WAFERS

5.1 Before processing, the tool operator must ensure that a 10’ perimeter area around the tool is barricaded with cones and yellow caution tape.

5.2 The tool operator must also ensure that ambient monitoring has been set-up and is operating correctly.

5.3 The tool operator must also ensure that the glove box (fume hood) is clear and will be ready for receipt of the newly processed FOUPs.

6. HANDLING ARSENIC-DOPED WAFERS FROM P3I CHAMBER

The following step-by-step procedure shall apply to handling of arsenic doped wafers from the P3i chamber prior to transporting to a metrology station and/or downstream processing station:

6.1 Remove the Arsine dedicated labeled FOUP (FOUP) from the P3i chamber.

6.2 Open the glove box (fume hood).

6.3 Place the FOUP inside the glove box (fume hood), and close the glove box (fume hood sash is closed to practicable working level of 14”). Ensure the outside of the glove box (fume hood) is labeled with the following: “Danger – Arsenic Contaminated FOUP – Arsine Off-Gassing Occurring – Please Open in Exhausted Enclosure Only.”

6.4 Using the gloves provided inside the glove box open the FOUP, NOT applicable if fume hood is used.

6.5 Place the detector probe inside the FOUP above the highest positioned wafer.

6.6 Record the Arsine level from the detector following the table headings in Attachment A - Sample Record Example.

6.6.1 Typical time for the wafers to out gas is 10-12 hours. Once the Arsine level is less than 0.5 ppb, keep the FOUP in the glove box (fume hood) for a further 30 minutes; recording the Arsine levels at 5-8 minute intervals.

6.6.2 If the level after 12 hours is greater than 0 ppb, leave the FOUP open in the glove box (fume hood) until the level decreases below 0.5 ppb. Once the Arsine level remains below 0.5 ppb, keep the FOUP in the glove box (fume hood) for a further 30 minutes; recording the Arsine levels at 5-8 minute intervals.

6.7 Once the 30 minutes have expired and Arsine level is still less than 0.5 ppb, close the FOUP and remove it from the glove box (fume hood).

NOTE: For transport off-site: repeat measurements every 24 hours (once a day) <u>until three</u> consecutive measurements of less than 0.5ppb are achieved and documented. This condition will permit the initiation of transport off-site procedures in Section 7.

6.8 Once the FOUP has been removed from the glove box (fume hood), place a “Date and Time Sticker” on the outside of the new FOUP, enter the date and time (1 week hence) that the FOUP should be returned to the glove box (fume hood), if further processing has not occurred. See Attachment B – Date and Time Sticker Example.

6.9 Confirm that the downstream processing station is ready for receipt, and carry the FOUP to the downstream processing station (MNF01 or MNF07).

6.10 If the downstream processing station, MNF01 or MNF07, is not ready for receipt, the FOUP can be placed in storage for one week before it must be placed back in the glove box (fume hood) for further out gassing.

6.11 If placed in storage the FOUP must still be tagged with the following label: “Danger – Arsenic Contaminated FOUP – Arsine Off-Gassing Occurring – Please Open in Exhausted Enclosure Only”.

6.12 The storage location of the aforementioned FOUPs shall be inside the glove box (fume hood) that has a sign posted with the following – “Danger

– Arsenic Contaminated FOUP – Arsine Off-Gassing Occurring – Please Open in Exhausted Enclosure Only".

6.13 If the downstream processing station is ready for receipt of the FOUP, carry the FOUP to the downstream processing station (MNF01 or MNF07).

6.14 Once the wafers have been through the MNF01 and/or MNF07 processing stations, remove the wafers from the dedicated FOUP using a wafer transfer station, and place in the normal Fab wafer processing stream.

7. TRANSPORT OF ARSENIC DOPED FOUPS

7.1 Wafers implanted with Arsine by the P3i implantor tool at CNSE are prohibited from leaving the facility for further processing unless they meet the following requirements, and are approved by the EHS department.

7.2 Transport Requirements to IBM - Fishkill or Yorktown

7.2.1 This transport process has been established for R&D only, and is allotted for a finite amount of time (target end Dec. 2008), until the In-Situ Capping Process, being developed, is qualified.

7.2.2 The IBM engineer responsible for the Arsine doped wafers is required to ensure all documentation is prepared for the wafers to exit CNSE and enter the Fishkill B323 Control Center or Yorktown Lab, prior to the wafers being transferred from the CNSE online FOUP to a transport Front-Opening Shipping Box (FOSB).

7.2.3 The IBM process engineer shall provide the B323 Control Center SiView or metrology laboratory entry documentation to the IBM Albany P3i team member, prior to wafers being removed from the CNSE glove box to the CNSE Control Center.

7.2.4 Air sampling measurement requirements, as listed in Section 6, for transportation off-site must be met. Such measurements include: date of process and date of measurements, times, measurement results, person(s) who conducted the measurements, and contact information. missives. See Sample Record Example table in Attachment A.

7.2.5 A copy of this information MUST to be sent to IBM and CNSE safety contacts (CNSE – Jennifer Trodden jtrodden@albany.edu, East Fishkill – Richard Melville, rjmelvil@us.ibm.com; Yorktown – Jennifer Gardner, jengard@us.ibm.com, IBM liaison - Paul Kozlowski, pkoz@us.ibm.com;) and the appropriate IBM process engineer(s) before the FOSB is moved to the CNSE Control Center and leaves the site.

7.2.6 The IBM process engineer is responsible for providing the CNSE Control Center the appropriate exit documents for the wafers and transporting the FOSB/wafers off-site.

7.2.7 When the documentation is complete, the wafers shall be transferred into a FOSB in the CNSE Control Center.

a. The FOSB must be sealed in two plastic liners.

b. The outer plastic FOSB liner must be labeled with “Danger – Arsenic Contaminated FOUP/FOSB – Arsine Off-Gassing Occurring – Please Open in Exhausted Enclosure Only” and the required CNSE exit and Fishkill B323 Control Center input documentation for immediate input onto the line.

c. Additional prominent label on FOSB stating, “DO NOT OPEN IF PAST DATE: XX/XX/XX, FOSB MUST BE RETURNED TO CNSE Albany Nanotech Facility. Contact _____ (Responsible IBM Engineer)”
NOTE: XX/XX/XX is one week after last Arsine measurement was recorded.

d. The IBM engineer will transport the wafers from the CNSE Control Center to IBM – Fishkill or Yorktown. All those involved in this process must be trained in accordance with the training requirements, outlined in Section 8.0.

7.2.8 Once ready for transport the FOSB must be transported and input into the FISHKILL B323 Control Center, Fishkill Metrology Lab or Yorktown Line within 24 hours of leaving the CNSE Control Center.

7.2.9 If the FOSB is not placed on line or within the metrology lab within 24 hours by the IBM Process Engineer, the FOSB must be taken back to CNSE and measurements, stated in Section 6, must be repeated in the glove box; and transportation procedures, as stated in this section, shall be repeated.

8. TRAINING REQUIREMENTS

8.1 All those involved in the process outlined in this procedure shall attend a CNSE specific “Safe Handling of Arsenic Doped Wafers” training session.

8.2 Topics to be covered in training include:

- Hazards of handling Arsenic doped wafers;
- Processes outlined in this procedure;
- Engineering and administrative controls put in place to eliminate employee exposure;
- Use of the Honeywell continuous monitor; and
- Change-out of the monitoring tape.

8.3 Training records shall be located with the EHS Manager. Such records shall include the nature of the training, content, the date and length in hours, instructor(s), participants, and training proficiency exam results, if applicable.

8.4 Training shall be conducted on initial assignment, and whenever there is a change in this procedure.

8.5 No one other than those that have attended this training session is authorized to part take in the procedure outlined herein.

ATTACHMENT A

SAMPLE RECORD EXAMPLE

FOUP #	Start Date	Time	Arsine Level Detected (ppb)	Initials	Comments

ATTACHMENT B

DATE AND TIME STICKER EXAMPLE

FOUP#: _____ **START DATE AND TIME:** _____ **END DATE AND TIME:** _____ **INITIALS:** _____	**FOUP#:** _____ **START DATE AND TIME:** _____ **END DATE AND TIME:** _____ **INITIALS:** _____
FOUP#: _____ **START DATE AND TIME:** _____ **END DATE AND TIME:** _____ **INITIALS:** _____	**FOUP#:** _____ **START DATE AND TIME:** _____ **END DATE AND TIME:** _____ **INITIALS:** _____