EECE5606 Laboratory Template

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Title: Lab Tour **Lab week: 1**

1. **Lab Description (10 points)** ***(What is this lab about?)***

In this lab lesson, students were shown around the clean room room. Various important factors Operations of sputtering, etching, lithography, microscopy, and the operation of the associated instruments were discussed. Finally, the student were acquainted with the different kind of silicon wafers used in industry and taught how to handle wafers.

2. **Lab Objective (10 points)** ***(Why are you doing this lab?)***

This laboratory class was an introductory session aimed at introducing the student to the protocols and procedures observed in the facility. The main objectives of the class were to teach the student proper layout and the procedure or protocol to be followed in the laboratory.

3. **Methods (20 points)**

1. Suiting up

In order to protect the cleanroom from contamination by bodily fluids and also the human body from harmful chemicals used in the cleanroom is a process with a special type of clothing, which you have to wear a belt , gloves, face masks, bouffant hats, hoods, jumpsuits , boot covers and googles. Cover one's feet/ hoes with booties entering the gowning section of the cleanroom. All pockets in the clothing must be cleared out except for a smartphone, which must be carried into the cleanroom for the purpose of making emergency calls. After entering the Gowning section of the cleanroom, the gloves must be worn first, followed by a mask, and a bouffant cap. Next, the hood is worn to cover the head and neck, followed by the jumpsuit, the boot covers, and goggles after this, one is ready to enter the cleanroom.

2. Entering the cleanroom:

The cleanroom facility is equipped with two subsequent set of switch-operated automatic folding doors. To open the door, one must press the red switch which automatically opens it. After entering through the first door, one must wait for the door to automatically close before opening the second one this is to make sure that contaminants from the gowning room do not enter the cleanroom. There are several things that must not brought into the cleanroom, such as paper, pencils, felt-tip pens, ersers, food, drinks, carboards, or uppainted wood. A special lint-free cleanroom paper is provided inside the cleanroom along with a ball-point pen and a clipboard.

3. Using the wet-etch bay:

The wet-etch bay is the first room that one enters after walking into the cleanroom. It contains a table with a ventilated hood where acids such as the hydrofluoric (HF) acid are used for wet etching. When performing wet etching, additional protective gear such as the acid robe, plastic face

shield, and special acid gloves must be worn. Care must be taken while operating the acids and in the event of chemical contact, one must immediately begin rinsing the affected area with water, then contact the TA, lab manager, or a lab engineer. The wet-etch bay also houses the Evatec sputtering station, which is a highly automated system used for sputtering piezoelectric layers.

4. Using the deposition bay:
The deposition bay is the second room that one enters after walking into the cleanroom. It contains instruments such as the Dektak3ST profilometer (metrology), the AJA sputtering machine (RF magnetron), and the e-beam evaporation machine (shown in Figure 3a and 3b). The PVD machines must be handled with care as per the TA's instructions as their operating voltages are dangerously high and electrical discharges can prove fatal. Moreover, the plasma radiation in the sputtering machine must be viewed carefully, as it can cause blindness.

Three important wafer processes discussed in the lab are:
1. Handling wafers:
Wafers must be handled carefully using special tweezers to grab it at an edge such that the wafer edge is perfectly seated in its grooves. Wafers must be picked up using the tweezers with the dominant hand with the other hand below it (palm facing the wafer) to catch it in case it falls.
2. Cleaning wafers:
Wafers must be cleaned using a solvent clean, followed by rinsing in DI water, then a RCA clean and DI rinse, then a HF dip and DI rinse, and finally a blow dry.
3. Cleaving wafers:
Wafers must be cleaved by making a small, but deep cut on its flat edge using a diamond scribe. Then the cleaving must be done by holding the two diametrically opposite edges of the face, keeping the cut as the axis of symmetry, and pressing into the plane of the wafer. If the cut was done neatly, the cut would produce a straight-line crack propagation, which is desired. Care must be taken to not shatter the wafers into tiny pieces as the shards can be dangerous. Furthermore, goggles must be worn during this process to protect the eyes from said shards.

4. Outcomes and Measurements (15 points)

The outcome of this laboratory class was that the students were introduced to laboratory and tools. The students were trained to gown themselves and handle wafers.

5. Comments (5 points)

It was observed that the cleavage of wafers were in a straight-line when a single clean cut along a certain direction was made using the diamond scribe rather than many cuts in different directions, which produced curved/branched breaks. This is because each kind of wafer, ⟨100⟩, ⟨110⟩, and ⟨111⟩, has their own cleave planes, and when the wafer is diced in these planes, a neat straight-line cut is produced. When the wafer is cleaved along the 'off-crystal plane', the cleaved edge will fracture in unwanted directions. To cut the wafer in these directions, special tools are required.

6. Analysis Questions (30 points)

a. Safety is the top priority in a laboratory environment. Discuss five potential hazards that were discussed during the laboratory tour and safety walk through, ranking them in order of importance.

Ans. The five potential hazards in descending order of importance are as follows:

i. Chemical hazards: Chemicals such as HF, HCl, HNO_3, H_3PO_4, H_2O_2, and TCA can cause severe irreparable damage to the body.

ii. Electrical hazards: High voltage discharge from sputtering machines can be fatal.

iii. Mechanical hazards: Sharp wafer shards resulting from improper wafer handling or cleaving can be dangerous.

iv. Fire hazards: Chemical explosions or short-circuits can cause fires to break out.

v. Biological hazards: Bodily fluids like sweat from improper gowning can contaminate the cleanroom

b. You notice an unlabeled chemical in a Teflon bowl left unattended on one of the wet benches. What would you do if you were a staff member?

Ans. Any unlabelled or unidentified chemical must be assumed to be extremely dangerous like HF and handled carefully. Testing of the chemical must be done to determine its nature.

7. Attendance (10 points)

Leave this answer blank – to be used by TAs.