

Biomedical Ultrasound: Fundamentals of Imaging and Micromachined Transducers

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Lecture: 15

Introduction to Cleanroom

Welcome to this lab video and here what we have done is we have recorded the lab videos so that you have a little bit better perspective of what I am teaching in the theory classes. Now if you recall we start with silicon right and how silicon bowls are fabricated or from bowls how we can slice the bowl to form silicon use different techniques and then something we called as a clean room right.

So, how to enter the clean room and what are the precautions that you need to take before you enter the clean room. So, gowning protocol, wearing different PPEs and other things are part of the protocol of the clean room. So, you see the video and see how the clean room, what is the introduction is, how to enter the clean room, what are the precautions as I already said and I hope that you like the lecture. We have been putting lot of efforts so to bring this lab components to all of you through this NPTEL platform.

Welcome to the TA session. Today's lab demo will be focused on how to enter the clean room and what all protocols we need to follow. Generally, all the spaces, all the labs are clean as such, but why this room we are calling it as a clean room? The reason is here the temperature, humidity and number of particle counts are controlled in such a way that the process or the microfabrication which we will be doing, which will be carrying out inside the clean room will not get affected through the external environment. So, the three major factors that is maintained inside the clean room is temperature, humidity and number of particle counts.

Number of particle counts tells us the class of the clean room. So, suppose we have 0.5 micron of size of particle size. If it is greater than 10,000, then it is a class 10,000 clean room, 0.5-micron size particle in per square feet.

So, if it is greater than 10,000, then it is class 10,000. If it is greater than 1,000, then it is class 1,000. And likewise, it goes to 100 and 10. So this clean room which we will be entering is a class 10000-1000 clean room wherein the white area or where we will be carrying out our bed benches and the physical vapour deposition, those areas are class 10000 clean room and the lithography area, or the yellow room is class 1000 clean room. Now this why clean room is required at such for microfabrication.

So, we are focusing on the dimension which lies in micron level. we try fabricating or we fabricate devices which are of 10-micron, 15 micron, 20 microns, which is one-tenth of the thickness of the hair. So, if a hair falls, if a single hair falls onto the device, it has the ability to disrupt the device and it can hamper the yield of the process. also we shed as a human we shed lot of dead skin cells and we have in our sets we have lot of metal ions which can affect the devices and the process which we will be doing inside the clean room so it is our need that we need to fabricate devices we need to increase the yield of the device fabrication at the same time we need to protect the cleanroom from ourselves as well as this cleanroom protocol or the cleanroom PPE kits which we will be wearing will protect us from the hazardous chemical which will be used during the process of fabrication. So, it's time to go inside the cleanroom.

We'll see what the governing procedure is and what all protocols need to follow when we go inside the cleanroom. I have this storage box. It is called desiccator because for temporary amount of time or for temporary, we can create a vacuum in this desiccator, and we can keep our samples inside this desiccator. So, that we can carry out from one lab to another lab for characterization or for further processing so I have one sample that I will take inside to carry out a process, so this is the desiccator and all the materials which we take inside the clean room needs to go in a pass box. I will show you the pass box in some time.

So, I will first remove my shoes. Socks can be intact. So, this clean room has a limited entry or limited people can enter inside the clean room because there is a safety test which needs to be cleared before entering this clean room. So, this is the biometric system which limits access. So, I'll enter the clean room now.

Two things I took inside the clean room. We are in the governing area now. So, if I want to take it inside the clean room, I have to keep it in the pass box. The pass box is a chamber wherein UV light comes in. And if there are any particles or germs mostly, that will be killed before the material is taken inside the clean room.

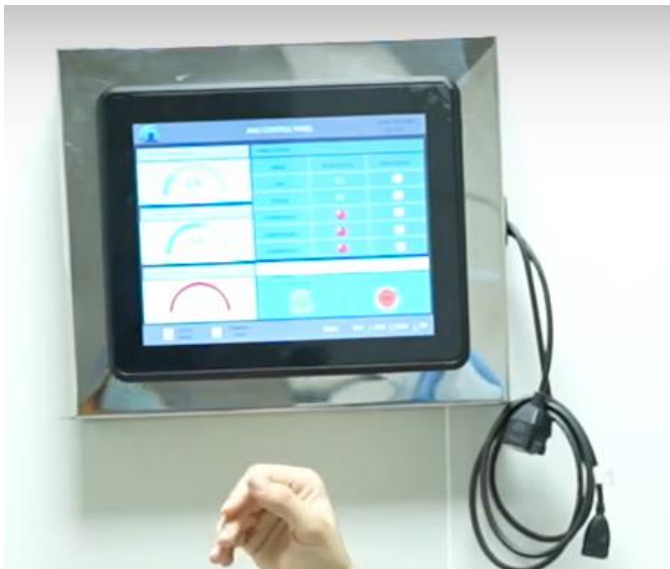
Phones are not allowed inside the cleanroom so I will keep my phone here and this is my sample which I will be keeping inside the pass box. So, this is the pass box. I can open it. It has UV light inside and I will close the door from this side. It has a door from the back so when I am inside the cleanroom, I will open the back door and take my desiccator out.

A few more things I will tell you before we enter the cleanroom. There are some material restrictions which we cannot take inside the cleanroom. Firstly, related to us, it is prohibited to apply perfume because perfume has VOCs which generate particles which whatever you can smell is a VOC and that means it is generating particle which will increase the particle count inside the clean room. Also, for the ladies, they can't wear cosmetic products. because again they might shed particles then few more things which

are listed here here you can see you should wear dry and clean clothes so you can't come with drenched clothes. Also, jackets or furry clothing are not allowed because again they will shed particles and dirty and stinky clothes are also not allowed.

The clothing choices will be, I try to wear full sleeves and full pants. If full sleeves are too much then a half sleeve is fine but for pants we should wear full pants not shorts or three-fourth because we should not expose any part of our body inside when we are inside the clean room and this is a part of safety. to us from other chemicals, which we will be using in the processes inside the clean room. So accordingly, I am dressed. I have three-fold sleeves.

Kurthi and a full pant below so, and it's clean and dry. Now, I'm ready to go inside the clean room. So now, I'll be showing AHU control panel which is installed in the lab. So, this is the AHU control panel.



Here we can see what the real time temperature is, relative humidity and what is the status of the compressor which are helping to keep the temperature inside the clean room and we can switch on switch off the AHU using this. So now it's time to go inside the cleanroom. So now we'll start the gowning procedure to go inside the cleanroom. First, I'll be wearing mask. So, this is important, why? Because we are inhaling, exhaling.

So, when we are exhaling, we are throwing out some air from our body. So, that air might have some particulates which can sit or settle down in the clean room. So, to stop, to restrict that, I will be putting the mask. and ideally if you are having cold or cough you should not enter inside the cleanroom now as I have long hair and the females who have long hair should tie a bun so before wearing the hair net I will tie a bun when we are putting the hair net this is the hair net all the hair should be inside this hair net so I'll cover my head such that all my small small strands of hair are also coming inside and

here I have covered my face and my hair completely now Before wearing the shoes, I have to wear the shoe covers. These shoe covers will prevent any particulate matter from our feet to go inside the cleanroom.

So, if you are wearing socks or if you are not, still you have to wear shoe covers. So, once I wear a shoe cover on one leg, I should keep that leg inside the gowning area where we will be wearing our gown. similar for the next leg and i'll take my gown from this cabinet this is a garment cabinet or where we will be keeping we keeps our clean room gowns this has air circulation so if some particles or the dead skin cells are there on our cleanroom gown, the air inside this garment chamber will flush out all the dead skin cells or the particles which are present on our gown. So, I'll be taking my gown. I'll place back the hanger again and every time I take out the gown i will make sure that the door is closed because the air is circulating and it is cleaning the gown when both the doors are closed now I'll the sleeves. I'll take both the sleeves into my hands because I don't want it to touch the floor when I'm wearing them. This is sort of a bunny suit. So, I have to completely unzip it. I have to put both my legs like this and wear the sleeves properly now before zipping it, I'll just place the hood properly so the elastic band should properly come at the back side of your head so that so that you will feel comfortable and it will be secured now I'll start zipping it and I will secure this velcro now most of my body part is covered with this bunny suit except the legs or the feet so for that I will be using this long cleanroom shoes it has some extended fabric which will come till my calf so I will start wearing it so I will first secure this velcro I will put the bunny suit inside completely inside and zip it, I am done with my left leg same I will do for the right leg.

So, now the only thing which is exposed is my hands for that I'll use nitrile gloves these gloves are little bit chemical resistant and won't shed any particle inside the clean room, so I have a small size nitrile glove and I'll wear it. Here, there is one catch we need to put the gloves on to our cuffs or onto our gown so ideal ideally it should be like this similar same thing I'll do for right hand, and I'll insert the cuffs inside the gloves. So, why because why we are doing this practice if some chemicals will happen onto our hand or body so the liquid will flow from the gloves to the gowns it won't go inside, inside the gown and it will that will not expose your skin your skin will not expose to the acid or the liquid which we were handling. So, I'm fully gowned. I have my mask, hairnet, gown and I've secured my hood.

I wore long shoes and gloves. Now I am completely ready to go inside the cleanroom.



The thing you are seeing in front of me is the sticky mat. I will step onto the sticky mat and tap my feet two to three times. That will make sure that if there are particles on my sole, that will just stick onto the sticky mat, and I will be ready to come inside the cleanroom.

The desiccator which I have kept inside the pass box now it's time to take it out so this is the back door I'll open this and take the desiccator out and close the door, so I have my sample inside this desiccator. So, this is the rotating knob which I will use to break the vacuum. So, when I rotate it anticlockwise direction the atmospheric air will gush inside this chamber or this box desiccator and it will come to atmospheric pressure. Now I will open the desiccator and take out my sample.

So, the sample is here. Now I'll start my process on this sample. This is all for today's lab demo. This is the clean room demonstration, clean room entry, which one should do every time we enter the clean room. Thank you.