

Sensors and Actuators
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Lecture - 52
Human Machine Interface for Controlling Deposition System

Hello, welcome to particular module. module is really interesting because if you recall the last lab component; we were discussing each and every or most of the parts within the PVD system and when we talk about PVD; we were talking about thermal and E beam evaporation.

Now we should understand and remember for thermal evaporation you cannot evaporate a material has a melting point close to the boat melting point or the source holder melting point either there is coil or boat on which you will load the source which you want to meet. the source material should not have a melting point close to the source holding material which we call as a boat or a coil. Because otherwise boat or a coil itself will start melting and is what we do not know there we do not want correct.

in case, if the melting point is extremely high we will go for electron beam evaporation. Because in case we will be using crucible and then in the crucible, we are loading the source material we want to evaporate electron beam will come and it will scan the metal or material and it will heat the material; it will deposit it will melt and deposit the material on the substrate. how does whole thing work?

What vacuum pressure you need to understand before you change it to the high vacuum valve; there is a certain procedure when we operate vacuum system there is a rough vacuum, there is a back vacuum, there is a high vacuum you need to open a vacuum valve after you retain a certain back vacuum. we will be discussing in the lab class.

Just to quickly help you out Pirani gauge is a gauge can be used for a vacuum around 10^{-3} raise minus 3 torque; while planning gauge can be used for a vacuum around 10^{-6} raise to 10^{-7} raised to 7 minus 7 torque. Here we are not using the oil pump, but we are using the turbomolecular pump. If you have attended any thin-film physics class; then you will understand there are several kinds of pumps are used to create vacuum

including oil pump, get drain pump, turbo molecular pump and as each pump has its own pros and cons.

Recently all these vacuum systems or thermally operation systems, immune systems, pertain systems; they have the turbo molecular pump to attain the high vacuum . please focus on module; is one of favorite modules because actually, you will be able to see how the system is in operating mode. And you will see how the substrate is loaded where is the E beam and you cannot see E beam actually, but otherwise crucible there are 4 crucibles and then where is the boat .

how the chamber looks like. whatever we learn in theories one thing when we look something in the lab or we experience in the lab is a very different thing. I hope you like particular module and any questions again you are free to ask me in the forum. I will request a few of students to show it to you along with we have called an engineer from Hind Ivec Mister Rajanna.

And he will show us how system operates, but we can also operate independently; is a very simple and easy system provided you understand the concept al. I will see you in some other class till then you take care; bye.

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Welcome everyone, today is the second day of installation of system as you can see they are still trying to set things up, but most of the items have been installed yesterday we

showed you the internal structure of the electrical wiring. after the people from the company they have connected the wiring they have plugged in the power supply. especially separately for the control panel, you need to give power as well as for the chamber area; you need separate power.

for both these power supplies have been given and we have kept the chiller unit and the compressor unit outside; you can see a light outside the glass there. is the utility room we have created for the equipment inside the lab. As per safety protocol you should not have gas cylinders, compressors, chiller units etcetera inside the lab. we have kept it outside in a utility room and we are taking the tubes and wires from there into our equipment.

Chiller unit as I have told is for a giving sufficient cooling to the coil and the E beam system everything holder and you saw the crucibles boats and all.

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Now what we are trying to do is if you can see left side of the instrument. as you can see we have completed most of the tubing required for the functioning of instrument. we have done the tubing blue tubing is for the air supply, we have done the cooling water in and outlet.

These two tubes if I can touch I can feel it is cooled though it is coming from the chiller unit outside. water supply will take in and take out the water and we have an exhaust

for the rotary pump as you can see we have spoken yesterday rotary pump is the roughing pump of the system. for exhaust is here; so is because of safety purposes which it is better we exhaust these air outside to the utility room not inside the lab facility and we have other sections for venting and needle valve inlet which are yet to be made. more, but for the basic operation, we have made the connections.

These two are the processor gas processing gas.

Processing gasses.

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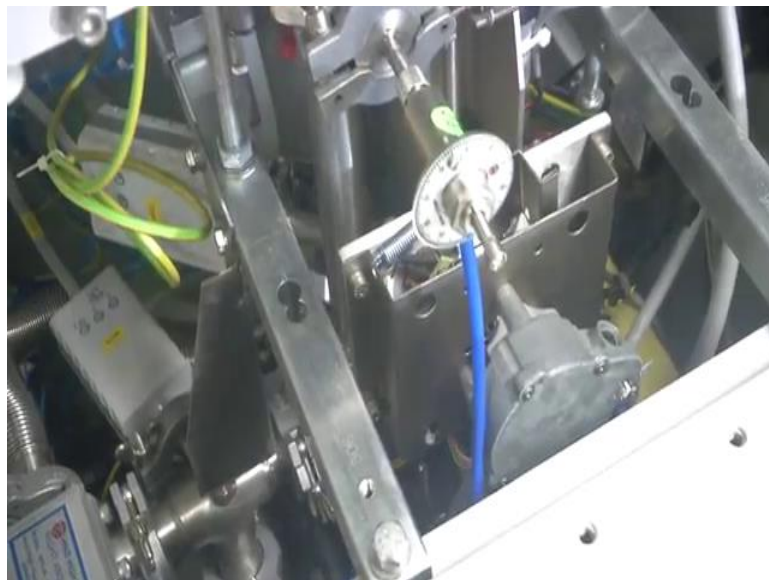
These two are processing gasses; the other two are for the purging and the creating vacuum venting for general gasses we are are used like nitrogen compressed air and all. those connections are made. we are ready a bit to show you exactly the functioning of the control panel, how vacuum is getting created inside the chamber and for the E beam gun are we getting the plasma all those things. once it starts we will see .

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is Pirani 1, is Pirani 1; piranic agent 1 is a vacuum measuring is for measuring chamber vacuum Pirani 2 is another vacuum valve is a turbo molecular pump. you need them.

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is the high vacuum valve for the connecting chamber.

Chamber from the pump.

we have opened the system because we are going to start it. he is checking everything inside whether it is fine. At the time it is very difficult to see the inside of after it starts

working. is the golden opportunity to see how the valves are connected inside, how is the high vacuum valve looking like, what are the how are the gauges connected.

We already saw the pending gauge behind the chamber; now we have seen the Pirani gauges here which measures the different vacuum levels. is actually the heart of the system the vacuum system is very important. you can see the system here; you can see the angle backing valve here. He has told you if is these are the pinning Pirani gauges that measure the high vacuums and the turbomolecular pump is inside; it is a very small pump compared to the rocking pump as we saw yesterday here.

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here where the finger goes is where the turbomolecular pump is.

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And there next to it; we have one is the high vacuum; high vacuum valve.

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just now I have shown you the Pirani gauge; the angle valve, the high vacuum valve, the turbo molecular pump inside. I told you we have seen the penning gauge, but I am not sure whether we saw it yesterday. here you can see the penning gauge here.

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It is called the cold cathode gauge also. the data for let what is the pressure it is measuring comes out through Ethernet cable is connected to here. is the gauge is connected to the chamber here in the chamber is very very cold because of them; so line you are seeing here on the chamber has a cold water circulation inside is for cooling the chamber; so is there.

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And metal piece you are seeing is grounding; is grounding between the is the door of the chamber, is the chamber's main body those two are grounded. as to protect the user; so those things are there. cable you see let me let us focus there.

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is the top of the top cover of the chamber ok.

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here we can see a big black color ribbon here the black big black color ribbon is actually the earthing wire for the chamber. these are the main things you can see these

tubes; these tubes carry the cooling water inlet-outlet cold water from the chiller unit for again cooling purposes and let us see and remaining when we functionally show you.

Ok.

We will see.

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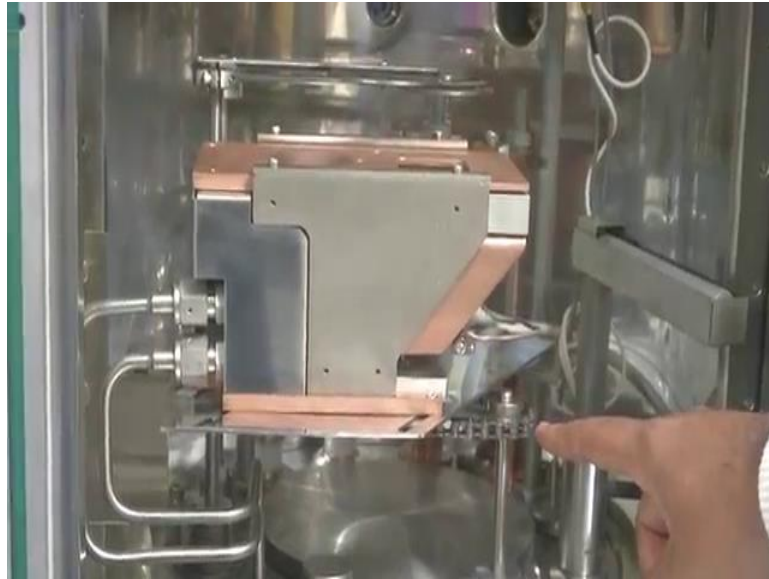


is graphite crucible is used for operating aluminum, copper, gold (Refer Time: 10:00) will be (Refer Time: 10:04) system.

(Refer Slide Time: 10:05)

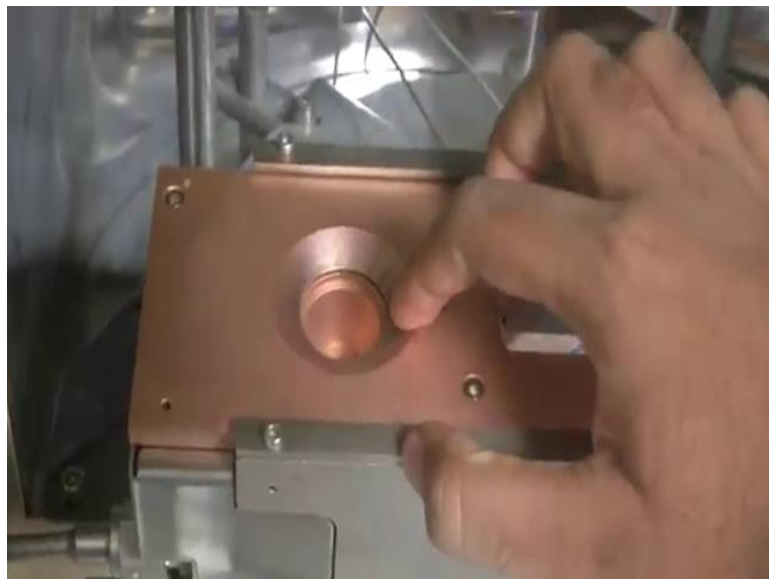


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We have seen the substrate holder rotation before, now we will see the source rotation. We can see the crucible holder now we are changing the speed of the rotation here we are changing the source. you can see the belt here moving changes the crucible. you can see the belt moving; now let us look at the crucible, we will go inside and look at the crucible moving.

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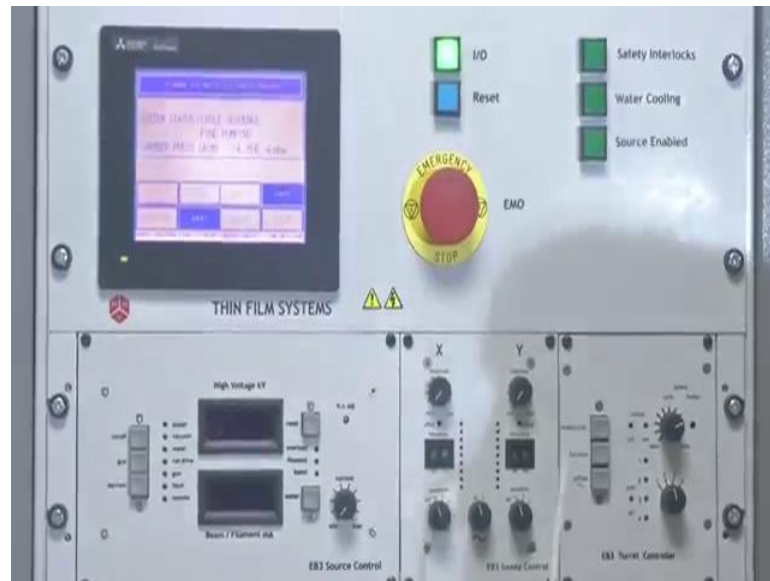
you can see here now it is in one source now can you change the source?

Source 4 1.

Now, it is in source 4, we are changing to source 3; we are changing to source 2; now we can see it moving. is the crucible where we are going we have shown you the crucible standard crucibles.

The crucibles will come and sit here is source rotation.

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now the system is almost ready. the start of is the control panel we have explained before; now what we are trying to do is to create the vacuum inside the chamber. in , because it is the first time we are operating it; it takes some cycles to arrive at exact timings for arriving at specific vacuum points. the team here they will explain like exactly what is involved in g y; where we will is a human-machine interface which can be used to control to a large extent the process.

is the system will be operating through HMI; is set after up to high vacuum is going to auto cycle if you go for process LTHT going for an only manual system.

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going to the vacuum sector press start button when press start button what a pump is getting a (Refer Time: 11:56).

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If it will take time for reaching the turbo speed 10 to 15 minutes. Once is the turbo is ready you can press the cycle button. When the so.

(Refer Time: 12:10).

Turbines reading .

(Refer Time: 12:13).

(Refer Time: 12:14) status to be.

Can go along the system.

fine pumping means it is a turbo know.

(Refer Time: 12:21) high vacuum.

High vacuum.

High vacuum (Refer Time: 12:22).

Here the one. switch on turbo (Refer Time: 12:28) is to me (Refer Time: 12:29).

Means turbo is running.

Turbo is running; after cycle sequence, it will come.

Ok.

When the, so press the center button, open the seal valve and reach the minus 2 vacua; chamber vacuum. Once you reach by these two vacua, again you go automatically open high vacuum 1; when you open a high vacuum 1 penning rating will be started. Penning rating will be starting is minus into minus x to the power.

Minus 2 also it will be written (Refer Time: 12:55).

Fine.

Minus 2.

When we reach the ultimate vacuum just to is the process; stat process means the bulb and the iron department.

If you press the iron button will behold holding is on and holding help.

(Refer Time: 13:14).

(Refer Time: 13:15) gas inlet gas (Refer Time: 13:18) needlework; yeah switch on LT, HT, circuit baker.

(Refer Slide Time: 13:26)



Switch on switches LT means HT clean the iron movement training. When iron movement training whole (Refer Time: 13:34), clean the substrate than the switch off CP 1, switch on HT. will be (Refer Time: 13:44); switch on (Refer Time: 13:46) put it also by controlling the (Refer Time: 13:51).

(Refer Slide Time: 13:59)



At the same time; suppose if you want to see the three gauges gradients.

You go just go system in and.

(Refer Time: 14:03).

You can see independent.

How?

you can see the entire structure of the system here.

(Refer Time: 14:08).

What are the different valves (Refer Time: 14:10) getting there 4, 3, high vacuum all the (Refer Time: 14:14) gate valve.

Yes.

whichever is blue in color; means, those valves are on they are working ; others these are not on; means, they are not working it.

Show (Refer Time: 14:24).

(Refer Time: 14:25) nothing all cross condition.

(Refer Time: 14:27).

I think all it (Refer Time: 14:30).

nothing all will be I go to be a nearby thing in the .

No (Refer Time: 14:34) all.

is all.

(Refer Time: 14:36).

is all; is all.

is the hierarchy; hierarchy means to process is the initial pumping process.

I am the pumping process.

IO is when we are operating need come.

(Refer Time: 14:42).

you are telling us before we start all these will be green but still, we are in the vacuum cycle only.

We did not move to the process.

Process.

And all; so when we go to process only these things will come here.

has to (Refer Time: 14:59). See in LT did not provide water process for for if and if only the main process means for water source is there water cross-section there has to satisfy.

now we have given power supply (Refer Time: 15:15) in the power supply is not on .

now switches on (Refer Time: 15:18) 2 or 3 on .

is mains on, but still, begin a move to process-related.

Ok.

Process.

(Refer Slide Time: 15:21)



when the process starts only we will switch on the relay.

(Refer Time: 15:27).

No.

When process after satisfying interlock and all.

It will move to process the next step.

(Refer Time: 15:40).

(Refer Time: 15:41) is all know.

once the process is ready to do process these lights will turn on.

Interlock and circuit switches (Refer Time: 15:49).

Then we can start the E beacon.

How do we where do we control the voltage and the EV?

(Refer Time: 15:54).

Here only we have to press then we have to (Refer Time: 16:00).

(Refer Time: 16:01) then we have to select the current (Refer Time: 16:04).

(Refer Time: 16:05) controller.

EB you cannot any switch on; after we do the iron bombardment cleaning .

(Refer Time: 16:09).

what way.

Yes, sir.

I will not (Refer Time: 16:12).

Ok.

(Refer Time: 16:14). [FL]

I got to pressure from the beginning the process thing will start.

It is no go minus 5 degree and is minimum minus 5 degree.

Sorry EP.

we have set it inside because at one point these switches will come on you know.

(Refer Time: 16:31).

we have set it inside or it can we can control it?

No, one vacuum switch is there and the water process which is there should be all should be satisfied.

Ok.

All should be in EMC condition then only (Refer Time: 16:46).

What is the condition for them to get satisfied we have been set it is also already?

We have to door switches all door switches; strong strengthen a lot of thing cabinet and control panel plot almost should be involved position and writing should be more than.

Ok.

at what point will turn on now? In the main what question will automatically turn on now?

No, it should be in working production only.

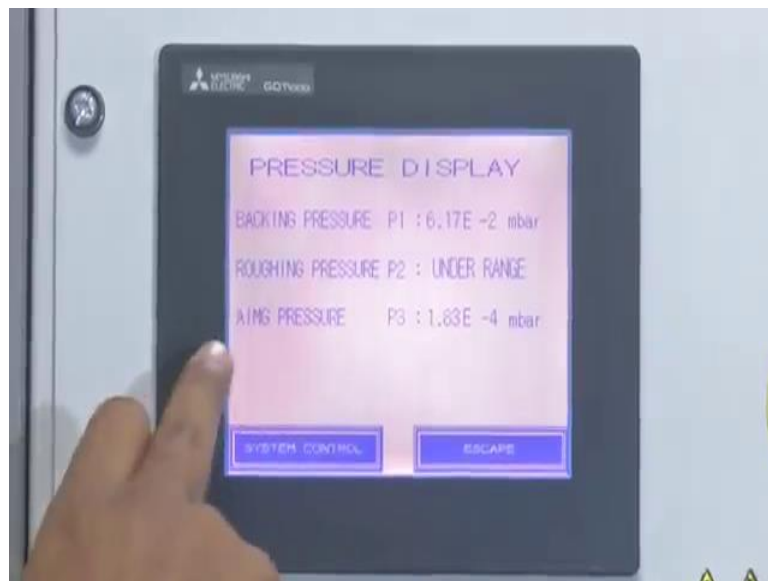
Remove process condition then only filter one.

now still with 1.9 into minus 4 (Refer Time: 17:20).

I may is (Refer Time: 17:23) to take the time of a thing (Refer Time: 17:25).

you can see a paper chamber vacuum here 1.91 E power minus 4 millibars just to reach E power minus 5 for the turbopump to crosses to start.

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time only all these things will turn on. we have to wait for as you know between three vacua as and when we create the 5.

5 vacuum; it is even more difficult.

Great .

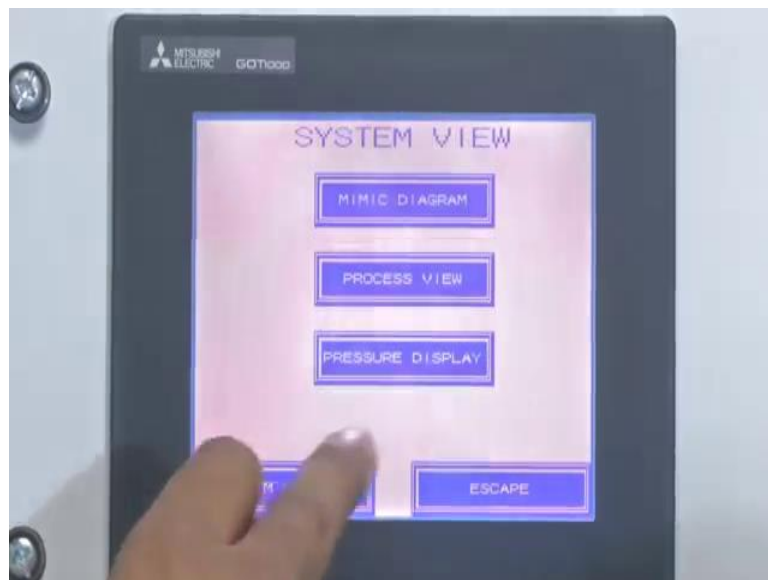
In pressure press there.

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We backing pressure roughing pressure AIMG pressure what is set the clock and set unit is the in time unit means if you want to millibar you can set millibar Pascals.

(Refer Slide Time: 18:11)



Ok.

Or torque process view (Refer Time: 18:13).

(Refer Slide Time: 18:13)



is not required.

Because of the microservice type service mode type.

(Refer Time: 18:24) after satisfying the introduction we will go on (Refer Time: 18:35).
interlock status will be based on it now how much time it will take (Refer Time: 18:39).

No, if we have some wished over and wished over puzzle set point.

After reaching set point.

what is a set point?

We will; we will set manually.

Whichever set point we require a minus 5.

I have a set it now; now for EV; we settled down minus 5 like I only from a (Refer Time: 18:57).

Like we have to set [FL].

[FL].

[FL].

[FL] (Refer Time: 19:15) what you will see on these three green buttons we are not there are set points for what flow rate LPM and safety pin locks where all the doors of the system should be locked properly; the front and backside everything. Once those things are done these things these water will slowly come out. water pulling is come up; so once they lock everything [FL] will come on.

Yes, sir or as mine.

on a safety pin locks have come on now source enable is depending on the pressure. it is set at a one-stop value only for the pressure; once is reached the source enabled will come on when all three are green we can start the process.