

**Fabrication Techniques for Mems-based Sensors: Clinical Perspective**  
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**Lecture – 45**  
**Biomedical and Electronic Engineering Systems Lab**

Welcome, in the past series of modules we have been looking at different types of equipment that are conventionally used in a micro fabrication lab. Especially in the lab that tests with micro fabricated sensors and components, we have seen a lot of equipment like microscopes, bio safety hoods, oven and lot of things and also gone through good lab practices and what are the precautions to be taken and all. So, in the same line of thought one of the main things that also that needs to be taken care of is the personal safety.

Safety of the people, who are working within the lab, because at the end of the day people have, people who are working in the lab need to be happy, they need to be content and be they should have a secure feeling in their mind that where they are working is a very safe place and they can peacefully do their work without being scared about any chemical contamination, any hazardous event that might happen like fire or anything.

In this regard it is very important that good lab should have sufficient safety precautions. These safety precautions are two fold; one is providing safety through setting up infrastructure that ensures the safety, I will come to that in detail and another one is promoting an ecosystem or a culture of safety within the personnel, who are working in the lab.

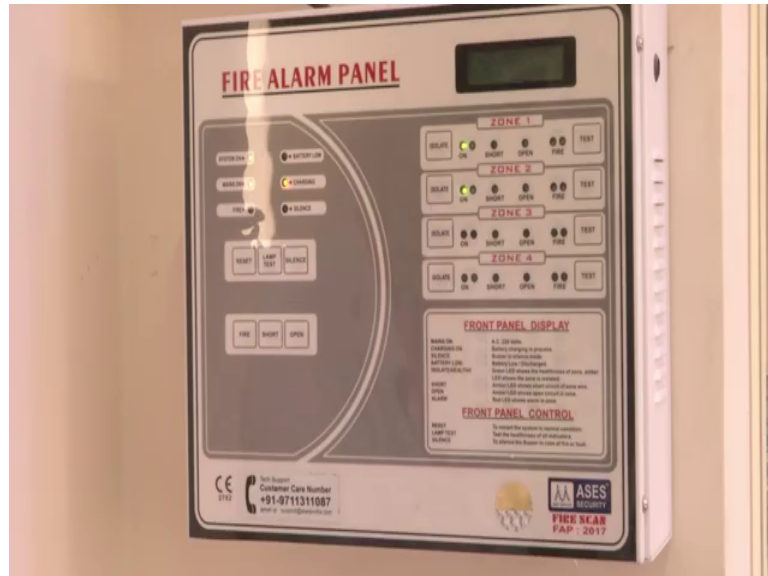
How can the second option be done? That is by setting out standard operating procedures of evacuation of cleaning in case of chemical contamination. So the lab should have set out, a clear set of instructions on what to do in case of any emergency so, that will be conventionally be document like an SOP document, SOP is Standard Operating Procedure.

So, this is usually there in almost any field, any if you go to any manufacturing facility shop floor, an industry, all a part of them getting licensed to do what they do is to ensure safety of the workers or the employees who are working there. How they ensure it is through two fold again, one is providing sufficient safety equipment and safety features, where they work and also promoting a culture of safety by setting out well laid out standard procedures and do's and do not's within the environment.

So, today in our lab also we have a safety mechanism, which is a very state of the art fire alarm system, we would like to take you through this fire alarm system. So, that you understand how this is also a very core part of any lab So, anybody who if you are doing research, you always do research, you should never focus on only your work ok, this is my research I will do this, two things are there in that you do your work, you use equipment there is a common facility in the lab. So, it is your responsibility to make sure that, you leave the equipment in the same state that it was before you started using it after your use is over. So, that the next person, who comes in to use it, will not find any difficulty in doing carrying out his work, this is a part of being a good researcher.

So, this is like you form a part of a research community. On the same lines, you should also make sure that everyone follows safe methods, safe protocols and you should be aware of what are the precautionary measures that needs to be put in a lab.

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Now, we will look at the fire alarm system that I talked about. So, here we have a state of the art fire alarm system so, the core part of it is about dividing, your whole lab into different zones and having dedicated alarms for each of that. So, if you see here, it is written zone 1, zone 2, zone 3, zone 4 so, this alarm system will be able to divide your entire lab, into 4 zones and have dedicated alarms for each of these zones. This is important, if because if yours is a very big lab, it has which has a very large surface area, then you cannot have one alarm for the whole area, because you will not know where fire might originate.

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So, it is important for you to divide your whole area into sub zones for this, we have these zones, but now right now in this enclosure as you can see this glass cylinder are not I mean glass door. So, this is one area so, this area is not that big. So, because it is not that big, we are using only 2 zones of out of the 4 zones in this fire alarm system. So, let us see that again so, we have 2 zones so, you see if you see the on light is on only for 2 zones that is, because we are using only 2 zones of this fire alarm system.

Now what else is there? So, basically what happens is there will be sensor, fire sensor that will be mounted on the ceiling of your lab, we will see that shortly once I finish explaining this front panel, we will see where actually that fire sensors are. So, those sensors will be placed in each zone so, one sensor will be placed in each zone and that sensor will be able to detect smoke, fire etcetera.

So, once this that sensor is active and it is actively detecting fire, you can see that this zone will be on ok, now if in the power line that goes to the sensor, if the power line itself fails, that can also happen right. So, if the power line fails and if the power line has a short circuit, that line that goes from this front panel to the sensor. If it has a short circuit, this short light will glow and if it has an open circuit, this open light will glow, these 2 are equipment failure scenarios.

Now actually if fire is there let us say, if actually fire is there then, this fire light know, you see right fire, this fire will glow and along with that it will trigger the alarm, once the alarm is triggered, people have to wake it evacuate the lab. So, we have to set out clear evacuation procedures from the lab once, that is done there will be people identified within the lab to deal with the fire, not everyone need to deal with the fire, because that will create it is like too many cooks spoiling the broth only 2 3 people 1 or 2 people should be designated to deal with any emergency, while other people should be allowed to evacuate, that is how usual standard operating procedures are.

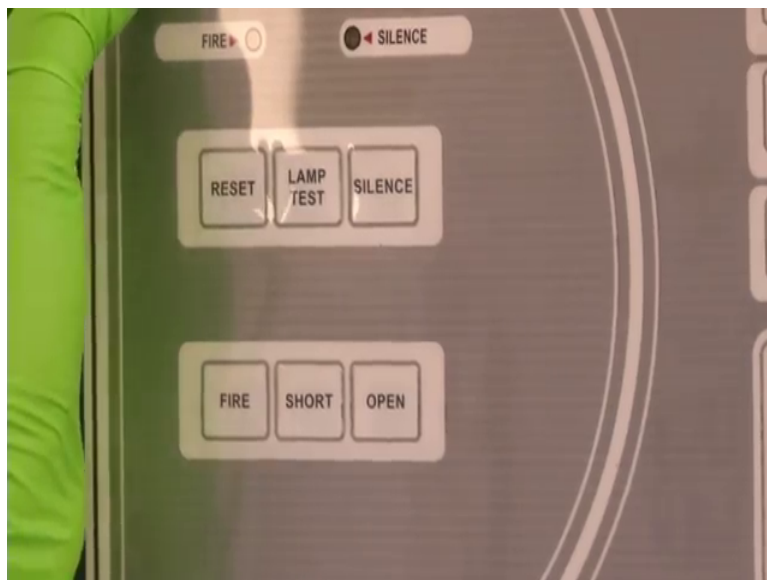
So, as soon as a fire alarm comes out, people will evacuate and the people of those people who are responsible for dousing the fire or dealing with the incident, they will come to this near the sensor and see what kind of situation has happened? Where has the fire originated? Immediately they will take measures to douse the fire. And if it is a false alarm, let us say the sensor has misbehaved or some heating has happened that is not harmful, but heating has happened near the sensor and because of which the fire alarm got triggered. So, we will resolve that issues and then once the issue is resolved, we will silence the alarm, because the alarm will continuously go, once when do you silence the alarm? We silence the alarm after the cause of the fire is found out and it is dealt with or resolved the once the issue is resolved, we have to silence the fire.

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This is how it works, this is how the basic fire alarm system works and you have another precautionary measure here, in this red glass. So, what it means is? In case of fire is there, you have to pull this and this is just like you see right there are smoke cylinders fire dousing cylinders kept in you might have seen this big red cylinders. So, it is similar to that you have to punch it, break it and set the alarm here. So, that parallelly that alarm also gets triggered so, that people can leave. So, this is the basic idea of the fire alarm system, there are other good features in the system like, you can reset everything to its ground state.

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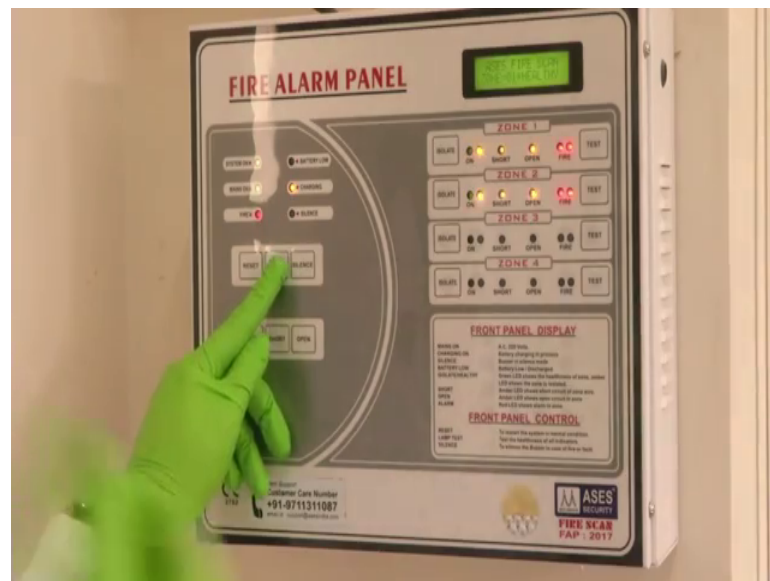
You can reset a like, if you see reset everything to the ground state. So, this led shows that the whole system is on the green shows that it is working then that power supply is coming to the fire alarm system. And if there is a fire this light will glow, if there is in a fire in any of the zones this light will glow and if you are trying to silence the fire, then this light will glow and this already has an inbuilt battery source.

In cases, there is a power supply shortage or there is no power in your department still fire happens you should have that precaution also right. So, for that if this has an inbuilt battery, which by default will be always charged through AC power supply. So, this is charging so, that is why charging light is on, in case power goes or you want to work from battery then, the battery light will come on.

So let us say, if I switch off, switch this off. So, I have switched it off, it takes some time for the capacitors and this light to go off so that means, that see the charging light is slowly going deep eventually, it will go off. See it has gone off now, because we are operating, but still other lights are on, what does that mean? So, now, the charging light is completely gone, I have switched off the AC power supply to the fire alarm, the charging light is gone, but then the system is still functioning properly.

Now, it is functioning from the battery. In case it continuously functions from the battery and the battery goes low, this battery lows light will glow. Now let us power it back on through AC, because by default if power supply is there, we should have your fire alarm system work from the power supply only, the battery is just an emergency mechanism for it to work, when there is no power. And then you can have lamp test here, what it does is? It will just check if all LEDs are working fine. Because, you are at the end of the day going to see hear the alarm or look at the LEDs and if the led itself does not work think about the situation, it is very bad right. So, occasionally you have to do this lamp test.

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So, all the important LEDs, when you press lamp test here, when you press lamp test, all the important LEDs will glow and you will know that, these LEDs are working fine. In case of an emergency, you will be able to see the LEDs and if you want to reset the whole system so, I have reset it, it will come back to it is it is ground state, because, once a fire alarm gets triggered, then it goes to a different state. So, you have to reset the system to deal with the next emergency that might come up after you are douse the current emergency. So, this is the overall fire alarm, control panel and there are test mechanisms, where you can test which or whether things are working fine or not?

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Now, let us quickly see the actual sensors that are mounted on the walls of this lab with that we can close this session on the fire alarm systems. Now, you are seeing a fire alarm sensor, that is you will see a pipe going into the sensor and it is next to the fans wing. So, there is a white color wing of the fan and next to that you are seeing the sensor.

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So, the power lines that white tube that is going into the sensor is the power line for the sensor and this cream color circular equipment, that is mounted on the ceiling of the wall of the on it is mounted on the ceiling is the fire sensor. So, as soon as some fire comes, see you are seeing the fan that is next to it. So, you are mounting it next to that so, that is another sensor. So, this is like I told you right, each lab you can divide it into multiple zones, each zone will have 1 or many sensors.

So, this is another sensor and you saw another sensor so, if a fire comes so, there is this black strip that is inside that fire will trigger. So, through the black strip the heat of the fire or the smoke will go inside to the actual sensors, this cream color box is just the enclosure for the sensors, then the sensors will detect the fire and it will send this sensed signals to back to the control panel that we had seen. If you look at it, this is also a sense of technology, see we in this course we are seeing micro fabrication, how to fabricate micro devices sensors and all? Interestingly, this fire alarm system will also have such similar sensors, which were fabricated using micro technology or even macro level also they might be fabricated.

So, see how the course you are studying and the sensors you are trying to understand are actually being used within the lab that tests, these sensors itself. So, it is this (Refer Time: 13:32) nature of this branch of study, that makes it very interesting, you can have umpteen multiple levels of usage of the sensors that you make in the medical field, in safety field, in appliances, consumer electronics, defense electronics, name any field there will always be an application for sensors.

Hope you have understood, today are the importance of a fire alarm system and general safety precautions in a lab and how important it is for you to be responsible researcher within the lab. And make sure that not only, you are well being, but also the well being of your fellow lab mates is taken care of while you do while you delve in deep into your research.

Thank you, see you next time.