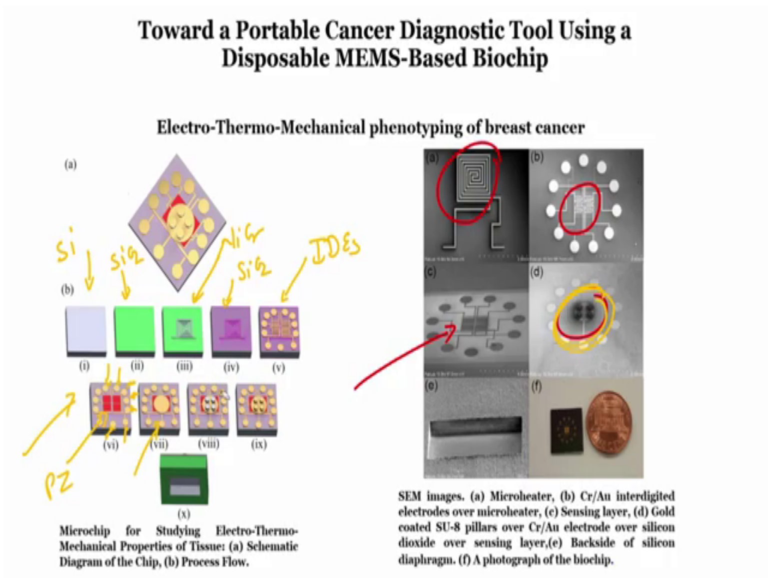
Electronic Systems for Cancer Diagnosis
Dr. Hardik J Pandya
Department of Electronic Systems Engineering
Indian Institute of science, Bangalore

Lecture – 14
Fabrication of Piezoresistive Sensor Contd..

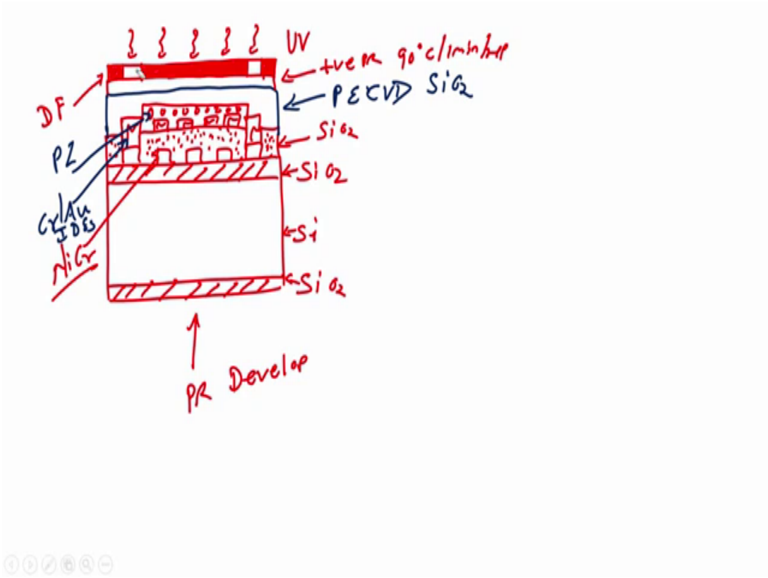
Hi, welcome to this module. In this model what we will see, we will see how can we deposit a gold pad over the Piezoresistive material.

(Refer Slide Time: 00:36)



So, if you see the slide, until the last module what we have seen how can we deposit piezoresistive material on interdigitated electrodes which are fabricated on a silicon dioxide a insulator below which there is a micro heater. So, let me teach you today how can we have this gold pad on the piezoresistive material.

(Refer Slide Time: 01:01)



But before that if you have a piezoresistive material; so, I will draw it here the wafer right with a piezoresistive material and the heater and then interdigitated electrodes. Now, you should also know quickly when you want to draw, it is the silicon dioxide. So, always good to repeat whenever we draw the process flow so, it becomes kind of a repetitive way of training your brain ok. If you understand the artificial intelligence and machine learning you will see that the iterations, number of time the system is trained the better the accuracy.

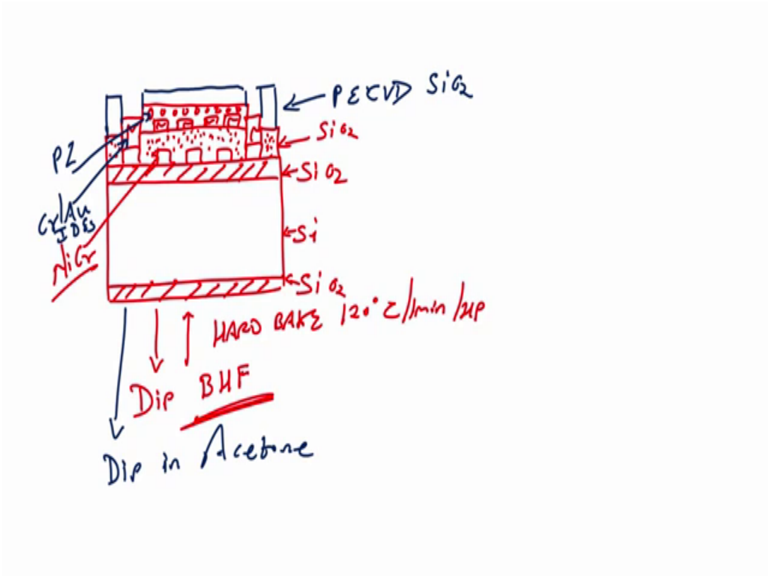
And then when you go for testing you will understand that your system shows a way better accuracy, if you have the samples which you contain it for long time. So, my point is whenever I am drawing a schematic I always try to speak, but you should also try to understand and speak along with these slides. It becomes easier and you are training your brain faster. So, this is a nichrome is a heated silicon dioxide with what which technique PECVD silicon dioxide which technique thermal oxidation. Silicon wafer is there and then this is nichrome using PVD.

And, then we have pattern using photolithography over that you have interdigitated electrodes right like this which is made up of chrome gold right, made up of chrome gold. There are design here like this and then over this what you have you have piezoresistive material piezoresistive. Now, next step is we have to deposit a gold pad on this piezoresistive material, but if I deposit gold pad directly on the piezoresistive material it will be shorted. So, what will I do? I will first deposit or grow silicon dioxide on this piezoresistive material . So in fact, let me change the color so, that it becomes little bit easier. I will have a silicon dioxide layer on the piezoresistive material. This silicon dioxide is deposited using PECVD right because, I want to have an insulating layer have an insulating layer between the goal pad and the piezoresistive material.

What is this material? Piezo resistive material. What is this? Chrome gold, chrome gold is pattern at which design? What is the design of the chrome cold? Interdigitated electrodes easy now PECVD so, PECVD so; that means, we have silicon dioxide. Now, what we have to do? We have to open the silicon dioxide or we have to open the contact which is this region and this region and we have to protect the remaining region right for that what can I do, I had to do a lithography. So, I will go for a lithography technique in which we will spin coat positive photoresist.

And, after spin coating positive photoresist we will go for soft bake 90 degree 1 minute hot plate right. On that we will load the mask now what I want to do, I want to open only this region and remaining region I want to protect my silicon dioxide. So, if I want to open this region and even in region if I want to protect it, then I have to go for a dark field mask; I have to go for a dark field mask. This is my dark field mask, after that field mask I will expose the wafer with UV light, I will expose the wafer with UV light ok. After this what will happen, that when I dip this wafer in a photoresist developer if I dip this wafer in a photoresist developer.

(Refer Slide Time: 05:59)

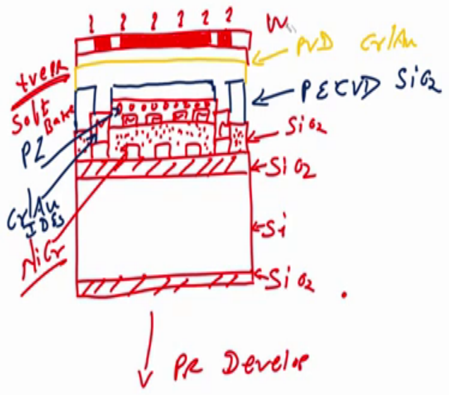


The photoresist so, I just show it right down here. The photoresist will be there in all the region except the contact area because, the unexposed region in case of the positive photoresist will be stronger right. So, I will have photoresist in this area. Now what is my goal? My goal is to remove silicon dioxide from the contact of the interdigitated electrodes and a heater electrodes or heater context right. So, in the next step after this would be to do the hard bake. Let us see if even if I means it is assumed that whenever you use photoresist you have to do soft bake, you have to do hard bake ok.

However, I will try not to miss so, do not worry. So, after this we will perform hard baking and after hard baking our next step would be to dip the wafer in buffered hydrofluoric acid; buffered hydrofluoric acid. If I dip the wafer in buffered hydrofluoric acid, then what will happen, I will have silicon dioxide protected only in the region which is protected by photoresist. I will have silicon dioxide left only in the region which was protected by my positive photoresist ok. Next step is we have to strip off the photoresist. So, what will I do? I will then dip the wafer in acetone.

So, once I dip the wafer in acetone what will happen, my positive photoresist will strip off; my positive photoresist is strip off. Now, over this I want gold pad over this I want to a pattern a gold pad. So, what will I do? I will just remove this things. So, I hope that until here is easy for you that we have deposited a silicon dioxide using PECVD.

(Refer Slide Time: 08:36)

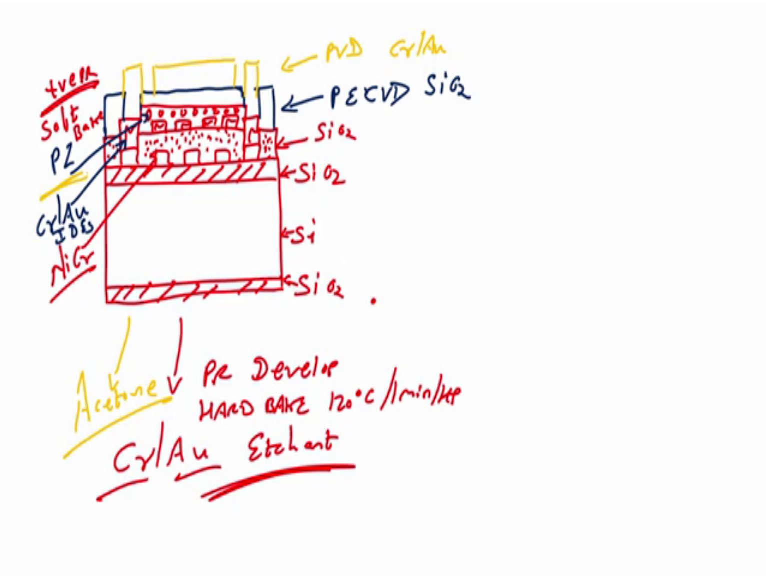


And then we have pattern it such that we can get silicon dioxide on all the region except the contact region. The next step is to deposit gold pad only in this region right and contacts in this region; contacts in this region because it will improve the thickness of the contact layer. And if the thickness of the contact layer increases or it the thickness is more the better. If you understand what are the ohmic contact and rectifying contact you even understand why the thickness of the metal is important or is related to the contact.

Now, over this because you want a gold pad we will deposit gold using PVD: Physical Vapor Deposition. When I say gold it is assumed that there is a thin layer of chrome below gold right. After this the next step would be that I will deposit photoresist which is my positive photoresist. And, then over the photoresist after positive photoresist spin coat I will not deposit, I will spin coat photoresist and after spin coating photoresist I will go for soft lithography. Is it correct word? No, it is not correct word, it is not soft lithography. It is soft bake right, after spin coating my positive photoresist I will go for soft bake. And, when I go for soft bake I will then follow with loading the mask.

And my mask is such that it will protect because, it is a positive photoresist I want to have a bright field mask which will protect the region in the way I am showing you right now. So, the region which is dark here right because, there is a positive photoresist this region will not expose the wafer with UV. So, if I use UV here for exposing the wafer you can see that the dark area will not be exposed and the gold below the dark area will be protected. So, if I use UV light to expose the wafer and then I perform a photoresist developer.

(Refer Slide Time: 11:22)



Then what will I have? I will have my photoresist only in this area, this area and this, this is my positive photoresist right. After that I had to go for hard bake; hard bake is done at 120 1 minute hot plate. After that next step is you have to dip the wafer in chrome etchant followed by gold etchant, chrome etchant followed by gold etchant. When you do that what will have, when you dip the wafer in a chrome etchant followed by gold etchant what you will have is this pattern right and then the next step is to strip off the photoresist. So, I will dip the wafer in acetone, when I dip the wafer in acetone my positive photoresist will be stripped off; will be stripped off.

Thus, I have a gold pad on interdigitated electrode which has a piezoresistive material; you got it easy it is very easy right. So, when I have this then I will get my this design without SU-8 pillars. These 4 dots that you can see are SU-8 pillars over gold pad right. So, if I follow this schematic what we have seen, we are taken a silicon wafer. This is oxidized silicon substrate, this is a nichrome, we have an insulator. We open the contact of the insulator and fabricate interdigital electrodes, over that we have piezoresistive material. Then we have insulator, we open the contact like this context, this one right 8 of those this one, this one and then we deposit a gold and pattern it.

So, we are on step number 7 right now. The next time in the next module what I will teach, I will teach how can you fabricate the SU-8 pillars which are right over here and followed by how can you make those pillars conductive. When you do that you had to go for one more process; one more process where you have to create a diaphragm. And, that will be the end of how to design a biochip MEMS space biochip which will consist of and a micro heater, interdigital electrodes, piezoresistive material, electrical sensors right and a diaphragm.

And then we will see why we have taken so much pain to understand this particular design. And, how can we use this design to understand the change in the tissue property as cancer progresses right. And, then you go through this lecture and I will see you in the next module.

Bye.