Lecture 16
Understanding the process of photolithography

Welcome, this very important module, for this particular session of lectures. The reason is because, we today understand a very important, aspect and that is Photolithography. So, what is the purpose of photolithography? And why we want to perform for the radiography? Or why we want to understand photography? So, let us take few examples, let us take few examples. So, that you understand, how we can use photolithography, for fabricating, different devices or different structures, on the devices. Now you, I am holding one wafer in my hand. Right? And it has few patterns, it has few patterns there is another refer in my hand again it has few patterns. Right? There are two wafers in my hand with few patterns as you can see. Right? Now how can you design this pattern? How can you design these patterns? The answer is photo lithography. Okay? So, we are learning how to perform photography? I will show you few, few more device. Just to make sure that, we clearly understand, what we are learning today? You see, there is a heater on this if; you can zoom in little bit, yeah. So, you can clearly see or hopefully, you can clearly see, there is a heater. Right? heater, which is, right over here, in this area. Alright? And these are two contact pads of the heater to contact pads of the heater, heater is right here, to contact pads of the heater. How can you fabricate this heater? That's the question. All right? How can you fabricate this heater? And we will learn this thing today. All right? And then you will see them, in subsequent classes, when we talk about micro ranging devices for, clinical perspective. Right? How can you fabricate those devices using photolithography? So, let us see on the screen.

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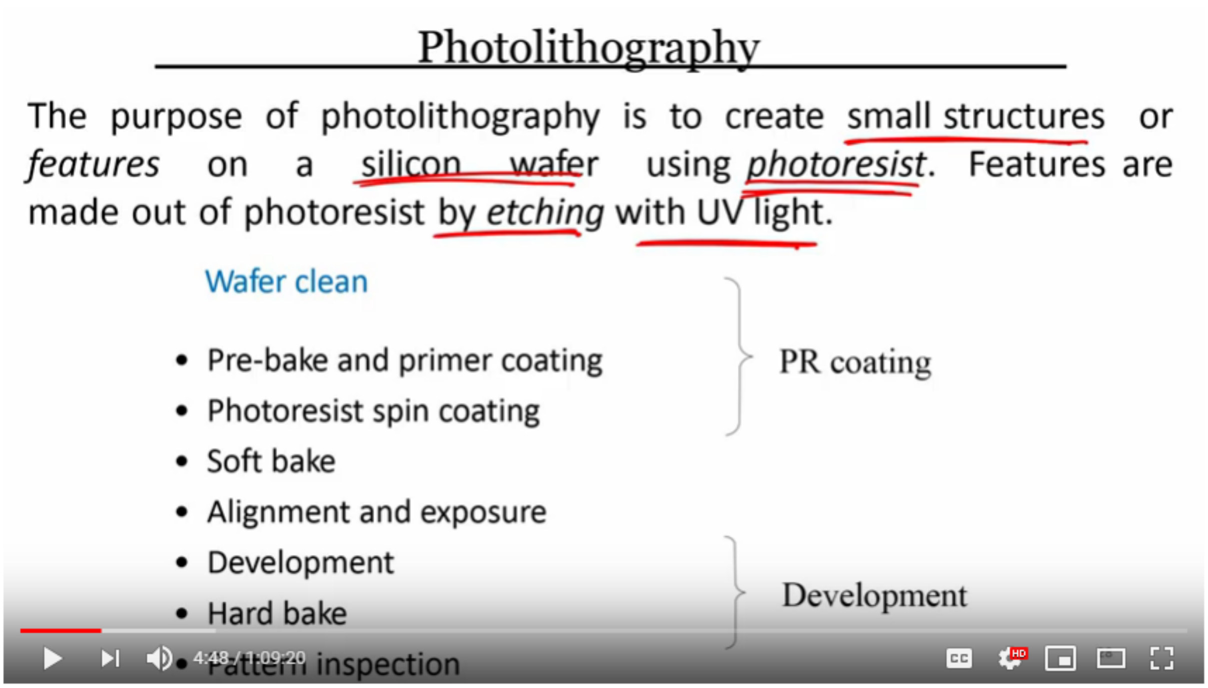

Photolithography, photolithography comes from of word, photo and then, lithos. So, Lithos and graphic, is a Greek word, used, which means carving from a, single stone, carving from a, single stone. The purpose of photolithography is to create and of course, photo means, nothing but, photons, light. Right? Light to carve a single stone, here in our case, is a single crystal, which is silicon. So, anyway, the purpose of photolithography is to create small structures or features, on a silicon wafer, using Photo resist Photo resist. We will see, what is a Photo resist? Okay? And features are made out of Photo resist, by etching with, UV light. Okay? So, what we understand? We can create, small features, one; we can use silicon wafer, but it's not just limited to silicon wafer, we can also use glass, as we have just seen, we can also use, an insulator, like alumina, there is a polymer involved and that polymer is called,' Photo resist'. This polymer is photosensitive polymer. And we will be using this polymer to create several features, by etching the polymer, with the help of UV light.

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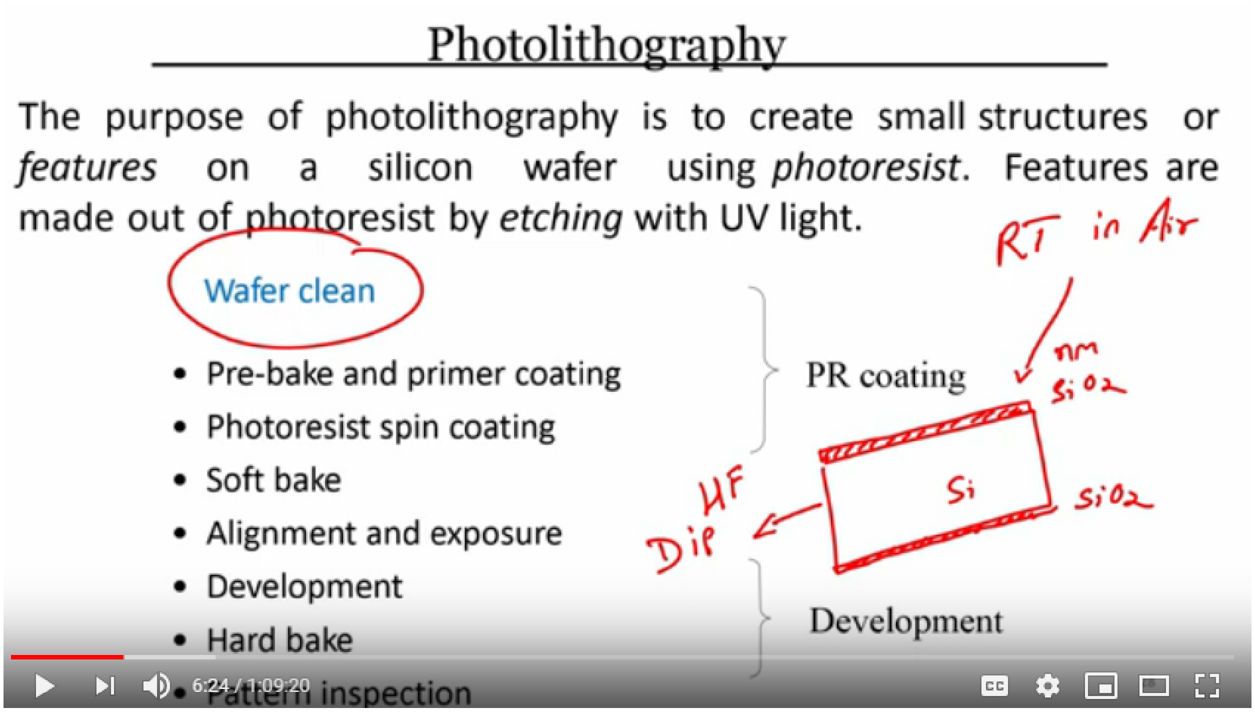

So, now when you talk about photolithography, there are several steps involved and the first among several step is, wafer cleaning. You cannot or you should not start any process, in micro-engineering without cleaning the wafer. Now cleaning the wafer does not just mean to clean by, clean with the DI water or to dry with nitrogen or to just pre bake it, cleaning of wafer means like we have discussed in other earlier classes. Right? We have a wafer; we have a thin layer of, oxide. Even we don't do anything in air, at room temperature, in, in air; there will be thin layer of, oxide, few nanometers. Right? few nanometers of oxide, grown on silicon wafer. So, first thing that you have to do, is dip this wafer, in HF, HF dip, this is very important. When you perform HF dip, what you will see is, the silicon dioxide, the silicon dioxide can be etched, from silicon wafer. After silicon dioxide is etched, then you have to perform, the rest of the step,

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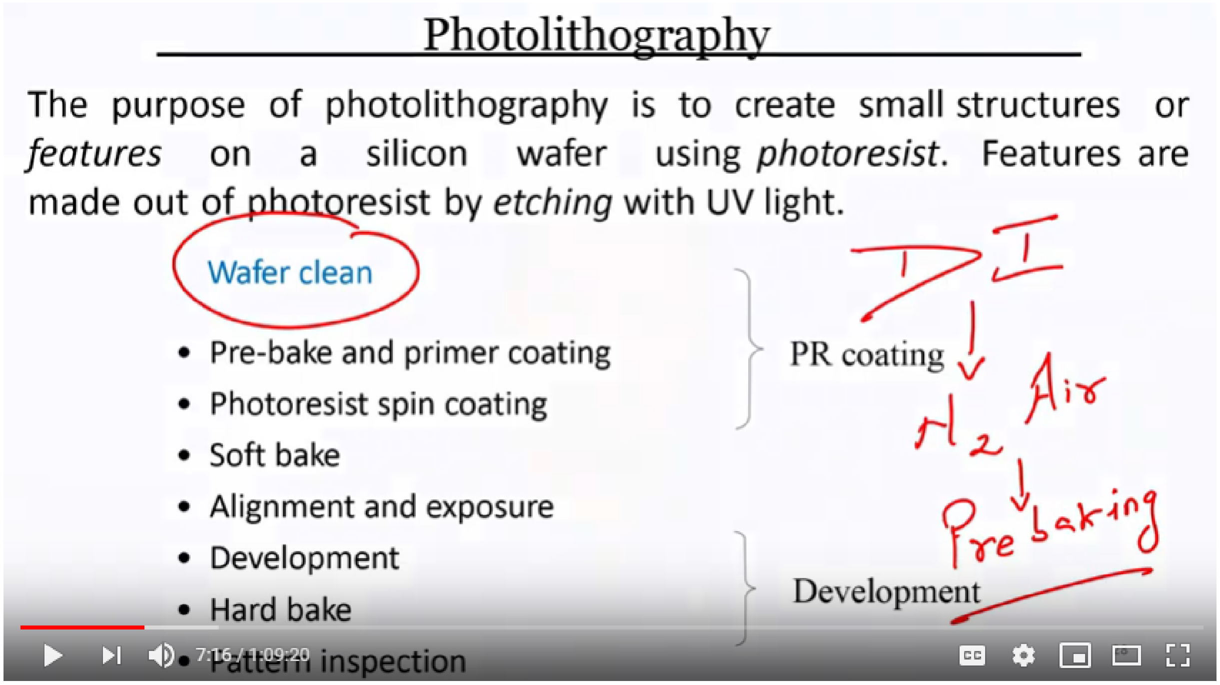

which is, cleaning with DI water, de-ionized water, followed by drying with, N2, hydrogen air. Right? Followed by, followed by, pre-baking, pre-baking. Alright? to remove any moisture, on this surface. So, what are the process? First you have to perform, HF dip, then you have to, clean the wafer or rinse the wafer, with the help of DI. After rinsing the wafer, with Di, you have to dry the wafer, with help of nitrogen, after drying the wafer with nitrogen; you have to pre bake the wafer, to remove any moisture. After, this, your wafer is ready for photolithography. So, to perform photolithography, the first step would be if you see the screen, first step would be; Pre-bake, we performed

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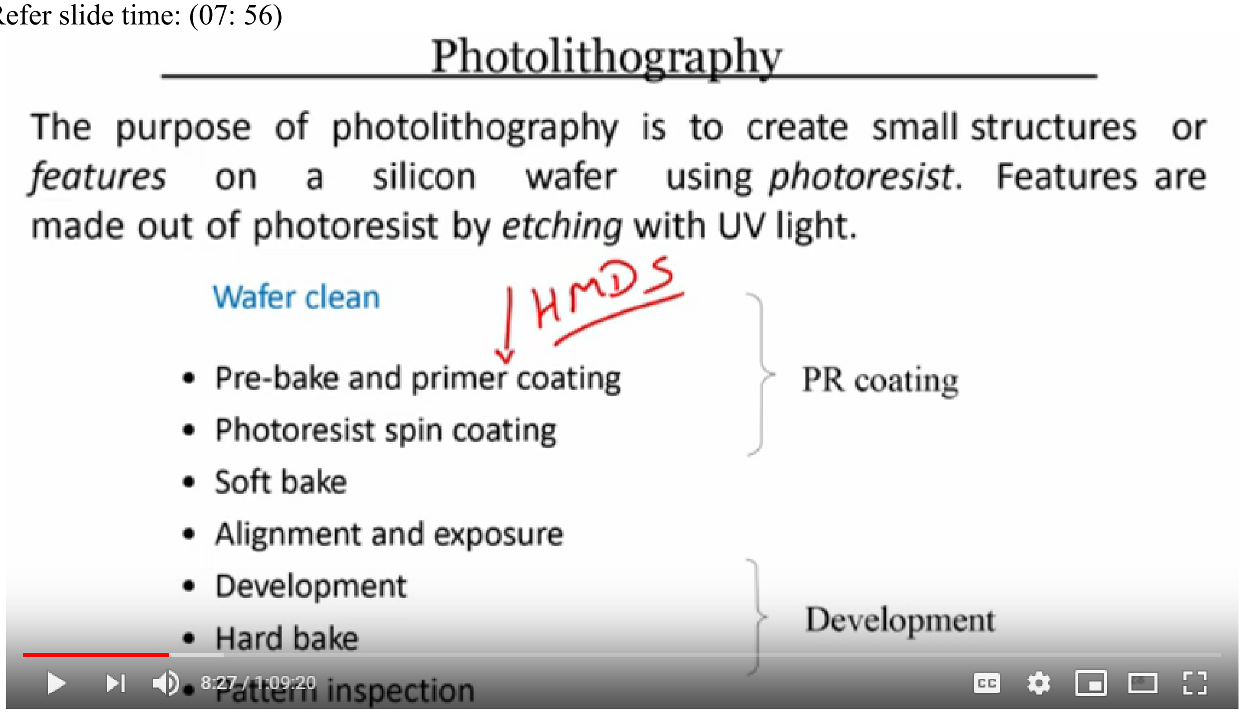

Pre-baking already, and Primer coating, HMDS is one of the primer, that we can quote. And this will improve the addition of, Photo resist, on the surface of the, substrate. After coating HMDS or primer, the next step is, Photo resist, spin coating. We have to spin coat Photo resist and the thickness of Photo resist

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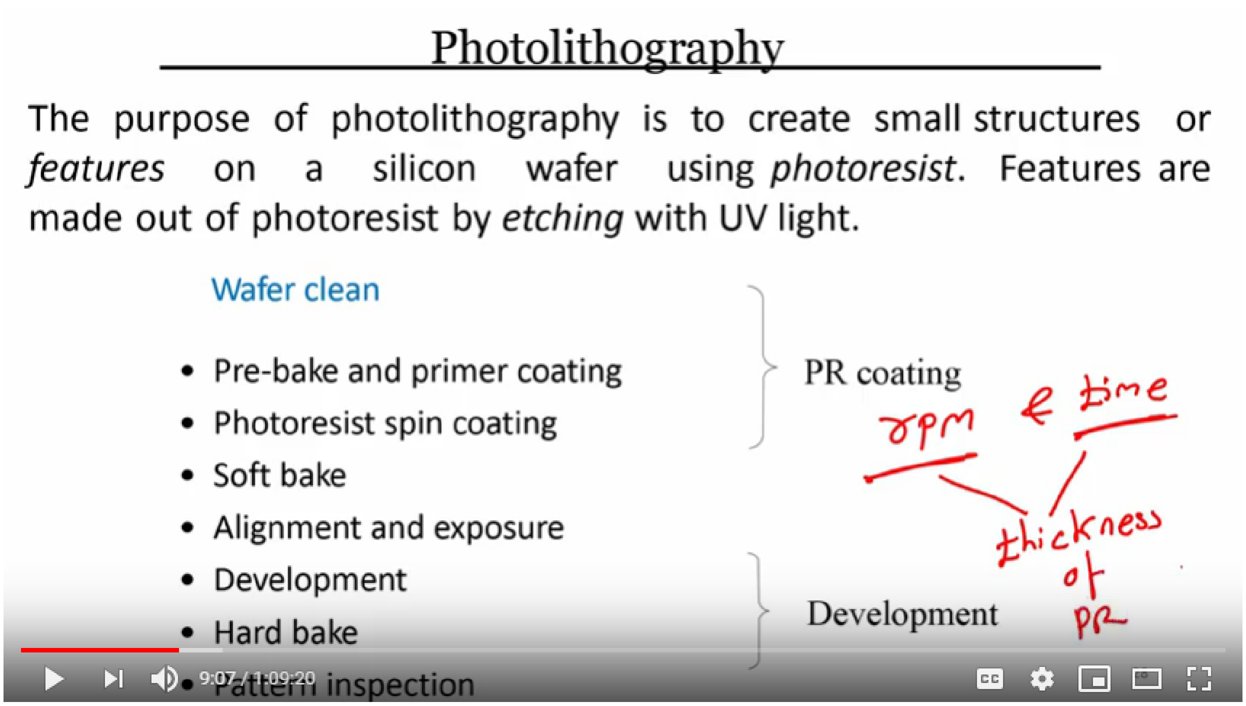

depends on the RPM and depends on the time. Right? How many rotations per minute, we are programmed? For how much time, we are spin coating, the Photo resist? Based on or depending on, rpm and time, we can know or we can determine thickness, of the Photo resist. So, once we perform spin coating, with Photo resist,

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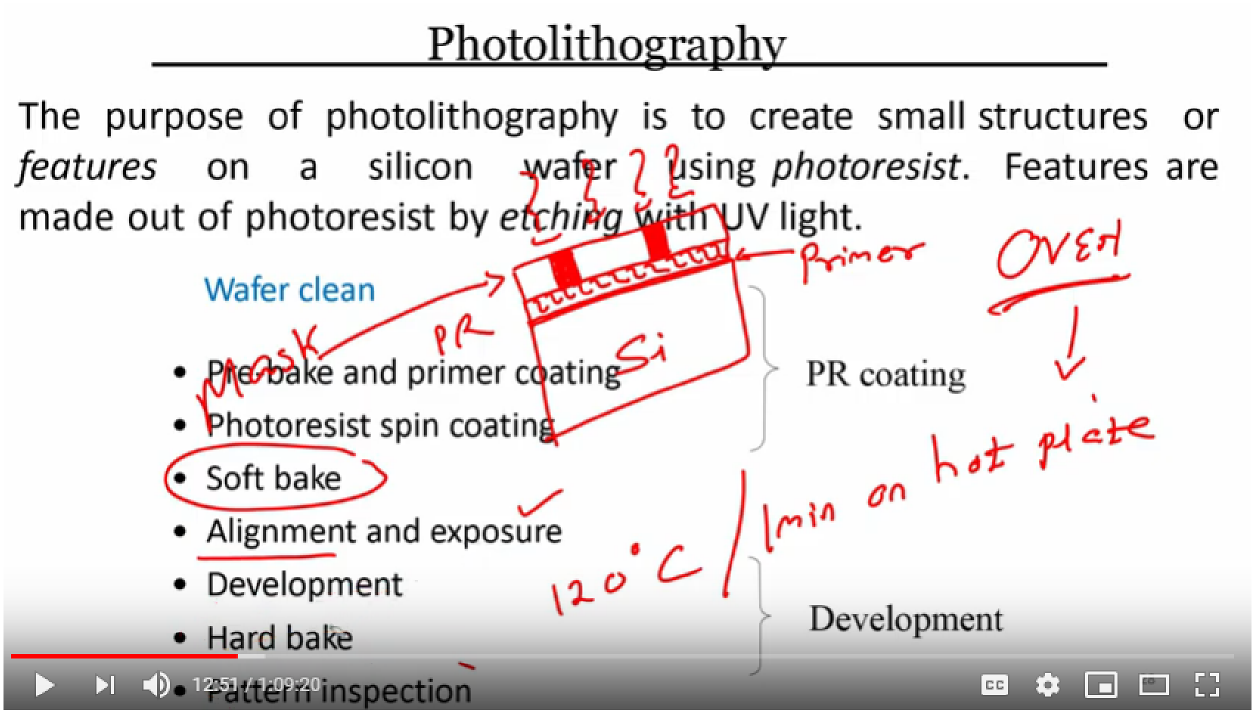

we go for soft bake. Now in a conventional situation, soft bake is done at, 90 degree centigrade, for 1 minute, on hot plate. This time would vary, if I use oven. After soft baking, I had to perform, alignment and exposure. So, I have a wafer, I clean the wafer and then on this wafer, I quote a primer, on the primer. Right? I of course pre-baked it and then coat the primer. On that I will spin coat, my Photo resist, spin coat my Photo resist, this is my silicon, this is my primer. After Photo resist, I have to get a mask, let's say, this is a mask, will talk about the mask and Photo resist, how it will work, depending on its type, mask has masks are also classified, depending on its pattern, that is, we'll discuss it later. So, this is your mask, you do align the mask and then perform UV exposure. Right? After UV exposure, you have to unload the mask and dip the wafer and dip the wafer, in a beaker, in a beaker, which contains Photo-resist developer, Photo-resist developer. After developing Photo-resist, you have to take out the wafer and perform hard baking, hard baking in a conventional way, Convention Photo-resist, that is positive, negative Photo-resist, is performed at 120 degree centigrade, one minute, on hot plate. Let’s write it down; on hot plate. After performing hard bake, you can inspect the pattern, after performing hard bake; next step is, inspecting the pattern. So, we will take an example, we'll take an example, to see, what we have discussed, right now. Okay? So, that we understand clearly how Photo-resist or how photolithography can be used.
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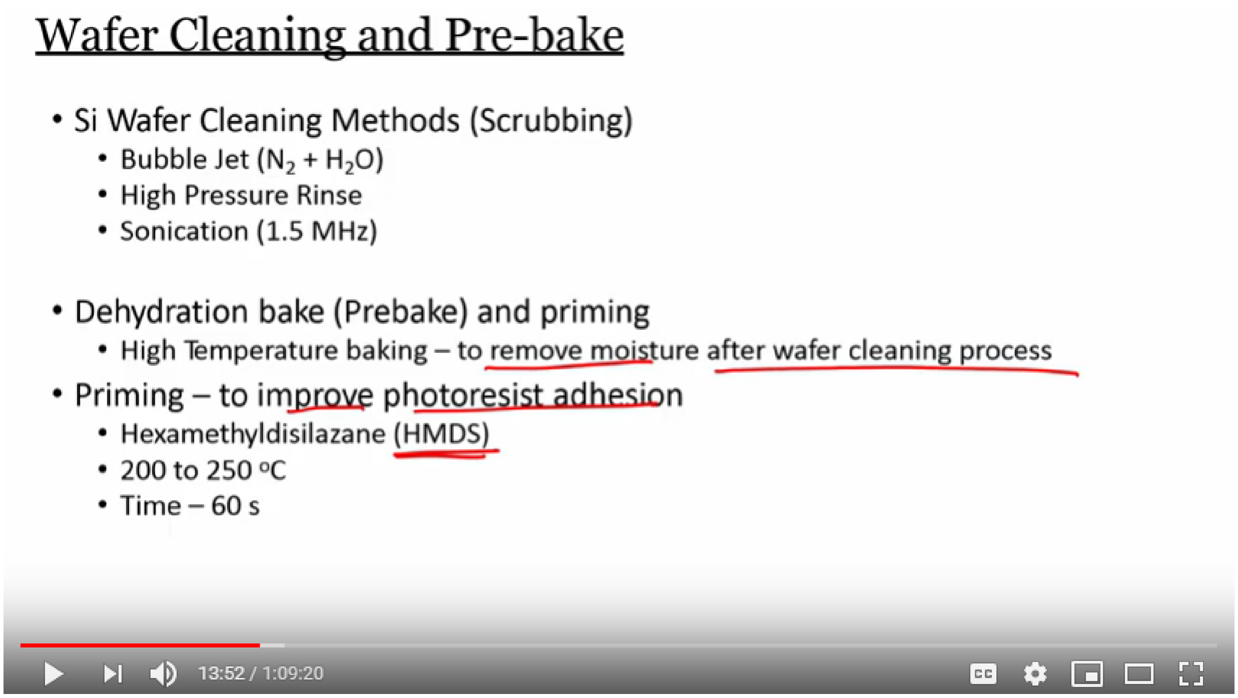

So, like I said, before cleaning and pre-baked, can be done, by bubble jet, high pressure rinse, by Sonication dehydration or pre-baking can be done, at high temperature making to remove moisture. Right? to remove moisture, after wafer cleaning process. Priming or primer is used to improve, Photo-resist aeration, HMDs is used, HMDs is your hexa methyl, dye psilocin and that is used to, improve the addition, of a Photo-resist onto the substrate.

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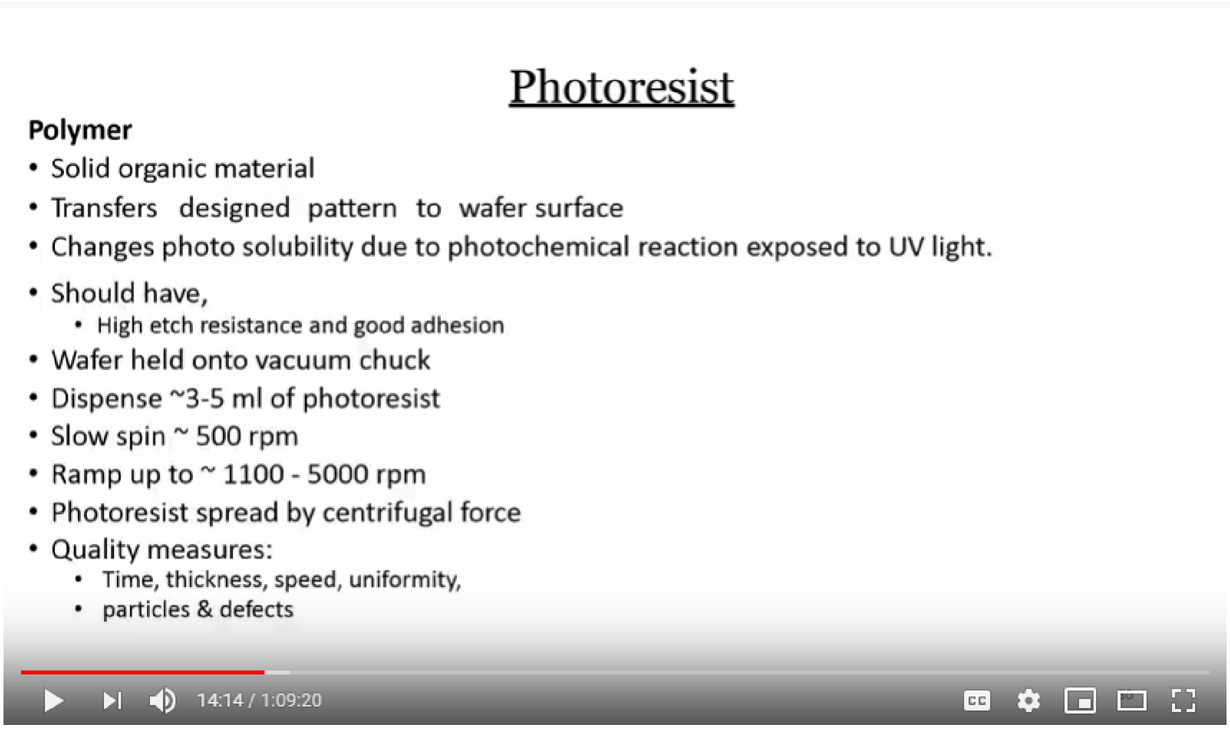

So, what is Photo-resist? Photo-resist is solid, organic material. It is used for transferring the design pattern to this wafer surface, changes photo solubility due to photochemical reaction, exposed to, UV light. Okay?

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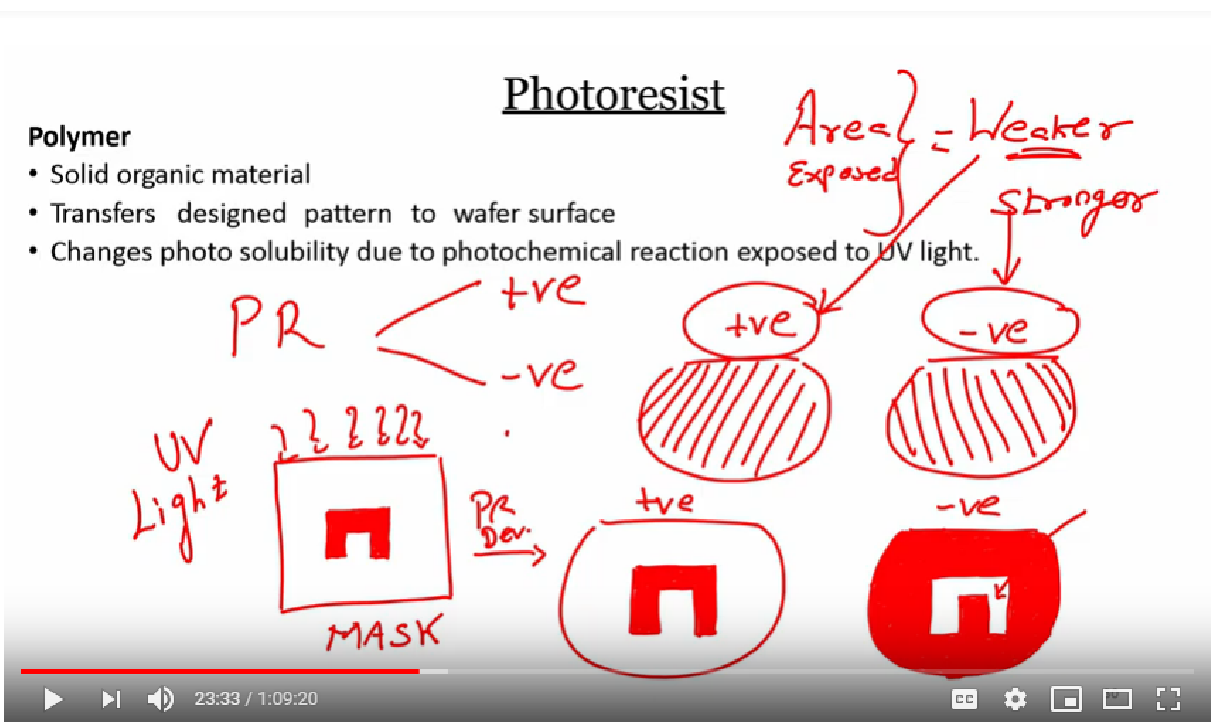

So, let us first understand the role of Photo-resist. Okay? So, if I say, I have Photo-resist, Photo-resist are two types, one is positive Photo-resist, second is negative Photo-resist. Okay? Now let us take an example, of this particular pattern this pattern. Okay? Now there are two wafers or let us draw the top view of the rather than cross-sectional view, there are two wafers, one wafer is coated with positive Photo-resist, second wafer is coated with negative Photo-resist, this is your mask, this is your mask. So, if I use this mask on the Photo-resist. So, I will I have to so, what does that mean? If I keep this mask, on this wafer like this and the wafer is coated with positive Photo-resist, what will happen, that when I expose this, when I expose this, I will have, when I, when I expose it to UV light and I develop, the wafer. Right? In which I use this kind of mask, then I will have, my Photo-resist, protected in this area. Okay? So, what do you understand here? What we understand is that the area, which is exposed, becomes weaker. And the area which is not exposed becomes stronger. Right? Why because, the mask was this. Right. And we had positive photo resist coated on the wafer and this wafer if I place under this mask and if I expose it and I develop it, then I obtain this pattern, for positive Photo-resist. In case of negative Photo-resist in case of that sensor of positive Photo-resist, we have used wafer which was coated with negative Photo-resist, negative Photo-resist, then when I expose, with UV light, when I exposed with UV light, what I obtained? I obtained pattern, which I am drawing. Right? Now I will obtain a pattern, which looks like this, take one more minute, because, it is very important I do not want to rush it through, yeah you see. So, that is if I use negative Photo-resist, sorry and I used this mask, then I obtain this kind of pattern and this pattern means that, the area which was exposed, gets stronger and the area which was not exposed, gets weaker. So, in case of positive Photo-resist and negative Photo-resist we had to remember in positive Photo-resist they exposed, let's see here, let us write down exposed, can you see no exposed let's say area exposed becomes, weaker in case of negative Photo-resist it, becomes stronger, which one area exposed. Okay? In case of positive Photo-resist it, becomes weaker in case of negative Photo-resist it becomes stronger you can see here. Right? This is the area 3 just move remove the mask, remove the wafer sorry then you can see this is the area which is not exposed, the area here which is not exposed, remaining area is exposed so in case of positive Photo-resist what I obtained is the area which was not exposed yet stronger, area which was exposed gets weaker here, correct in case of negative Photo-resist the area which was exposed, this area, this one this area is exposed right? is transparent is exposed exposure what UV light area which was exposed became stronger an area which was not exposed this is the area which is not exposed, correct becomes, area which is not expose becomes, weaker in case of negative Photo-resist, you can see here it becomes weaker. So, Photo-resist is developed, Photo-resist is developed in this area. So, it's very important to understand Photo-resist, because we will be using positive and negative Photo-resist extensively, when we understand photolithography. So, let me show you a few more points.

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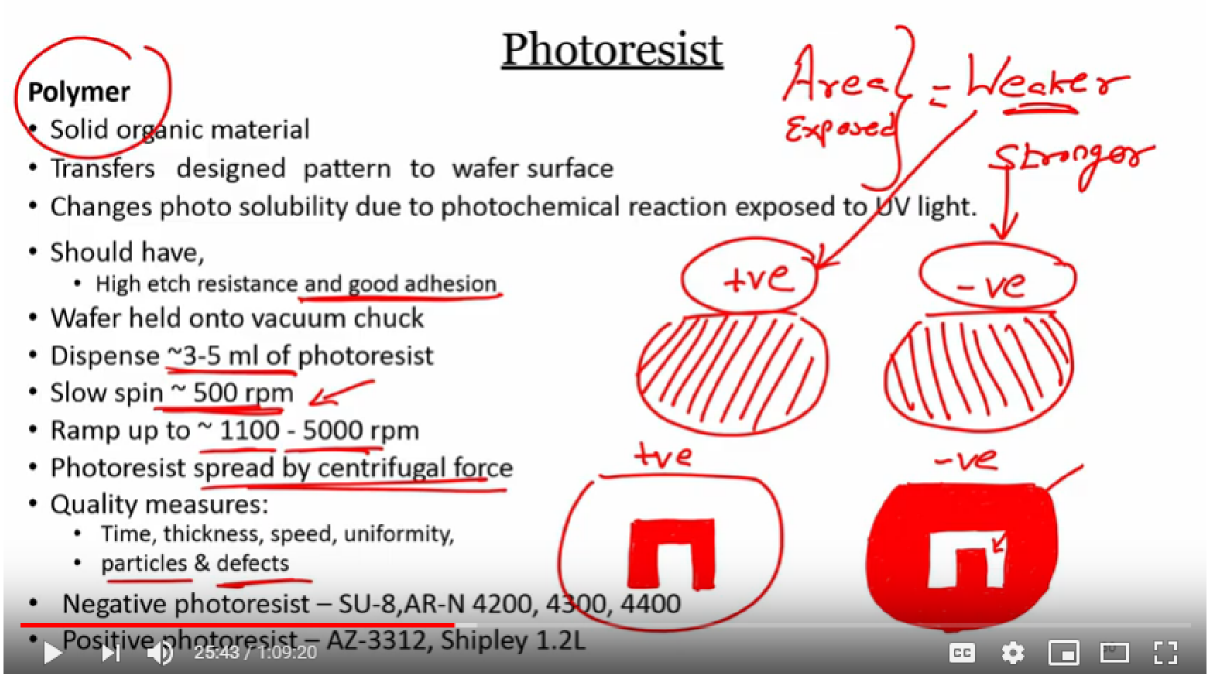

Now what should the Photo-resist consist of what this is a polymer should have? polymer, should have high edge resistance and good addition that is a requirement. Right? And how this performs this how the polymer is coated onto the wafer? these are the steps, first this spends 3 to 5 ml of Photo-resist, second slow spin at 500 rpm, followed by high ramp up to 1100 to 5000 rpm, depending on the thickness that you want Photo-resist is spread through, centrifugal force and the quality measures, for this Photo-resist can be time, thickness, speed, uniformity, also we can see particle, the particle and defects if any on the Photo-resistor, when we coat the Photo-resist we have to take care of this many parameters. Now if you if you see here, there is a requirement of slow spin, this slow spin is to uniformly distributed Photo-resist onto the wafer. And then we ramp it up to 11 hundred to 5000 degree, a 5000 rpm so, that we can obtain the thickness of our desire. Now there are two types of Photo-resist like we have discussed here, positive and negative type, negative Photo-resist can be SU- 8 and it, can be N forty two hundred, forty three hundred, forty four thousand four hundred, positive Photo-resist can be AZ three, three one two it can be from Shipley 1.2 liters per city one point.

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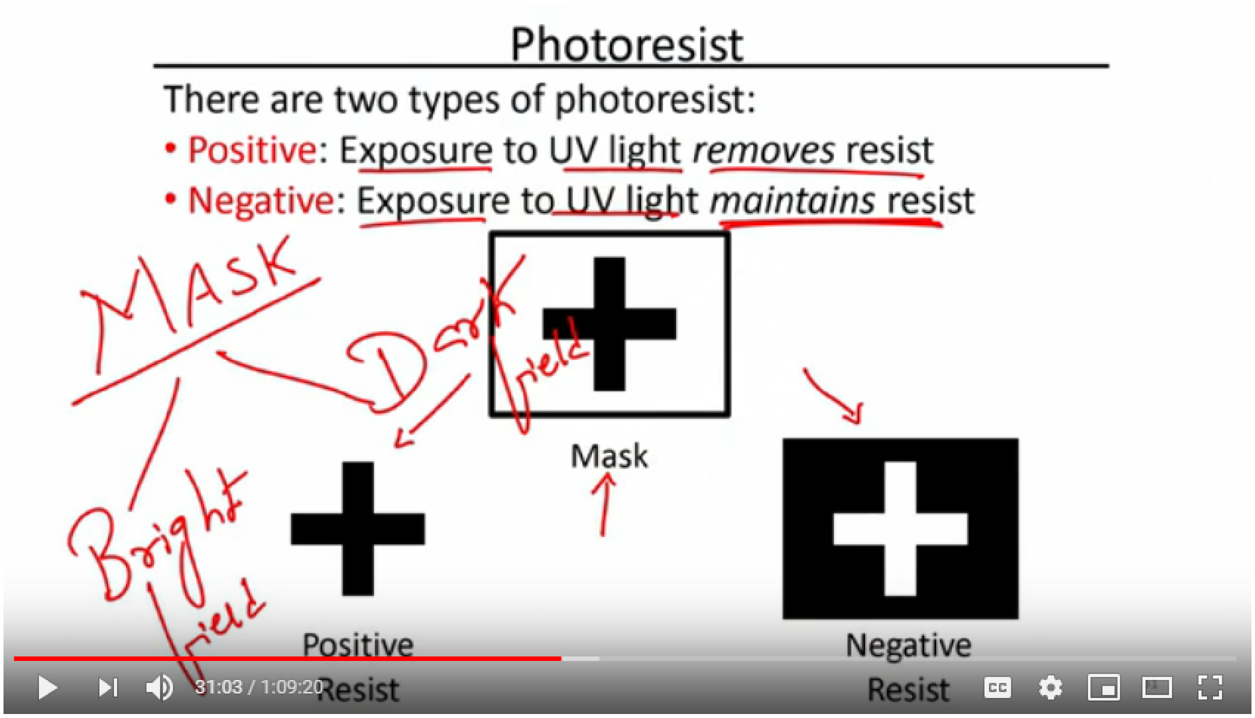

So, like I said when you talk about Photo-resist, Photo-resist are two types, one is positive Photo-resist, that is exposure to UV light removes this resists, exposure to UV light removes the resist or exposed region becomes weaker, correct negative or resist exposure to UV light maintains resist or the exposed region becomes stronger. So, this is a case, that if you have a mask, then if I use positive Photo-resist, I will obtain this pattern, if I use negative Photo-resist, I'll obtain this particular fashion, if I use the mask which is shown in schematic here. So, since we were talking about masks, let us see how the mask looks like how the mask in reality looks like. Okay? So, when we talk about masks, masks can bright field masks, it can be dark field masks, bright field, dark field, two days of masks. Okay? Bright field dark will mask. So, let us see how bright field mask looks like and then let us see how dark film us looks like. So, I will how it to you mask holder, mask is in my hand. So, you don't have to worry about zooming in this time, you just see that I am holding a glass plate I'm holding a glass plate. Right? This is a five inch mask why we are using five inch because, we were interested in using a four inch wafer like this correct, we were interested in using four inch wafer, four inch wafer five inch mask. So, whenever you are using wafer depending on the diameter of the wafer you have to change the size of the mask. Now what you see in masks? Can you see my finger, can you see my face, you can. Right? But there is some pattern, through which you cannot see, through which you cannot see. So, most of the area in this mask is empty is transparent so this mask is nothing, but bright field mask, field is bright, you see this field is bright, bright field mask and there is some pattern on the mask, there is some pattern on the mask, with some alignment mark right over here which you cannot see, from there it is impossible. But the point is there is a glass it can be chrome mask, it can be a chrome mask. Now, let us see one more mask. So, we can clearly distinguish what I mean by bright field and dark field mask. This is another mask here. Right? What you can see? you can see there are two patterns, on the bottom which are transparent remaining field is dark, remaining field is dark. Right? But here on the two bottoms you can see some patterns are there so, this is your dark field mask this is your, dark field mask it can be used as a mirror just kidding. So, we have bright field mask and we have a dark film mask you know guys in, in Fab Lab you are wearing a gown and everything, you can see your face in this, I'm just kidding, don't do that, so, this is your bright field mask, this is your dark field mask, very easy to identify no it's very easy. Okay? So, both are for both are 5-inch masks. So, coming back to the screen for the Photo-resist positive-negative mask bright field, dark field

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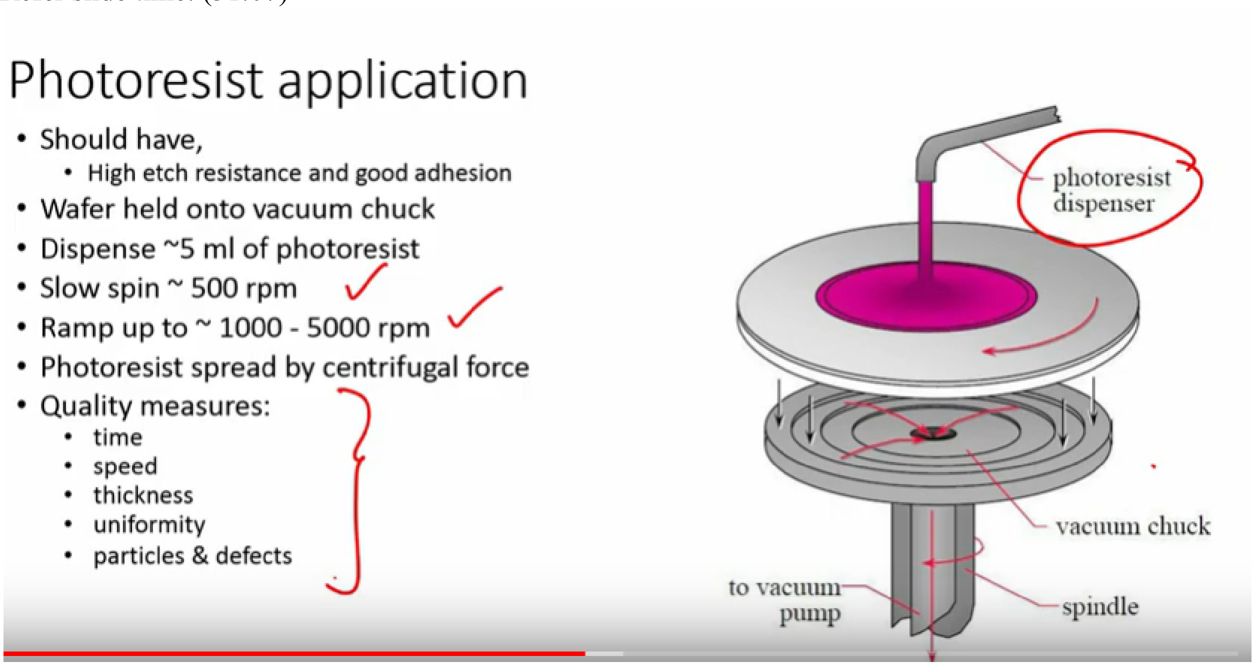

So, how can we spin coat Photo-resist, onto a silicon wafer? Right? So, we need a vacuum Chuck, which you can see here there is a vacuum Chuck right there is a vacuum pump this, this goes to the vacuum pump - vacuum pump there is a spindle, the spindle, which spins. Right? And we said in the starting there's a vacuum Chuck here. Now here the vacuum will be created, here in this area center, this is the wafer, wafer you can also say substrate, substrate. Right? And subset is folded onto this, vacuum Chuck with the help of vacuum and once it is attached or holded through vacuum then, we start dispensing Photo-resist so, there is a Photo-resist dispenser. So, once the Photo-resist is dispensed, then we had to follow, slow spin, ramping up and once it is spin coated and it stops we can see time, speed, the quality measures, can be time, speed, thickness, uniformity and particle size.

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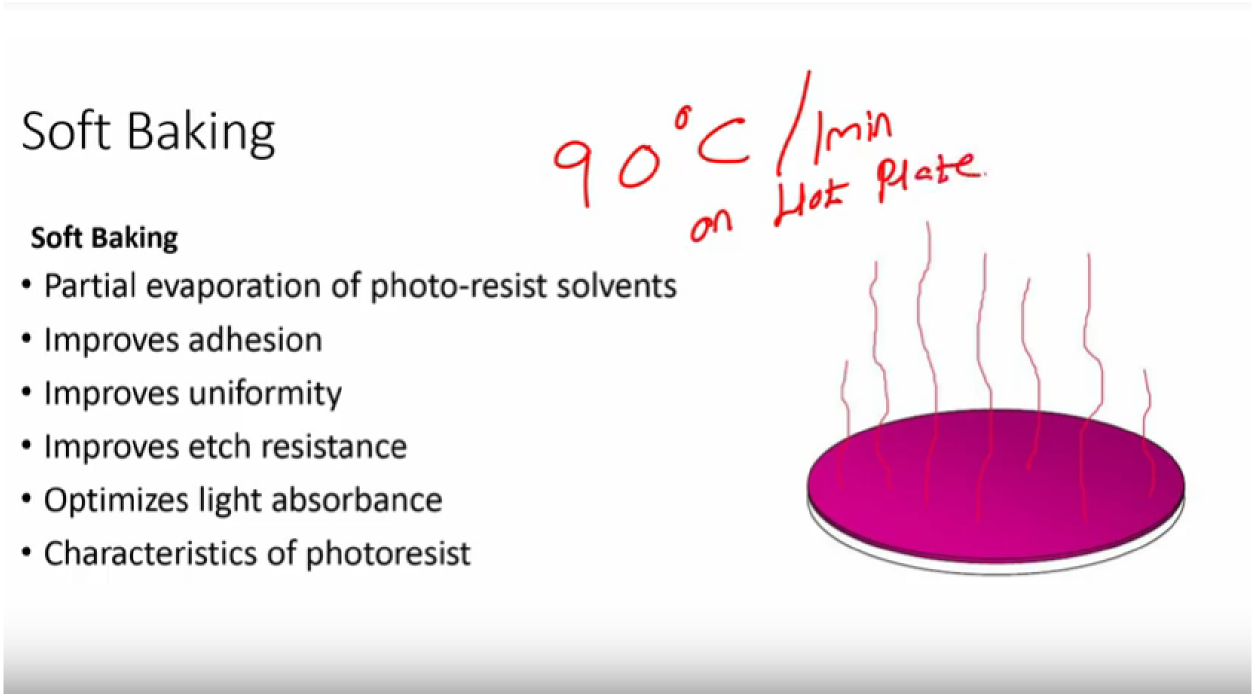

So, if you remember, the steps in Photo-resist is, first easier after spin coating there is a soft baked, soft baked like I said, 90 degree, 1 minute depending on type of Photo-resist, one minute on what? on hot plate. So, soft baking when we perform,

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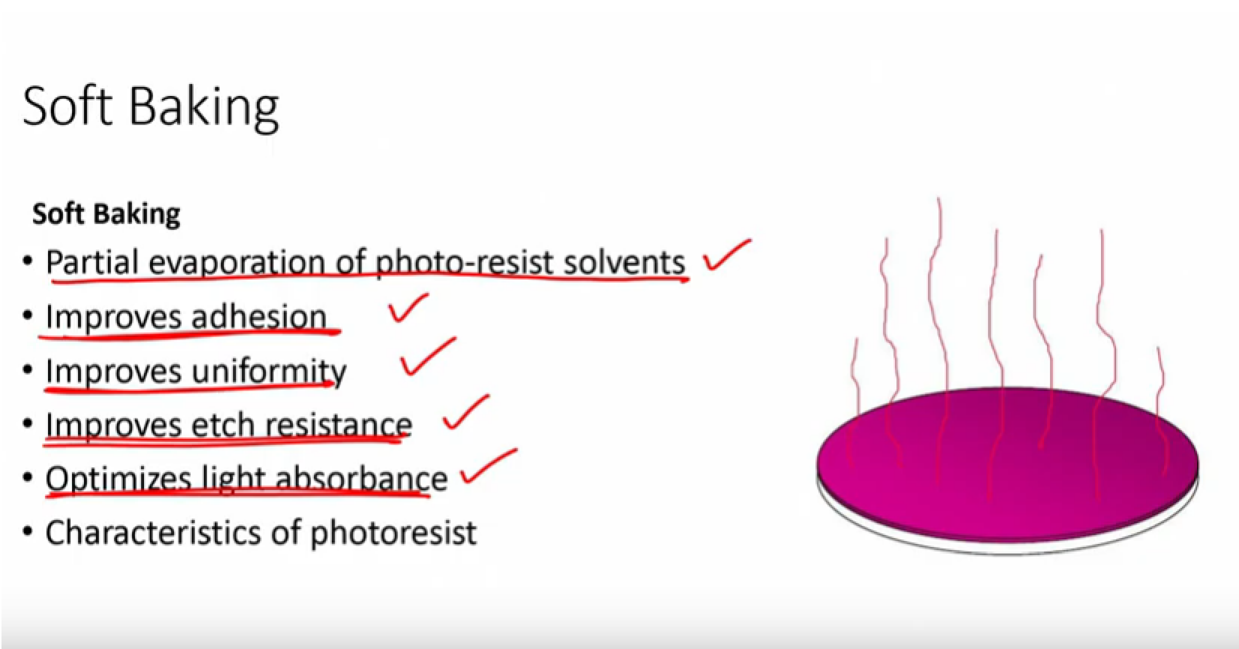

What's the advantage of soft baking? What is the advantage of soft making? First is partially operation of Photo-resist solvents, second is it improves adhesion, third is improves uniformity, fourth is improves etch resistance, then optimize light absorbance, finally characteristics of a Photo-resist of course there is a characteristics of a Photo-resist. So, optimized light absorbance, improves etch resistance, uniformity improves adhesion and partially operation of Photo-resist solvents. So, characteristics of Photo-resist can be defined if depending on is it bright field Photo-resist, is a dark field Photo-resist and also, also what kind of mask you use. So, now we know what's advantage of performing soft baking?

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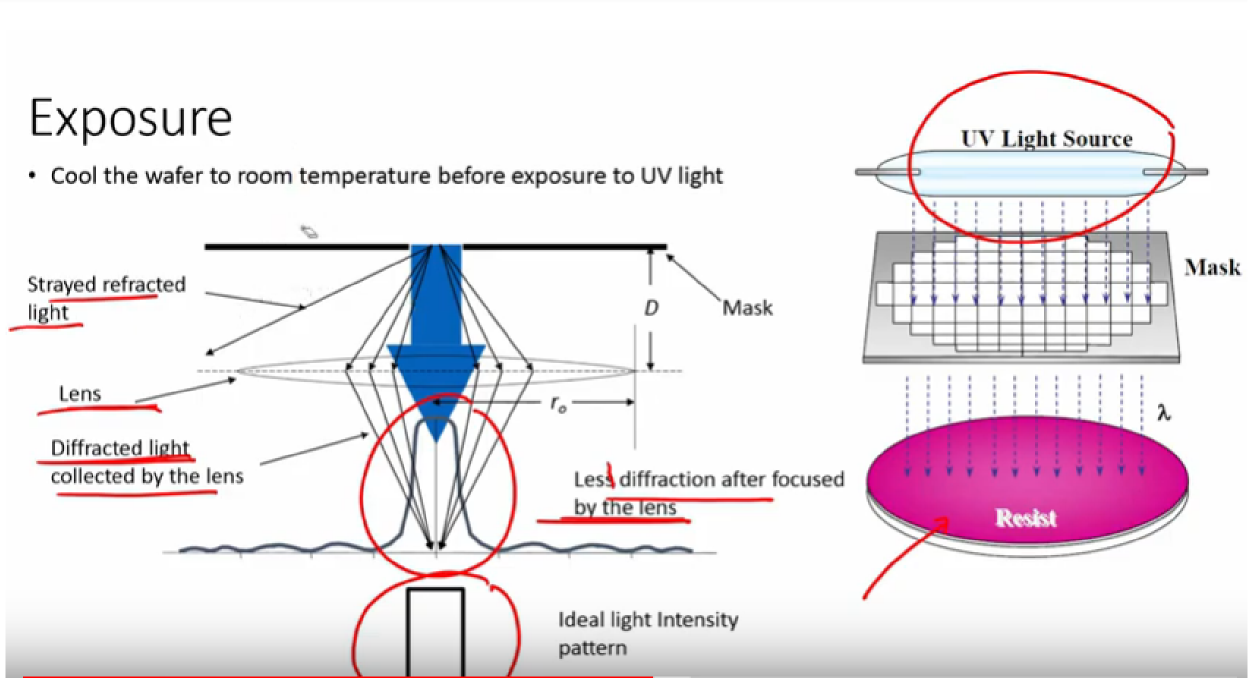

After soft baking, we have to align the mask, first is load the mask and then align it with the spin coated wafer. Right? So, when you align the mask, after that what you perform? Perform UV exposure. So, you should have a UV light source, you should have a UV light source. The idea intensity pattern should be like this. However, the intensity on the wafer, the UV intensity on the wafer is somewhere like this. How it is have, how it happens? There, there are few is a mask, to the mask, when the UV light passes through, there is a straight refracted light, for there is a lens here and through the lens the light is diffracted and collected by the lens. Right? which falls on the UV, so lens different, diffraction, after focused by the lens. Right? It falls on the photo resist coated wafer and it cannot pass through the, dark area, it can only pass through the, bright area, it cannot pass through dark area, it can only pass through light area. What cannot pass? UV light, cannot pass, UV light cannot pass.

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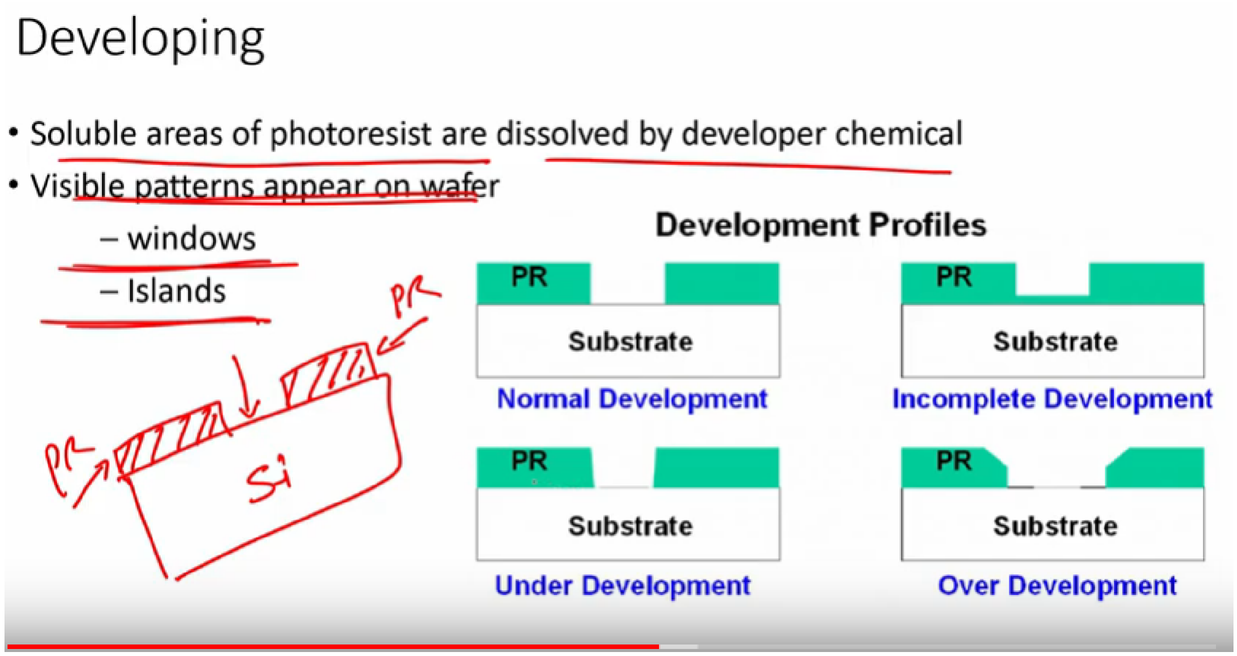

So, after the Photo-resist is exposed in UV light, like I said, depending on the foot, so, after that, depending on the mask, n type of Photo-resist, will obtain different pattern. Right? So, how can we obtain by developing Photo-resist, in Photo-resist developer. So, the soluble areas of Photo-resist, are dissolved by developer chemical, visible patterns appears on the wafer. Right? Either windows or islands, whatever we have designed, whatever we have designed. Right? Suppose we are designing on the wafer some electrodes, then these are some islands these are some valleys. Right? Or we are creating, a pattern like this which is your Photo-resist, then this area we want to etch, this is your Photo-resist, this is your silicon we want to etch silicon. Right? So, this is a window that you are created; a window that you are created you will take an example in later class.

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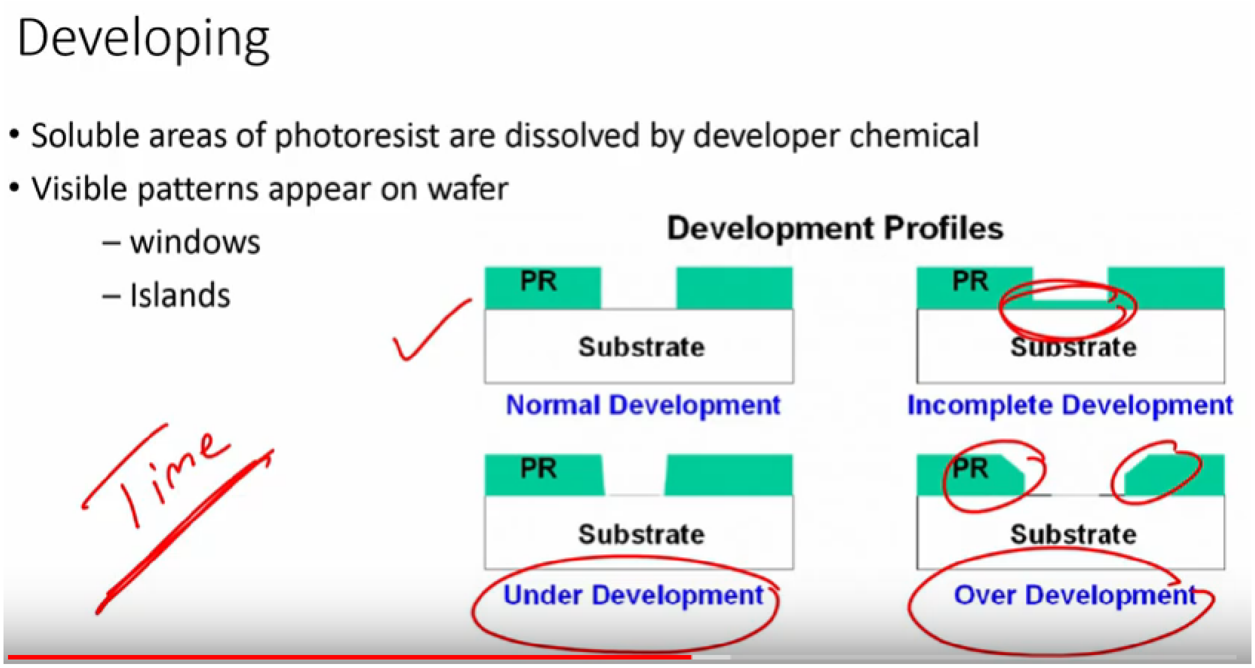

So, when you develop the Photo-resist it is, a normal development you will get pattern which is shown here, however there is under development, then you will get the kind of pattern, it is incomplete development you can see here, it is overdevelopment then you will see this structure. Okay? so, the time is very crucial, the time to develop the wafer in the Photo-resist or develop the Photo-resist in the Photo-resist developer is very important, is crucial and if you exceed the time then there is a over development, sometimes there is an incomplete development, if you take out the wafer before time and then can be under development.

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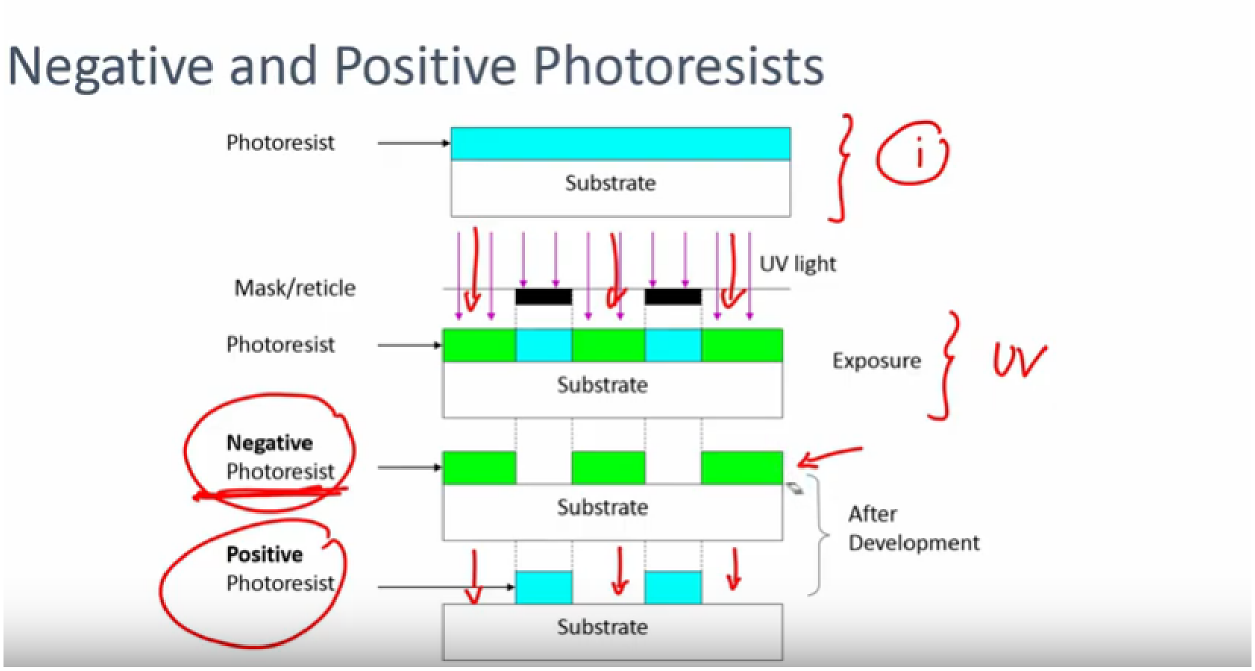

Having said that, let us see negative and positive Photo-resist example. Right? Which we have just seen but in form of schematic so, if I have a substrate and if I quote this substrate, with a Photo-resist I have a mask here, a mask here you can see the there are two dark areas, remaining there a bright field, it's a bright field mask or let us assume it surprised will mask, now if I expose this wafer, if I exposed wafer number one with UV light. Right? Then if it is a negative Photo-resist, if it's a negative Photo-resist, the area which is exposed you see, the area which is this one, this one, this one exposed will be stronger, you can see here. Right? The area which is exposed is stronger, in case of negative Photo-resist. While in case of positive Photo-resist, the area which is exposed becomes weaker, you see the area which is exposed becomes weaker, area which is exposed by UV light. Right? That area the Photo-resist will get developed, if it is a positive Photo-resist, you got it easy. Right very easy. Right? It's a negative Photo-resist and positive Photo-resist it's very easy to understand, what will happen if I use a particular Photo-resist.

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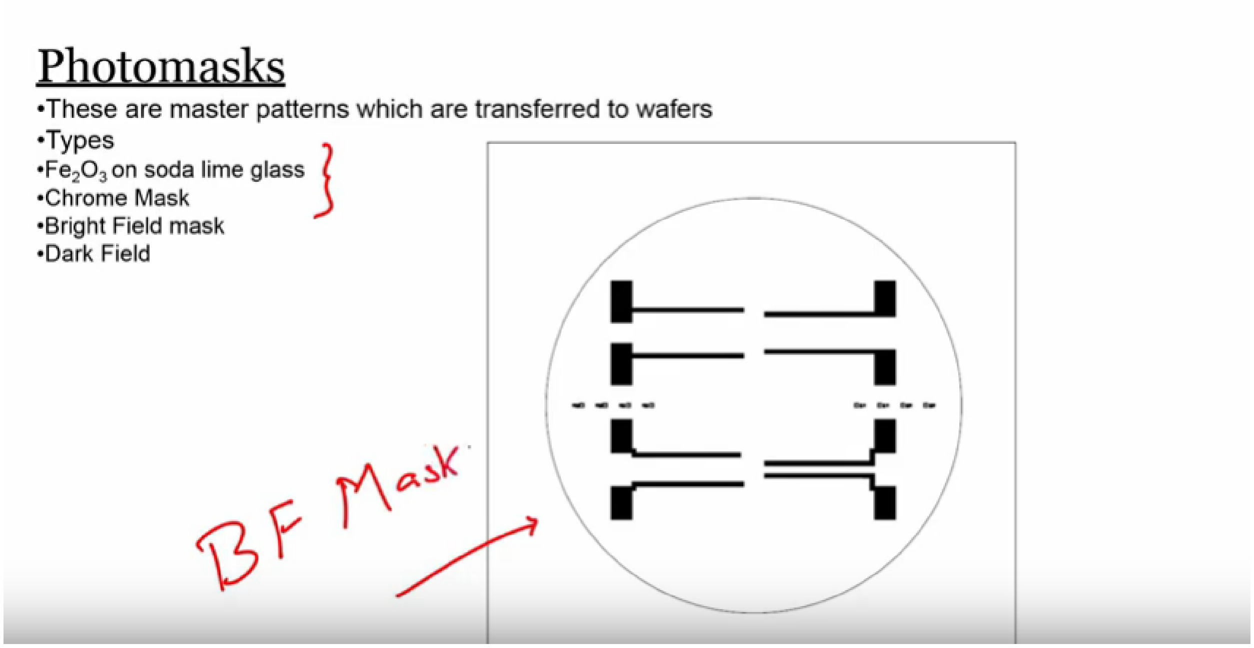

We have just seen masks, adjust in few masks and these are master patterns, which are transferred to the wafers. So, when you talk about types of masks, we have fe2O3, on soda-lime glass, we have chrome mask, these are two different materials, while the masks can be classified as bright field masks or dark field this is an example of, this is an example of bright field mask. Okay?

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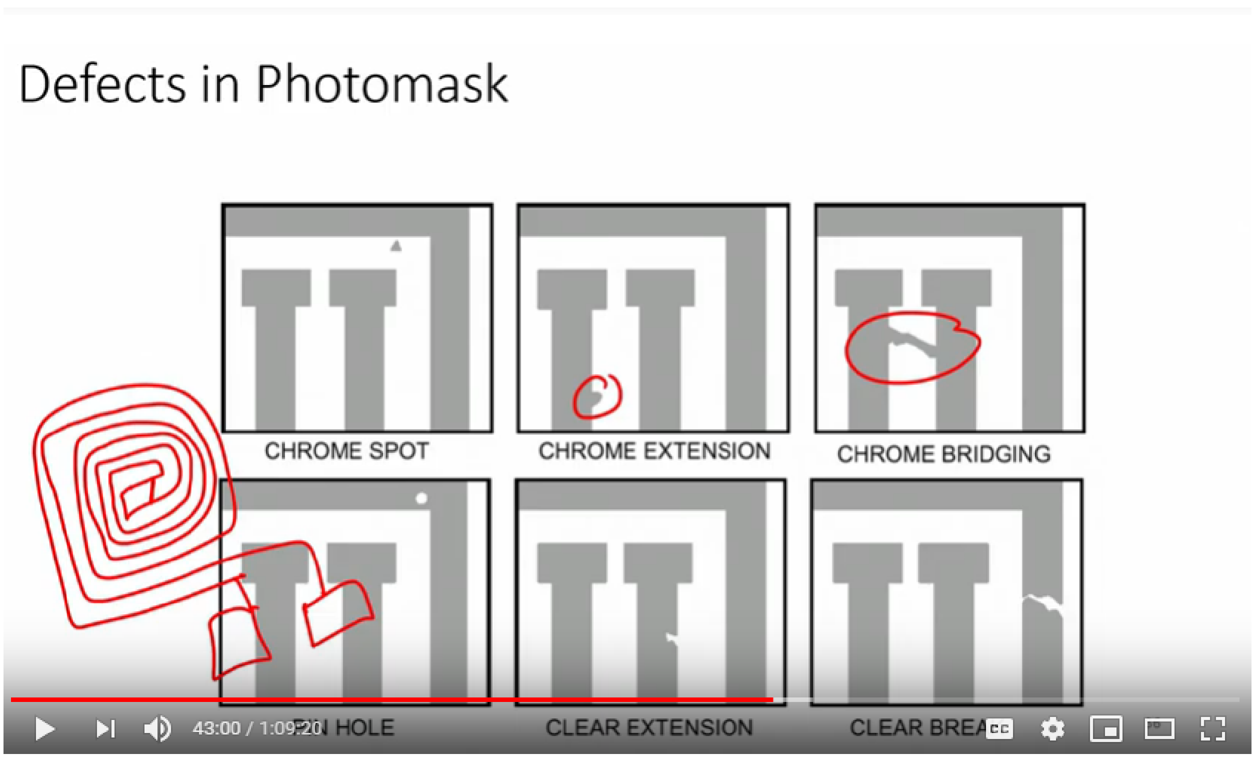

Now when we talk about masks, there can be defects in photo mask, defects in photo mask, what are those defects? First defect, that you will see is a chrome spot, now for us we don't care when we are going to make a bigger structure, we are when we are going to fabricate a bigger structure, but when you talk about MOSFETs then within this area there can be thousands of MOSFET. Right? So, we are losing those MOSFETs if we have the chrome spots, if we have chrome extensions, will not have correct results, if we have a bridging and if I am going to make a heater, it will be short. Right? If I make a heater let's say and if there is a bridging this is a short, the resistance would be different or let's say you have heater like this. Right? And if I have shot here, then it's gone, correct so, chrome bridging is not acceptable.

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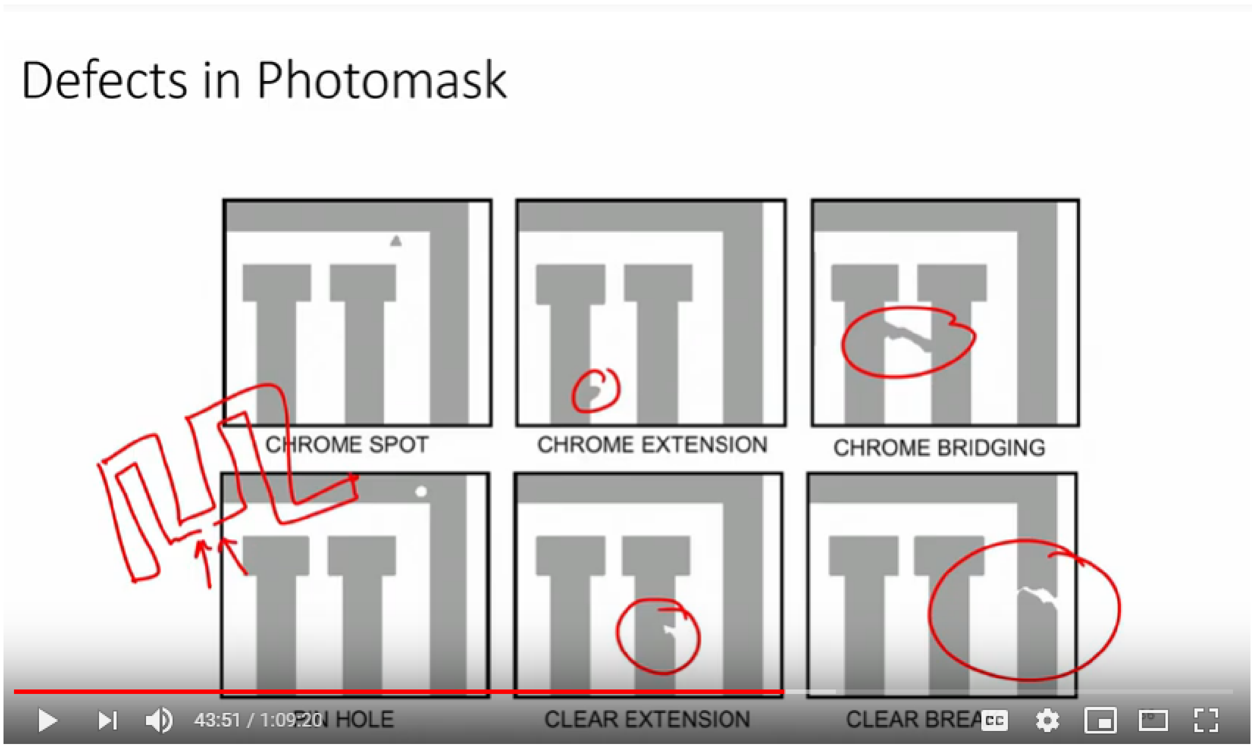

Next pinhole, chrome is not there at all not allowed then clear extension you see clear extension not allowed. Right? Because the value that we you calculate and value when you use this mask would be totally different. Next is clear break, breakage is at all not allowed. Right? If there is a break let's say if I make a, this pattern. Right? And if there is this is a break, then it's not to correct. Right? The design itself will give us a different value if there is a break in the mask. So, these are few defects that you need to understand, I need to observe whenever you start working with a photo mask. So, this is a video, interesting video where you will be able to see the mask aligner, mask aligner and it is an automatic mask aligner. So, I will play the video look at it it's a front to back alignment and it is very interesting to see this mask aligner, then let us, let us talk after the videos, that are here to follow and then we will discuss for another 5 minutes to see. What we have learnt

Start the video time :(44:43)

Hello, my name is Bernhard from this Micro tech development team, today I'd like to present our new generation of production aligner. The MA 200 compact which offers an advanced, technology design unmatched precision and a high degree of flexibility, see for yourself how easy it is to operate, the Chuck is stored in the bottom part of the aligner and is quick and easy to load, equally easy to insert are the mask holder. And the mask, now I load the carrier, that's all there is to it and the MA 200 compact is ready for operation. The processes of the MA 200 compact, can be controlled via touch screen, for some processes you can select between fully automatic and manual operation, a robot scans the wafers and determines their quantity, position and size. And the processing begins, the MA 200 compact processes wafers and substrates up to 200 millimeters regardless of their material, size, shape and thickness the machine runs and adjusts fully automatically, optimized for the processing though thick resists such as with thick resist left ship bumping wafer level packaging MEMS nanotechnology or telecommunication devices. The big advantage over steppers is the exposure of the entire wafer in one step, thus a throughput of more than 100 wafers per hour, can be achieved with overlay accuracy in the submicron range. Now let's slow the process down and take a closer look, first the wafer is pre adjusted onto the pre aligner in preparation for the ensuing alignment, a linear transport system loads the wafer onto the exposure Chuck which together with the robot arm guarantees the optimal and flexible handling of the substrate, no other mask aligner on the market offers a higher degree of alignment accuracy than the MA 200 compact, with the use of the recently developed and patent-pending direct align option from SOOS the mask is aligned directly to the wafer, guaranteeing and overlay accuracy, of up to 0.5 microns at 3 Sigma. The structures of the photo mask are conveyed via shadow cast, the patented wafer leveling system from SOOS compensates for topographic variations and wedge errors.

Thus guaranteeing perfect alignment and exposure results and the entire process is easy to monitor here on the touch screen because, of the MA 200 compacts newly designed microscope during exposure the mirror housing doesn't move forward ,the microscopes only move sideways thus reducing the vibrations of the alignment stage to a minimum, resulting in far greater accuracy. The optics of the MA 200 compact are optimized for thick resist processing and then resists it achieves a resolution, of three microns in proximity mode and a sub micron resolution, in contact printing, a microscope for bottom side alignment, is optionally available, it can process substrates with thicknesses, of up to four millimeters. The MA 200 compact here's a master when it comes to detail, no idea while designing it was to create a device that is both user and maintenance friendly, in order to further reduce your operational costs, the electronics and all important components are easily accessible as well as being arranged in a clear and logical manner, because of its compact size, it also saves valuable space in the clean room, the MA 200 compact is the ideal exposure system for application areas, with high demands in terms of package densities and micro mechanical structures. I can only recommend that you take a closer look at our new mask aligner in person and would like to invite you to do so, today the MA 200 compact from SUSS micro tech.

Video end time :(50:19)

Let us it is another video and again this is on the ‘Karl Suss MA6 mask Aligner’ SOP. How to use a mass calendar this is a video on this. So, let us see this video and then let us discuss.

Refer slide time: (50:40)

Start the video time :(50:46)

This is the ma6, it's used to expose our UV light to a substrate that has are either Photo-resist on it. So, before we learn the machine the first thing we got to do make sure the light bulb is turned on or even I've done enough. So, we come out to the back and you can see the lights turned on, by the recession here or you can see the right polling. So, you know that their life matters on, but in addition to that we want to find out how many hours are left on the light bulb. So, you check the power supply 4GS and it says 3-2 to 600 hours the vault is being used. So, the bulb has a lifespan of 4,000 hours so, when it's over 3,500 we would notify staff and tell them to change, it so we're pretty close to that now that the bulb is our. Okay? To use and there's nothing wrong with a Barrett and the power supply, if you want to log into the system, sub-assembly wrong again we check the logbook, the logbook would say that the last person who used his monocle and 221 note she had anything was wrong. So, you can see there's nothing wrong so, we're ready to turn the machine on and login, said along in computers, here you have to login to use the machine that otherwise won't turn on, Morgan has a cell functions first thing is the login, they you type in username and password ,you schedule. So, here's a machine of different hours you should check this to make sure nobody else is using, it 24 and it's 10a they'll be using it. So, therefore the user, also has a history tab there we can see the last our user then you can see that Monica's non user and she's allowed to write and log. So, let's know the machines already and so, getting news we just login. So, once you've logged in the machine will be able to power well and what we do now is we turn the on switch on here. So, we just on switch, now you can see the machine starting up as if then to read the screen, it tells you a lot of information so, it says let's go start fast slow but sort of like Venom's Right here. Now it says watch out machine is starting, with you know where the machine is ready for load and started up, ready for machine the thing we can do is change their parameters edit parameter. So, now even you can adjust the parameters such as time and distance and type of exposure. So, how do we edit the parameters or change, the difference from this P is the X left and Right? So, we move this way we change the gap change, the type of contact and then change exposure type. So, let's change the, it's there's a time first, service at five seconds now, we can change it to 25 seconds, if you hold fast and you can change it faster so, it's a funny film let's make it 26, now we wanted the slower. So, we don't get fast, we just so, now rules are just an exposure time, let's change the lighting gap, let's make that 40 and let's change, the we'll make a soft contact, I've changed there's different type of exposure, types some soft vacuum, hard supplemental to get more information. Right? Now we'll send in a soft so, what's the parameters asset we're gonna do now is the load the mask. So, how do we know the mass feel better press the button to change mask on the screen. So, we had change masks already below the mask so, here. So, the loggia mask in here - lifting disappear and putting it in you talking about you so, right now there that can dissolve you press enter. Now no vacuum is on and when you come back you, can see that it's stuck in then in the stuff very well. So, now we're going to put this in here. So, we carefully carry it, place it all in and when it's in the press change a mask and that's how you load your mask we're gonna be doing the backside linemen now so, what this does is and aligns teachers in their back, of Italy third see your mask microscope from the bottom.

So, first thing they do is and we have to have our mast loaded and then we turn the screen on and we make sure this thing says backside linemen microscope is on so, it's on but also we need to change this, to backside alignments. So, it can be their tops alignment or it can be backside alignment so, this is an elimination so, now the light is coming from the backside so, here you can see the light features said, that's the microscope from here coming looking up yet. So, they can look for those on the screen now and pretty much what you do is this controls the microscopes in the back. So, you can select one at a time move around so you find your features it looks like we found out an X under mask. So, either just the focus so, use this top straight left and right. So, the left one just the left the white letters will adjust, the rate that this we can also adjust the intensity you can also adjust the position. So, if I want to move this one up and down I'll hit the right I never move it up and down, if I want to help move the left one, it's a similar thing. So, can you find your mask and you think you're ready to do expose or an alignment, you'd grab this image same, press grab image button right here and then you're first that way it does it, it takes a picture of the mask. Now we're ready to load their wafer we press this button, versus Lord Wafer says this side and substrate are to each other. We were just made our way moron and when it's in here bring it up. So, now you can see you're in contact, this is the image overlay from the mask and these features right here, say that they define substrate on your wafer. So, how do you move the wafer we know that these buttons will microscope, wait for its these ones right it's these knobs right here this is why this X is on this side and this is the tilt so I'll give you an example I can turn this and you can see the background and then you can see this. So, this is the position on the left side and the right side is the X you can adjust the tilt with the Stuart and how you can adjust the focus, you can adjust the intensity or light. So, you would do that to find your alignment marks and then align them. So, once you have aligned them they're ready for exposure, then how do you expose you press first you the lemon check, which will bring it up, such you gonna make sure nothing moved and then waits in contact, exposure and then when you do exposure is good to turn your back away from the light. So, it doesn't damage your right exposure and then we just turn away. So, after exposure under a fur so, then what you do is come to a screen, then I will say first side unknown expose substrate. So, this is the best in Tibetan and then they reckon there will be least, then you can take your way throughout, the menu back in so, that's how you're under the reform after exposure, we're gonna do now is topside Light man's by using the microscope on the top, is aligned to the wafer, that's underneath to the glass. So, to do tops our alignment we need to move the backside microscope. So, we press this and then oh we can load our wafer in so, again you press slowly it says this slide and load substrate onto Chuck, the first until we did that the microscope all-American down, because we have the BSA registered right now button off. So, now it's down we will turn the TV screen on and what this is doing is taking, the neighbors from here onto the screen so again this these buttons right here control the accent of my position of the microscope. So, this have you found something here. So, we can turn out, it's pretty the power of elimination is pretty high, intensity. So, if you lower the power, then you can see that. So, you'll find the mask, lining up on this side. So, there are different features on this, this knob, right here. So, if you move it, this will, this will control the light microscope, the X position of the light microscope. And the left side has the same button. So, that I know the left knob, I can turn this way, then I move the right knob, I can turn it, this way. We can adjust the tilt, to make this match up, by turning this knob, right here. So, they look like its pretty messed up. So, what you do is, you do the same thing as a backside lineman. You align your lining masks on your wafer, today, right here. So, you can see that, if I move this, so, these, these, knobs control the substrate. So, I know this you can see that this has been moved. So, you can tell that's the actual substrate moving, not the mask.

So, for the simplest said you try to find your alignment marks, then align them to the features and then once you're the line that you do the same thing, when you do a lineman check and I'll bring the mask up, when any we expose it so, lupus expose and then you do expose. Okay? So, then you turn away so, the UV light does have choice so, after your double exposure so, it tells you first either unknown substrate so, you pull it out remember take it out. So, you finish the sample and Phyllis back in, now if you're done it you want to move this back up and you don't want to bring it back down this is where you pressed the SA button. So, by default this will not come down also to bring this up you press f1 and a microscope, it's always good to leave it in this disposition, with the microscope and the BSA button 'ON'. Because, now way microscope doesn't come on and off every time you're using it. So, after that we're ready to take out our mask, its compressed change mass it's pretty similar to loading it. So, reverse process change mask, you would take the substrate out, hit the enter button to remove a vacuum in any mask out, you press the change mask put it again and they will Center as you know the masses there so, now everybody would turn the system off. So, we'll make sure everything's in the standby position then you started the machine and then before you turn it off you want to make sure you're ready to log them vacuum point line my presume is about 4.65 the vacuum is about eight six taking the point eight six we use a full inch of a fold and silicon that we did 25 second exposure. Now we're gonna turn off listen we do is we turn off the switch here yes or the TV school and then we can walk out here did you reset the XY position then we did that. Okay? Okay?

Video end time :(1:06:14)

So, if you now see what we have learned? What we have learnt if you can see I'll show it to you on the screen here, I have in something in my head. what we have learned today is a step called,' Photolithography', the step called ,'Photolithography', in the last two videos what you guys have seen one is a automatic mask aligner you have to load the wafer it will perform everything a robotic arm will take the wafer and then it will perform the photo lithography. In the second one you have seen how can you perform front to back alignment, how can you align the wafer higher to align the mask, what is a procedure? The idea is to fabricate simple things simple devices like the one that I am holding in my hand or complex devices such as MOSFET or devices that can be used for clinical application like our drug screening device that we'll be talking about in, in fear the, the lectures to follow right Anderson in device will look similar to what I am holding right now in my hand this device can be used for rapid drug screening, that means that if a person comes with the cancer to a doctor, where the doctor has to decide which drug he has to or she has to give to the patient and which will work out.

But unfortunately there is no patient centric platform, that a doctor can try the recognition can try, before giving it to the patient. That means what I am saying is, if you take the cells from the patient, you lower the cells onto this device you flow the drug you get the results and tell which drug would be effective for this particular patient. Can you fabricate this kind of device? The answer is, 'Yes'. How? by understanding photolithography. Right? So, we will be looking at such kind of devices, such kind of interesting platforms that can be used for Rapid Drug Screening. Why I said Rapid Drug Screening? because there are multiple channels here. And a single in a single shot, we can perform eight different, eight different drugs, we can screen, using this platform or we can check, eight different patient samples, with single drug. So, such kind of applications, we can use it, using the Micro engineering platform and understanding the photolithography. So, just go through this particular, module and try to understand, try to focus and see, what things we have been discussing, in this module. And if you have any questions, feel free to ask me in forum and either me or my TA would reply, to your queries. Let us see, very interesting applications of this Micro engineering devices, in the classes to follow. Till then, you take care. Have a nice day. Bye.