Introduction to Mechanical Micro Machining

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Lecture - 63
3D surface measurement using interferometer

Good morning everybody and welcome again to our course on Introduction to Micro Mechanical Machining, but this class is related to demonstration of profile measurement of different type of micro components. Today we are going to discuss one of the techniques by which you can do measurement of a 3D components and this instrument is called the interferometric based measurement.

So, initially we have covered in our lecture, that there are 2D measurement also we can perform and 3D measurement can be also performed, but 3D measurements are more realistic in nature, because mostly the surfaces are exist in 3D nature. So, we will see the which way these instruments give you the measurement in terms of a 3D dimension.

Because, what is the objective? Once you complete your machining by a micro mechanical machining, we have to find out the what are the different dimension it has produced and we have to cross check with the design part, that whether there is deviation between the desired measurement and the what measurement you have received from the machine component.

So, these particular instruments will give you all the idea about the depth wise as well as width and the length wise; depending on which type of objective lens you are using. So, this is a noncontact measurement; so, your surface will not be touched by any type of measurement probe or measurement system, but it is a light based measurement.

So, light will be reflected on to the component and then it will reflect and you will be captured by one other standard reference and then it will create a interferometric fringes. So, fringe creation is more important and when it reflect, that means, the reflectivity also play a very important role here. Because if the surface is very very non reflective, then getting fringes is very difficult; so, let us first see that which way this instrument is working. So, if you see here in this instrument here what things are there? There are two different objective lenses are there; so, this particular objective lenses 5 x magnification.

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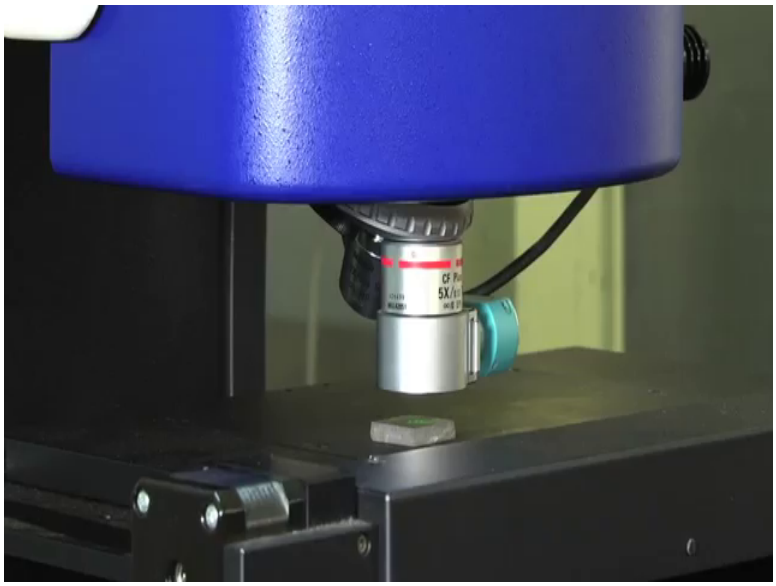

So, whatever component you are putting at the bottom that will be magnified by the 5 x or the 5 optical zoom.

There is another lens which is not used right now it has a 20 x magnification. So, 20 x; that means, your objective or the object will be magnified by 20 times. So, here how you can select these two things? That suppose your surface has a very very big range of the measurement; that means, suppose it is in 1 millimeter or 5 millimeters and you want to capture everything in a single measurement.

So, it is better to go with the 5 x because 5 x has a measurement area of a 3 millimeter by 3 millimeter. And, if you have a surface or the features which is very very small and you want to capture a small small detail of those say measurement; then you can use a 20 x. So, we have 2 different magnification lenses, but there are many ranges you can start with the 2; my 2 x magnification to 100 x magnification, depending on your requirement. So, here what we have done that from the fabricated micro tour we have cut a 1 micro channel with a depth around 300 micron and the channel width we will measure by this particular instrument.

So, once you complete the measurement you will understand that it is very difficult to see by naked eye that what are the dimensions are fabricated. So, to get those things this is the 3D measurement; there is another one it is called scanning electron microscopy by

which you can get the measurement in terms of a 3D with a higher depth of focus. So, let us go into the machine screen here what we are seeing here?

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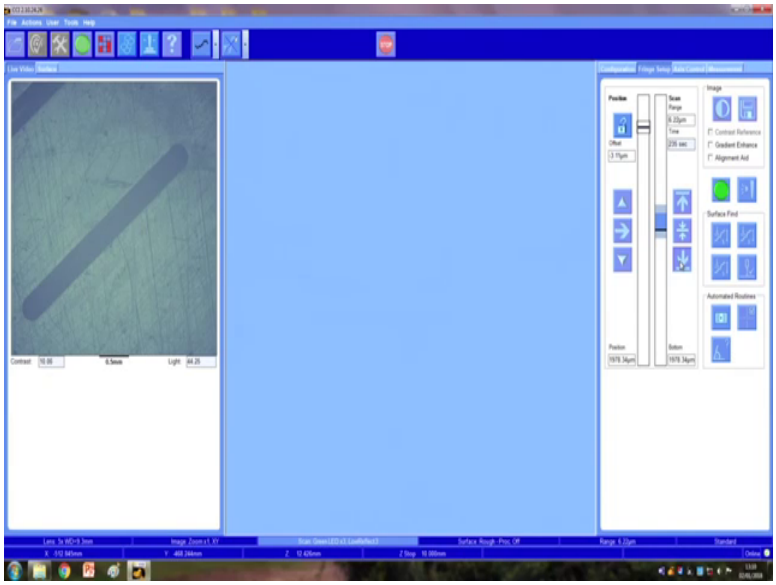

So, this is what you are looking at here this is the micro channel, which is fabricated on a PMA material. So, it is one type of polymer material or which is most widely used for the micro product studies and this is the size of that thing. So, here first objective is to create the fringes; so, that your machine can understand that where are the different surfaces are located?

So, first thing we have to find out, that first you have to see that because if your surface is very very large, you have to locate this particular location. So, by this way by moving of this particular screen; you can actually get the exact location. So, this is the location you can get this thing here and then we have to focus at the different different layer, because once you get a micro channel there are two surfaces; one is on the top surface and another one is the bottom.

So, your machine should actually get both the surfaces captured. So, first we will capture the top surface and then we will go to the down one. So, now, if you see it our microscope head is going gradually down and it will create a fringes on to the top surface. So, we are going very very slowly; so, that we can get all the things very precisely.

So, these are the fringes, which are created on the top surface; now these fringes whatever you are getting; that means, your surface is captured by the microscope reference surface. So, this is the top surface right now what we are we are getting. So, this is the top surface; so, we have to create a benchmark for the top surface measurement. And then we are going gradually down to get the bottom surface. Since the bottom surface is very narrow you will find a very less amount of fringes, but that is enough to capture the required details.

So, now, it has started if you see that internal part then you will get the information here. So, small amount of fringes are already captured by that you can see that; now these are the fringes. So, these things are created and let us start the measurement. So, now, your instrument is starting from the top surface and it gradually it will go down and capture all the details. Now it is measuring fringes here you can see there; so now, it is almost completed.

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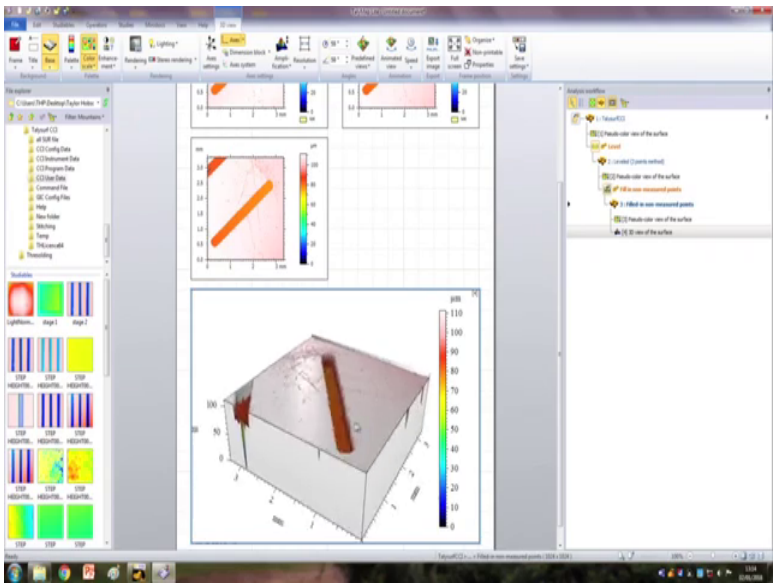

Now this is the new software; that means, earlier software was the machine software and this software is the analysis software. So, whatever things you are getting that is transferred to this software. So, that you can do different type of measurement here; so, this is the surface what we are getting here and here now we can convert this thing into the 3D view.

So, now, you can see that this is the channel which was fabricated by that end mill cutter. So, now, here whatever information you are getting now we have to see that what are the dimensions of this micro channel width wise and the length wise? So, what we need that we need a cross section of this. So, here what we can do that we operate this thing and then do the extract the profile.

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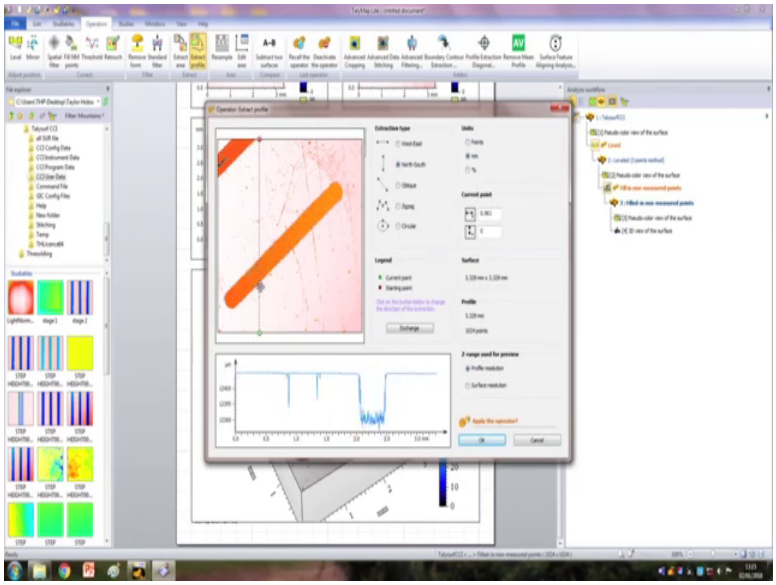

So, by this way you can see that we can get the different type of profile here; you can cut down from here to here and this will be the ; now let us take this thing and so, this is the cross section of the profile.

Now, if you want to do measurement of different heights and all the things you can select that also that you want to do some measurement there.

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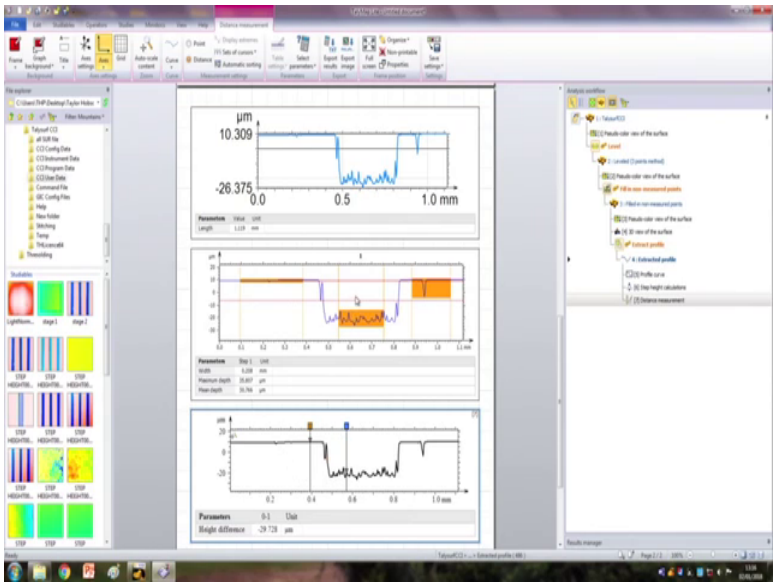

So, here you can see that what is the height is here. So, it is measuring from here to here and you can do that this maximum depth is 35 micron is the depth here and if you want to do measurement of other measurements. So, this is the distance measurement then you can do one thing that you create one reference surface here. So, this is our reference surface and this is the; and the bottom surface. So, this is telling you the height difference.

So, now, whatever is height from here to here that is the difference is around 30 microns that is also what we are getting here? So, this is the point wise, but here it is the area wise; so, it is getting the average area of this part and the average area of this and then it will give you the depth here. If you want to measure the width of this channel; then what you can do? You just start from here and move this particular thing to this location here; then let us say this is the horizontal distance here. So, here what we are getting here? So, this is what it is showing what who has changed these things?

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Now bought the things; so, from these particular graphs you can see that the general width is almost 300 micron if you start from here 0.3 millimeters. So, it is a width measurement from here to here and it is showing height measurement, but height is not important right now for us then what we can do that we put one extra bar here and that extra bar can be useful for measurement of that also right. So, this is the extra cursor; so,

now, what we can do? We can add this thing here. So, at that time it will tell you the difference this is the 0 and 1 difference is showing here. And this is for measurement of the width and if you see the measurement of 2 and 3 then you are getting the height difference it is a 30 micron is the height difference.

So, by that way you can do measurement of different different parameters; this is one of the thing. Suppose you want to measure the surface roughness on this component that is also possible; right now it will not show you some clear idea because it is right now very deep inside the surface, but still let us try we can get something from there. So, for that what we have to do? We have to extract some area out of it right.

So, this is the something we want to extract from the surface; then we can get some small thing here. So, this is going inside the surface; so, this is what we are getting here and these is the surface and suppose you want to do measurement of different parameters then what you can do? This is the parameter table.

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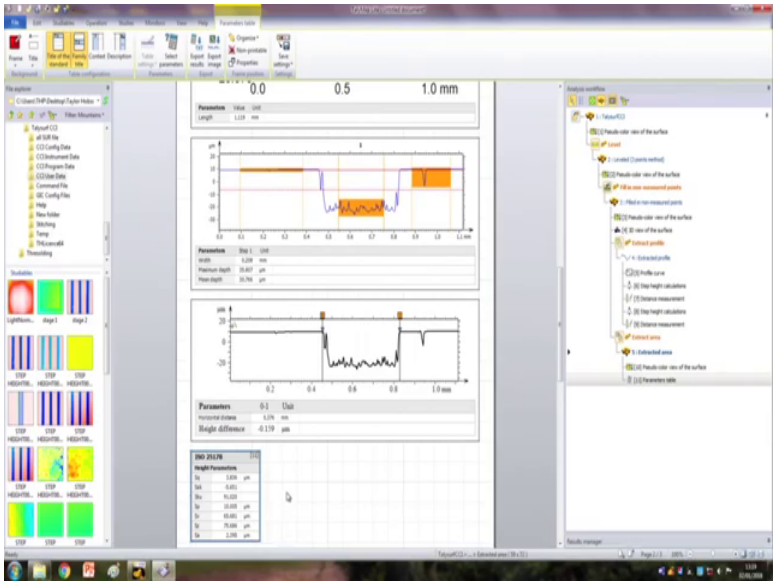

So, here it will give you the area roughness. So, area roughness is S a that is called area roughness if it is R a that is a line roughness it is showing 2.395 is the micron that much micron is the surface roughness. And suppose you want to do measurement inside the area; that means, along the line completely; then what we can do that we select this particular parameter then operate and select the extract the profile. Then what we will do

then let us put one full line starting from the end. So, this is the roughness line of the internal surface that is the bottom surface.

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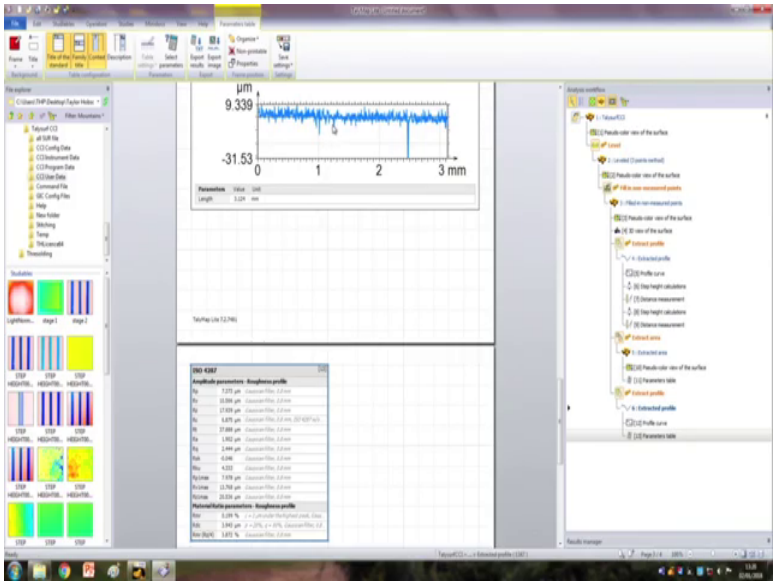

So, this is the part; if you select this thing and then again go to the study and do the parameter. So, now, it is giving you all the relate value related to the line roughness. So, here the surface roughness is 1.9 micron; which is showing here in this case. So, you can do different different kind of things here that measurement of area, measurement of length, width, surface roughness measurement all the things are possible by this instrument.

So, this is all about the measurement of a micro features by a 3D measurement using a noncontact methods.

Thank you very much.