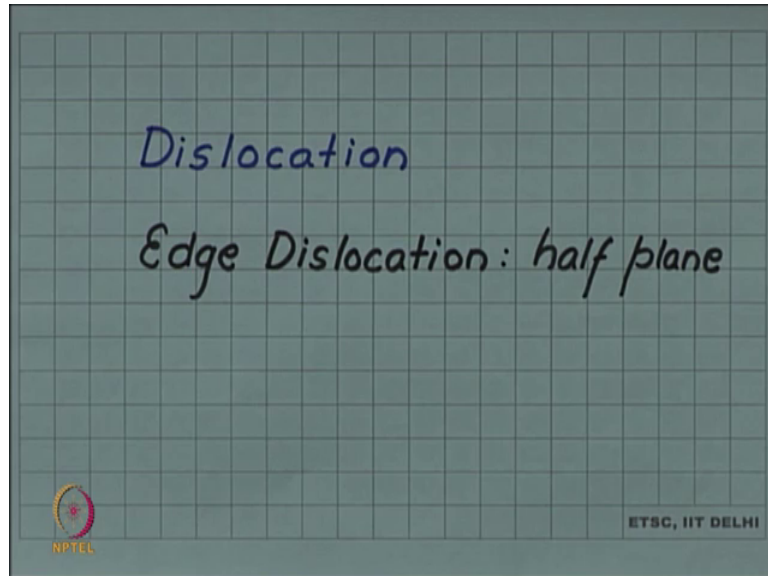


Introduction to Materials Science and Engineering
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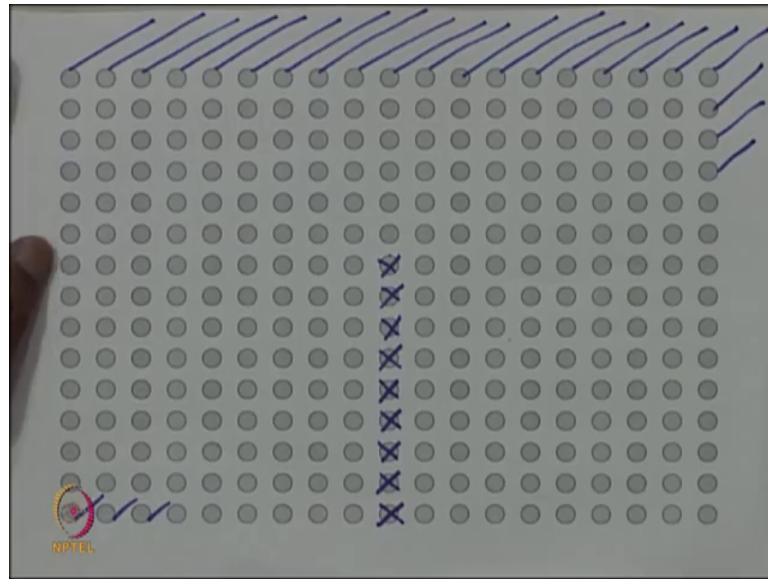
Lecture – 45
Edge dislocation: Half plane

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So we now discuss a new kind of defect which we have not discussed earlier and that is dislocation. They come in different varieties, edge dislocation is one of them we will have time to see others as we go along. So, we start our discussion with edge dislocation.

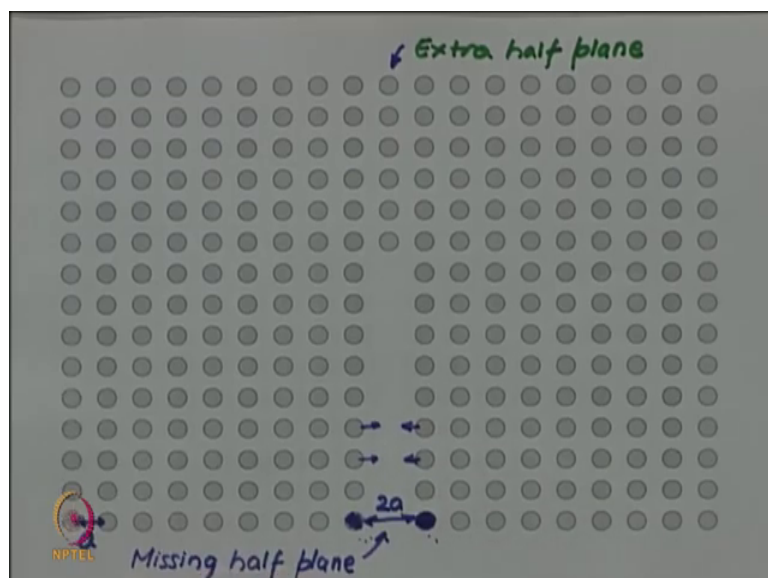
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Let us start with a crystal and imagine that we are seeing the front face of the crystal of a simple cubic crystal. So, the planes, planes are going in like this and what we have what we are seeing is a front face. Now, in this crystal I want to create a defect and the way I want to create a defect is just to remove think of a vertical planes, think of these vertical planes and one of the vertical planes I remove the bottom half of the vertical plane. So, I cross out all these atoms I simply remove them.

So, if I do this I will get a configuration something like this.

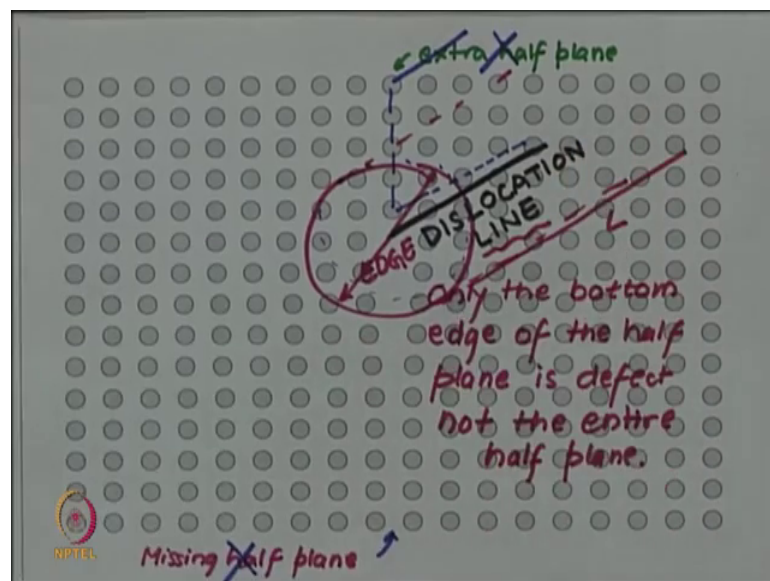
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So, you can see this is this was my middle plane which I thought of and I just removed the bottom half of the plane. So, you can think of this plane either as you can think of as the removal of half plane. So, we can call it a missing half plane missing half plane or you can call it as an extra half plane. Also if you see that now of course, we have created a defect, but then this is not a very stable configuration because you can see that these atoms this this atom and this atom across the plane where we have removed the missing half plane their spacing has increased to twice the normal spacing. So, if the normal spacing is a this is become $2a$.

So, this configuration will not be stable because these bonds have been a stretched to twice their normal length and so they would like to come together. So, these atoms due to their normal attraction will like to come together.

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So, if we allow this, if we allow this kind of relaxation we get a configuration something like this where again, so this was the location of our missing plane, missing half plane and this is our extra half plane and now I have allowed these atoms on the lower half I have allowed these atoms to relax together. So, that they can they have again come away from this region they have again come close to each other and they are perhaps at the equilibrium spacing.

Now, let us look at. So, what kind of defect. So, we have created a defect now and we have allowed for relaxation to achieve equilibrium as far as possible some lowering of

energy has been there due to these atoms coming close again, but then we are still left with a defect and what kind of defect is that. So, one way of thinking of it is that since there is an extra half plane I can think of as an extra half plane which is inserted or a missing half plane which is removed. So, it appears that this is a planar defect, but this is not the case and that we can see by simply hiding part of the crystal.

So, if I hide the lower part suppose I hide this part. So, you can see what I was calling as extra half plane is really not extra in the crystal it is a normal part of the crystal. In fact, if we now remove this if I think of this as an extra half plane and remove it I will create a defect here. So, although we are calling it extra half plane it is really not an extra half plane. Similarly if you now hide the upper part of the crystal and look at only lower half then again you see where I am saying missing half plane actually nothing is missing because these atoms I have already allowed to come to equilibrium separation.

So in fact, if I think that there is something missing and I try to insert more atoms there that would be a defect otherwise there is no defect there. So, this entire half plane either the missing half plane or extra half plane is not the defect. So, defect is concentrated only close to this region, where this plane our so called extra half plane has suddenly and abruptly ending. So, it is the abrupt ending of this half plane which is creating a problem and not the whole plane itself.

So, the defect is only at the bottom edge if I try to complete this plane like 3D into the page of the paper. So, this bottom edge if I draw a line close to this bottom edge, this line is the dislocation or the defect line. So, defect is concentrated here and this is a dislocation line and since this dislocation line is bottom edge of my half plane, imagined half plane it has been given the name edge dislocation, edge dislocation line. So, only the bottom edge of the half plane is defect not the entire half plane and you can see that this is a line defect.

So, once the the entire half plane is not a defect it is not a planar defect the defect is concentrated only around this line and so we will call this a line defect. Of course, you may think that there is a region around this line which is in defect. But then this cylindrical region, this cylindrical region will have the diameter of this region is much smaller compared to its length length will be several lattices spacing several 100 lattices

spacing whereas, the diameter is only few lattices spacing. So, it is like a thread which has a very small diameter and, but very long length. So, it can still be thought of as a line.

So, with this we have introduced the edge dislocation line as bottom edge of an extra half plane. But please note that the extra half plane this extra is a sort of imaginary extra, it is not really extra where the plane is there that plane is very much required.

Thank you, we will continue our discussion of dislocation in the next video.