Introduction to Materials Science and Engineering
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Lecture - 49
Screw Dislocations

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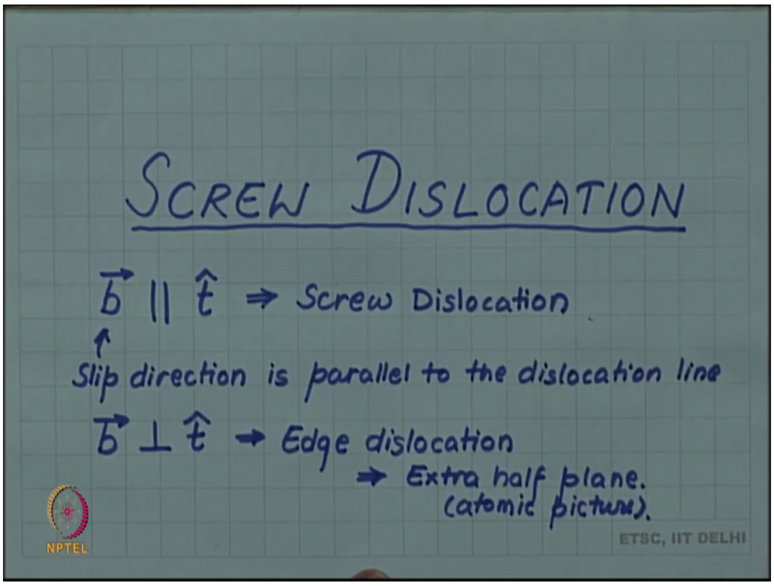

So today we will discuss a screw dislocation, we have already looked at where the defined screw dislocation in terms of burgers vectors and the line vector. We said that if burgers vector if the burgess vector and the line vector or the tangent vector are parallel then we have a screw dislocation. We have a screw dislocation which essentially means burgess vector is the slip vector.

So, the slip direction is parallel to the dislocation and t is the dislocation line. So, slip direction is parallel to the dislocation line.

We also saw another configuration, when b was perpendicular to t, that gave us edge dislocation, and then we saw the atomic model of this edge dislocation, which was an extra half plane.

So, there is an extra half plane associated with the edge dislocation, is the atomic picture, we want to we have not yet seen what is the corresponding atomic picture of a screw dislocation. So, in this video we are going to do that.

So, let us try to create the screw dislocation.

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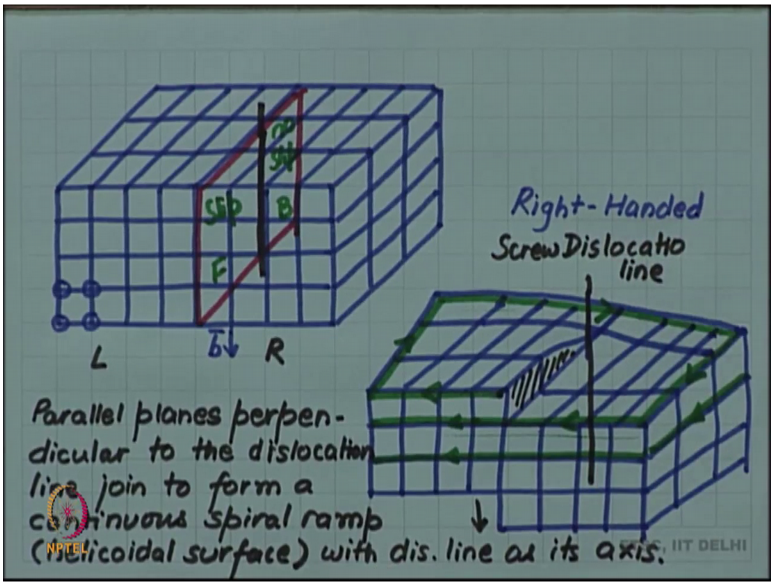

So, this is a perfect simple cubic crystal. So, you should assume atom sitting at each of the intersection points, I am not going to draw all of them. So, these are simple cubic unit cell with corners as atoms. Now if I want to create or distort this crystal to have a screw dislocation, I will have to have a slip plane. So, let me identify this plane this vertical plane as my slip plane, the vertical plane divides the crystal into 2 halves the left half and the right half, and let us say that the right half slips with respect to left half to create the dislocation line.

Now, if the entire right half slips with respect to the left half then there will be a complete slip, and there will be no dislocation line, because as we have seen dislocation line is the boundary between the slipped and unslipped part. So, on this slip plane on the red slip plane, I now draw a line which is going to be my dislocation line, this black line, which is defining a boundary on the slip plane and dividing the slip plane into let us say a front side and a back side, and I would like to confine my slip on the front side.

So, let us now try to slip to introduced a slip in this crystal, such that the right half slips with respect to the left half, but slip is confined only to the front side of this black line. So, the back side will not be not be slipping. So, that is the no slip region. So, we have we create a boundary between slip and no slip region. So, the black line will be will become a dislocation line, it is not as yet a dislocation line because all this drawing is superimposed on a perfect crystal, but now let me try let me challenge my drawing skills for you, to try to slip this right half by an amount equal to one inter planar spacing. So, that is what will become the burgess vector.

So, if I try to do that, you can see that on the front face, I have tried to create the effect of that slip the right part of the crystal has been pushed to one step down with respect to the left, and to complete the model let me draw the other lines. Something like this you can see we have created ledge here, and you can picture something of the kind of slip which you are trying to create, that the right half has slipped with respect to the left half, but the slip is confined only to the front of the vertical boundary, the vertical black boundary which we had decided to make a dislocation line.

So now this line has become a dislocation line, this is the dislocation line, and since the slip direction is parallel to the dislocation line, this will be a screw dislocation line from our definition. So, this will be a screw dislocation line, the name a screw comes from the fact if we try now let us start to make a circuit on the top face of the crystal, and I will try to make this circuit by starting at this point and going in a clockwise manner.

So, let me try to complete a clockwise circuit on this top surface. So, if I try to do that, you can see that I didn’t come to the starting point I have come to the next plane down. So, trying to make a complete circuit on this top face is not successful, because I have come to the second plane of the crystal, and you can imagine if I continue then in the next step I will come to the third plane. So, essentially what is what has happened is that discrete planes here in the perfect crystal, we had discrete planes perpendicular to the dislocation line, these planes somehow the dislocation has the screw dislocation has connected them into one single spiral ram.

So, let us note that the parallel planes perpendicular to the dislocation line, join to form a continuous spiral ramp, sometimes also called a helicoidal surface, maybe more accurately helicoidal surface because your spiral is a 2-dimensional curve, helix is a 3-dimensional curve, and the surface is in 3 dimension so, helicoidal surface and this is what gives the name a screw dislocation, and the screw dislocation itself is the axis of this helicoidal surface. So, with dislocation line as it is axis.

So, I hope this gives you some picture of the atomic picture of the dislocation line, that how the dislocate screw dislocation there is no extra half plane associated with this dislocation you can see, but the planes perpendicular to the dislocation line has become into a spiral or helicoidal surface, and this is what gives the name a screw dislocation, another thing if you see we will discuss that in some detail later, is that this spiral ramp is a right handed spiral, that is if you go clockwise the circuit is taken clockwise you are going down, this is what you will obtain if you curl the fingers of your right hand then we if there a curling is clockwise, the thumb is pointing down so, that is why this will sometimes if you want to be more precise you should call this a right handed a screw dislocation.

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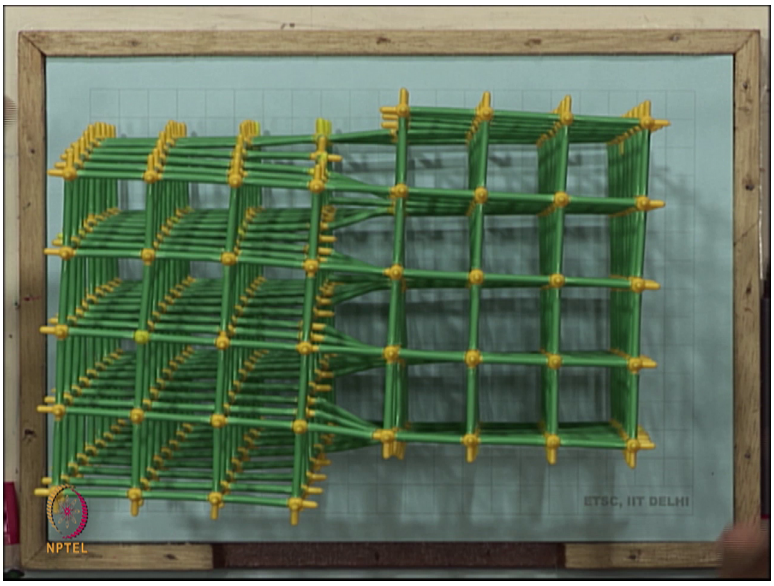

We have a model here which I will try to show you the right and left part, and they have slipped this is the vertical plane on which the slip is taking place, but the slip is taking place only on the front side of the crystal if I look at the backside and I am turning it 180 degree to look at the backside you can see that the backside there is no slip. So, on this vertical plane slip has taken place, but not on this side only on the front side.

So, somewhere on this vertical plane there will be a boundary between the slipped behalf which is on the front, and unslipped half which is on the back and that line will be the dislocation line. In the next video we will look at budget circuit in a different way we have already described by the circuit, but another way of looking at budget circuit we will see in the next video.