Introduction to Materials Science and Engineering
Prof. Rajesh Prasad
Department of Applied Mechanics
Indian Institute of Technology, Delhi

Lecture – 47
Characteristic vectors of a dislocation

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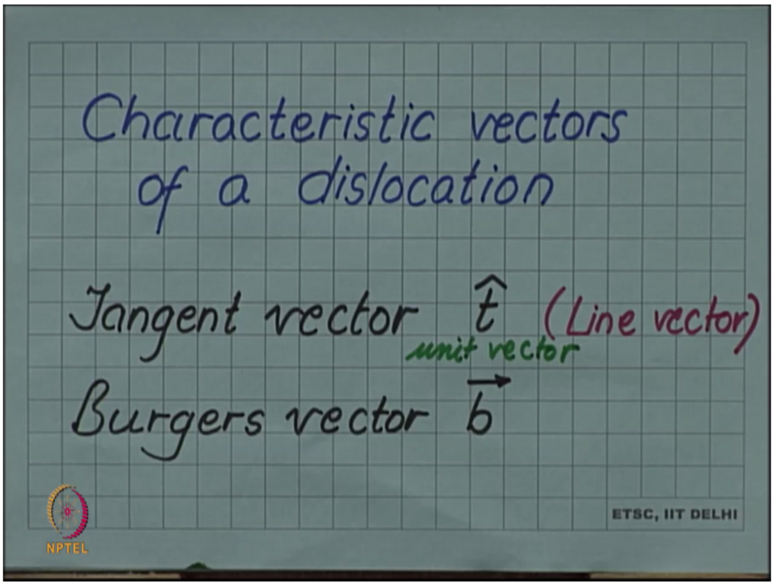

We have started our discussion on dislocations which is a kind of crystal defect, it is a line defect and last time we saw edge dislocation in two different ways: one edge dislocation as the edge of an extra half plane in the crystal and in the another way, we saw the edge dislocation as a boundary between slipped and unslipped part of a crystal on a slip plane.

Now every dislocation is associated with two characteristic vectors that is, the dislocation is characterized by these two vectors; one of them is called Tangent vector or Line vector, the symbol we have given is t and I have used a carat or a hat above t; to indicate that this is a unit vector.

So, this t is a unit vector; also when I was discussing the dislocation line as boundary between slipped and unslipped plane, we said that we have a Burgers vector which is the magnitude and direction of the slip. So, these two vectors characterize a dislocation line. So, let us look at a, last time I made some drawing but I did not show you a model.

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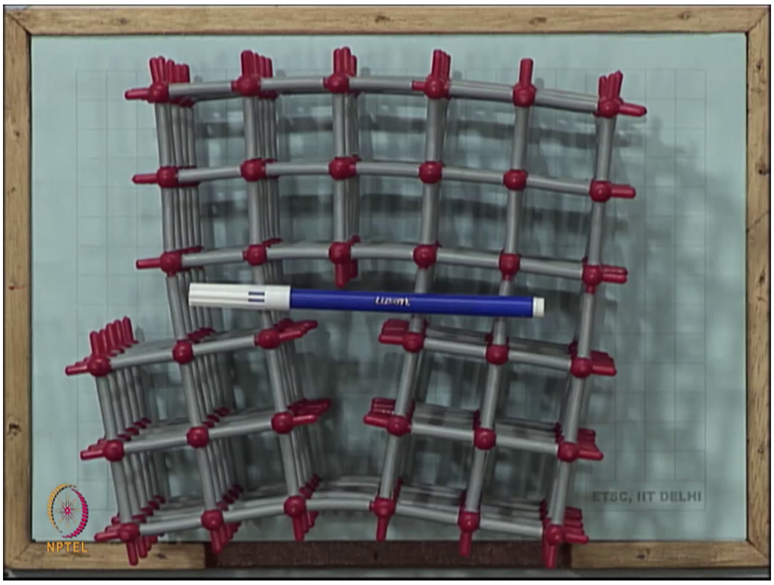

There is a model here or to picture the edge dislocation. So you can see, this is an extra half plane and you can imagine the edge of this dislocation.

So, if the line going into your computer screen here, if I can put my pen there, they can make it a stand parallel to the dislocation line yeah. So, that line that, line indicated by the pen seen here is the dislocation line. So, entire half plane is not a defect, it is not a planar defect; it is a line defect and the line defect is concentrated here. So, when I wish to characterize this dislocation line, I need to know the orientation of the line. So, in this case, the line is oriented into this model or into your computer screen where you are seeing.

So, a line going from the front of the crystal here into the crystal inside parallel to the bottom edge of this half plane is the dislocation line. So we need to know, which way in space the dislocation line is oriented. So, that is given by the tangent vector. Similarly, when I saw this in a dislocation line as a boundary between slipped and unslipped part on the slip plane, here the slip plane is the horizontal plane here shown by this pen. So, the plane going into the crystal along this line defined by this pen is the slip plane. On this plane if you see, on the left hand side, a plane is missing which is indicating that the first plane has joined with the second plane here.

First plane on the top is joining with the second plane on the bottom because it is the second plane on the bottom. There is a first plane on the top. So, first plane has joined with the second plane on the bottom, this second plane on the top has joined with a third plane on the bottom, third plane has been left hanging. So, that is the extra half plane. The fourth plane on top is also connect, is still connected to the fourth plane on the bottom. So, we can see that first went to second, second went to third, third remains hanging. So, first, second and third have suffered slip whereas fourth, fifth and sixth are still connected to fourth, fifth and sixth at the bottom.

So they have not suffered slip, they have not undergone slip. So, this half plane is the boundary between slip and unslipped part on this horizontal slip plane. So, when I look at it as a boundary between slipped and un slipped part, I need to specify the slip. And in this case, the slip, you can see is one inter atomic spacing here from the plane, from the originally existing first plane with a displaced first plane. So, this is facing which is the bond length here, in my simple cubic model is the bond length.

So this bond length, this inter atomic spacing or this inter planar spacing, if you think in terms of plane is the magnitude of the slip and the direction of the slip is in this direction of the model, in the horizontal direction. So, this magnitude and direction of the slip is called the Burgers vector of the dislocation line. So these 2 vectors, the Tangent vector and the Burgers vector characterize a dislocation fully. You require to specify these 2 vectors to get the complete picture or complete characteristic of the dislocation.

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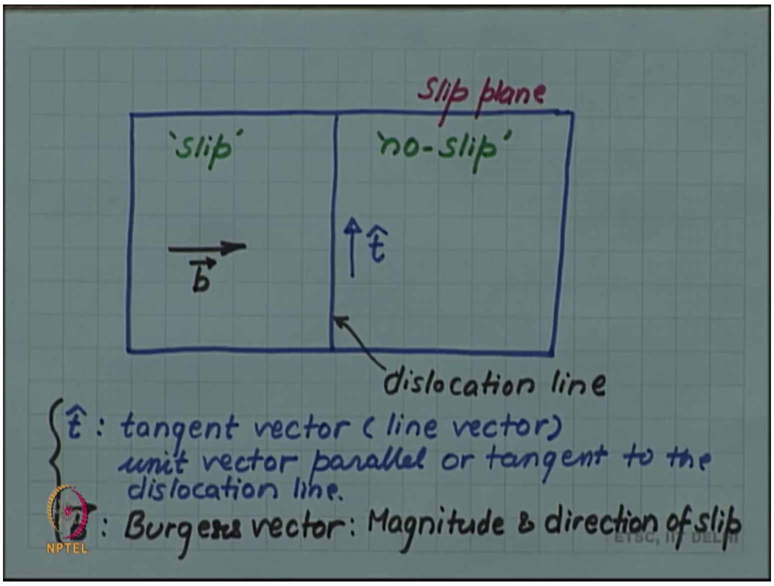

Let me try to draw the slip plane, not the entire model but only the slip plane. I think I had drawn it to you last time also.

But I am redrawing it. So, last time we had not simply not talked about the tangent vector; that is the only new thing I am introducing burgers vector I had talked about. So, this is, this plane is the slip plane. Let us call this the rectangle, the external rectangle is representing slip plane of the crystal. So, that is the horizontal plane in this model, that is the horizontal plane here in this model.

So, we are now looking down on that horizontal plane from the top and this is the position of the extra half plane. So, that is the boundary between slipped and unslipped part, there is dislocation line. And as we have emphasized, the dislocation line is boundary between the slipped part, the slip region and the no slip region.

The way I had shown you on the model the left hand side was the slip and the right hand side was no slip. Although these things can be interchanged, but we would want to go into that detail at the moment. So, we think of the left half as the slip and the right half as no slip and we have a dislocation line as the boundary between slipped and unslipped. So the question is, where is the dislocation line? What is the orientation of the dislocation line? So, we take a vector which is tangent to the dislocation line, we take a unit vector.

So, unit vector tangent to the dislocation line is called the line vector; this gives the orientation of the dislocation line. So, let me write it here. So, t is the tangent vector also known as line vector and this is a unit vector parallel or tangent to the dislocation line and as soon as I said slip. So, there is a direction of the slip associated and a magnitude of the slip associated so there will be a vector which will characterize the slip and that vector we are calling the burgers vector.

Now, the magnitude need not be unity. So, this is a vector which can have any magnitude. So, this b is we are calling the Burgers vector, Burgers vector which is representing the magnitude and direction of slip. So, for every dislocation, these 2 vectors are required as characteristic vector. We will have more to say about Burgers vector; there is another way of looking at burgers vector; not in terms of magnitude and direction of slip, but in terms of a circuit called burgers circuit that will be a topic of another session with these 2 vectors a dislocation is fully characterized.