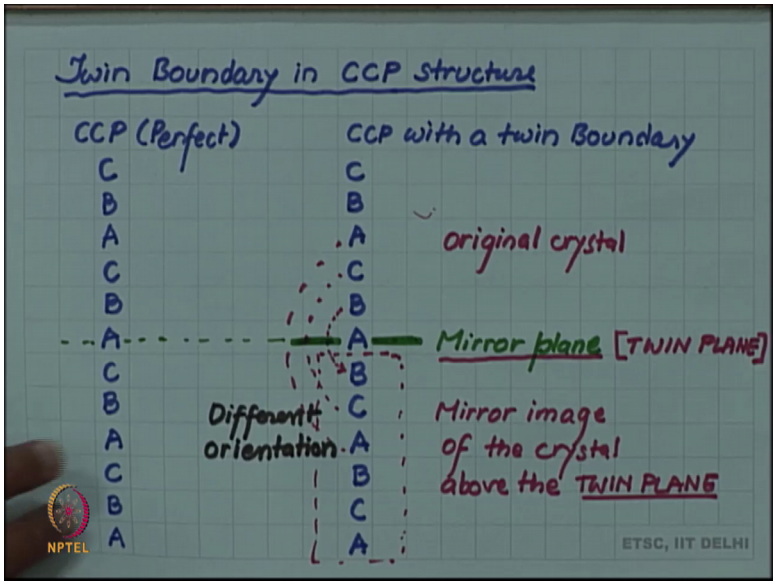
Introduction to Materials Science and Engineering
Prof. Rajesh Prasad
Department of Applied Mechanics
Indian Institute of Technology, Delhi

Lecture – 62
Twin boundary

We discussed about stacking fault in the last video. Another kind of fault which was there in the original list of our classification of various boundary is a twin boundary. So, in this video let us look at twin boundary.

(Refer Slide Time: 00:26)



Again we will take the example of close packed structures in CCP structure, let us look at. So, we have seen that if we have a sequence like ABC ABC ABC and so on, then this represents a cubic close pack structure, this represents a CCP structure.

Now, let me make another structure in parallel. So, this is a perfect CCP. Let me try to create a faulted CCP in which there is a twin boundary. So, suppose I think of one plane, let us look at this a plane and I keep the same orientation as in the perfect up to that a plane which is going to become a twin plane. Now to make it a twin plane all I do is, to instead of continuing the same sequence CBA CBA down below, as we had done here that CBA CBA was continuing.

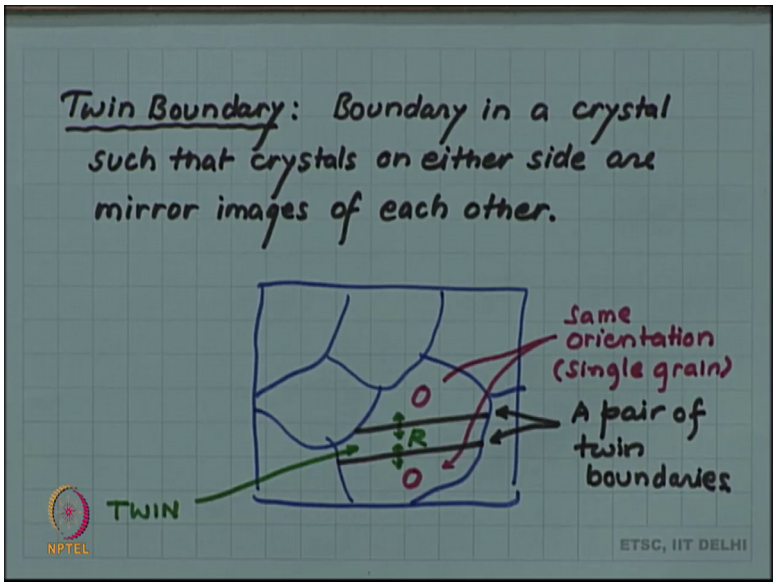
Now, I am assuming this to be a mirror plane, and reflect the structure above into this mirror plane. So, if I reflect this, then here instead of C plane I will get A B plane. Notice that I am reflecting B into this A plane. I am assuming that A is acting as A mirror plane and B is being reflected then; obviously, C will again reflect here as C A will reflect as A. So, now, the sequence below will instead of CBA will change into BCA. So, we will have BCA BCA.

So, this entire block, the lower block of crystal can be thought of as mirror image above the twin plane, this mirror plane is what now becomes the twin plane. So, we can think of one side, we can think of as original crystal. In fact, both are mirror images of each other. So, which one you call as a original is your choice, but since I have called the lower one as mirror image, I am calling the upper one as original crystal, and then the lower one as mirror image, the A plane being the mirror plane or the twin plane.

So, this becomes my twin boundary and you can see that C is being reflected to C A is being reflected to A. So, the entire block below has been reflected in this A plane to give you this new sequence, this new sequence unlike a stacking fault, a stacking fault you remember we had just inserted one plane or we could have removed one plane also to create the stacking fault, but here we have actually creating a new sequence which is A mirror like sequence of the crystal on the other side of the mirror plane.

This changes the orientation, the orientation now unlike in the stacking fault. The orientation here is not the same. So, this is a different orientation, and the two orientations are related to each other by mirror reflection. So, we can give a sort of general definition of twin boundary.

(Refer Slide Time: 06:37)



For our purposes, it is not totally general, but most twin boundaries are like mirror planes. So, twin boundary is a boundary crystals on either side are mirror images of each other.

It quite often happens that these twin boundaries, when you see it in a microstructure . So, these let us assume that these are grain boundaries and in this grain somewhere, they will A A given grain will have a twin boundary, and micro structurally twin boundaries are usually quite flat O, and they usually do not occur singly they occur in pair. So, you can see that this will have some given orientation, let us say O, then this is a reflected orientation R, because there is a reflection in the first twin plane.

But then there is another reflection on the second twin plane and the reflection of reflection will reproduce the original orientation. So, this will again have the same orientation. So, orientation on either side of this double twin will be the same, same orientation. So, we can assume them to be a single grain, single grain divided by a twin.

So, in such cases where you have such pair of twin boundaries then the region between the twin boundary is called the twin, and on either side you will call just the grain or the parent grain. So, you have parent grain or parent crystal on either side, and the twinned crystals on inside of these twin boundaries. This is a useful microstructure one, often sees in metallic crystals having twin boundaries.