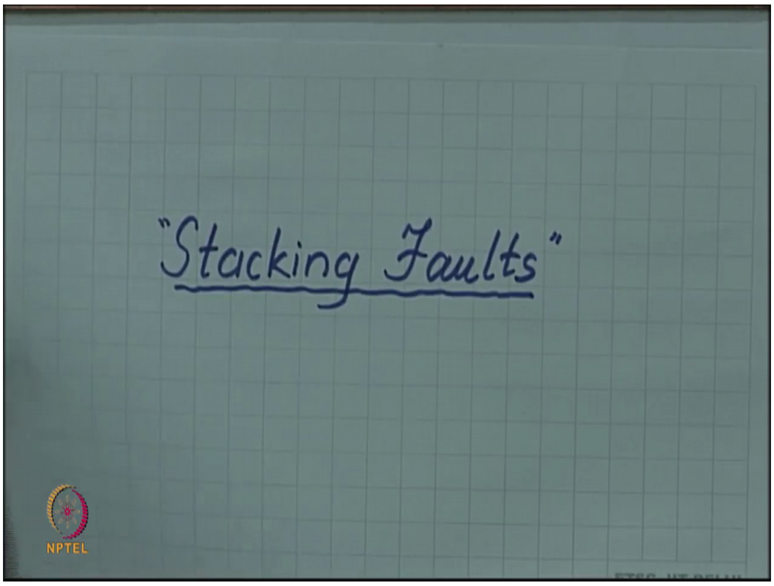
Introduction to Materials Science and Engineering
Prof. Rajesh Prasad
Department of Applied Mechanics
Indian Institute of Technology, Delhi

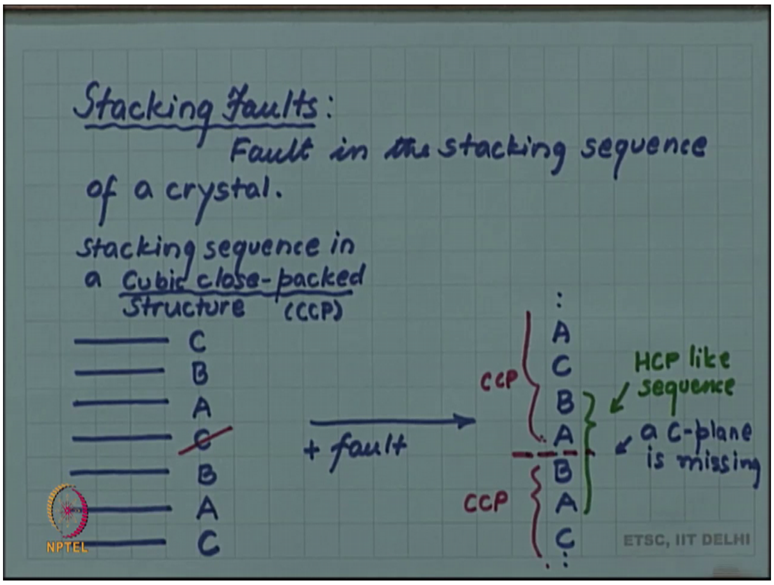
Lecture – 61
Stacking faults

(Refer Slide Time: 00:06)



We are discussing various kinds of crystal defects and we have already discussed line and point defects and currently we have been discussing the surface defects, and in the classification scheme which we showed to you in off surface defect, one of the surface defects was a stacking fault which is what we take up today. So, a stacking fault as the name suggests

(Refer Slide Time: 00:46)



Stacking faults is fault in the stacking sequence of a crystal. This is in relation to close packed structure you can understand. So, let us consider the stacking sequence of a close packed structure.

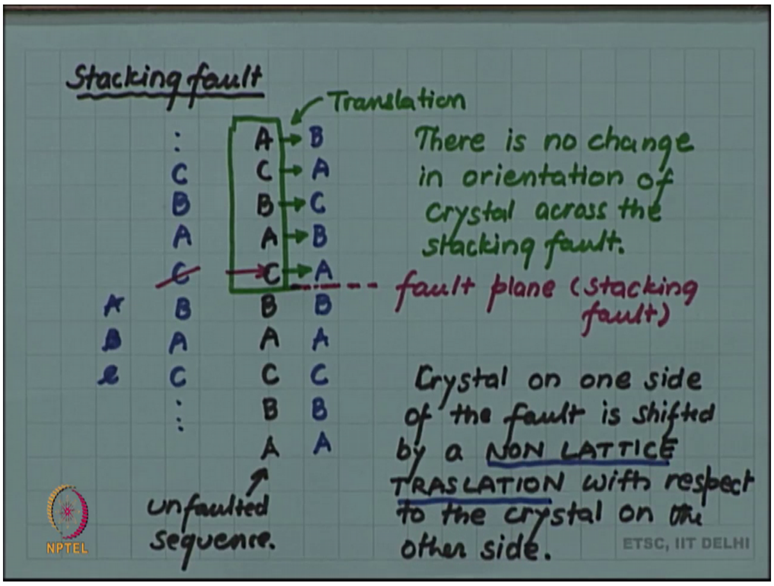
So, let us take a cubic close pack. So, we can think of the stacking sequence as A B C A B C. Now we can convert it to a faulted structure so this will be we know that A B C, A B C stacking sequence we have studied about it gives us a cubic close packed or a CCP a structure. So, each of these letters as you know represents a close packed plane represents a close packed plane. So, each of them is a plane which i am showing in edge view here and these planes are displaced with respect to each other and that is what the letters stand for.

So, A is exactly above A, B is exactly above B, but B is shifted with respect to A. We have discussed these in detail when we were discussing the cubic close packed the structure. Now think of a faulted structure so we are going to convert it into a faulted structure and let me try to remove one of the C planes. So, the fault is to remove this C plane. So, then the structure which i will get will become C A B and then C is missing. So, I again get A B C and it will continue. So, we are introducing a fault here, now if you study this structure you can see that you if i start with the C and look at the stacking sequence i have C A B then i expected A C C A B completes 3 plane repeat sequence and then i expected a C here that C we have deleted.

So, at this location there is a plane missing. So, this C A B region and further down is perfect CCP and if i look up again i have A B C A B C. So, this also is a perfect C C P, but somehow at this plane if i make a transition C A B then i was expecting C that is not there and then A B C A B C. So, if I cross this plane which is the fault plane the sequence is not what i was expecting it to be, and in fact if you locally see. So, the sequence is A B A B. So, it is like H C P like structure H C P like sequence near the fault plane.

So, this kind of defect can naturally occur in the crystal when the crystal is growing by addition of a newer and newer plane and where the C plane should have started if a plane is start because notice that both A and C have a identical probability to nucleate over B because geometrically the 2 locations are equivalent. So, only in the long-range structure it affects the energy for the local we nearest neighbor distance we cannot find any difference between whether the plane above B is A or is C. So, if by mistake as a plane comes over B where actually C plane should have come then we have a fault plane and this will be a 2-dimensional defect this entire plane will be a defect and that will be a stacking fault.

(Refer Slide Time: 06:40)



We can define it little bit more generally. Let us look at that fault again so we had we had the structure C B A, sorry the way i had written last time C A B, C A B and so on and i removed a C plane to create the defect. So, I got C A B A B C this is the fault plane. I have added few more planes here to show you that if you see the orientation of the crystal is not changing across the fault plane, this is the fault plane or this is our stacking fault.

So, the sequence here below the fault plane is A B C A B and then C was expected it is missing and above the fault plane also it is A B C A B. So, there is no difference in the orientation of the crystal below the fault plane and the crystal above the fault plane. So, let us note that. So, this is a difference from the different from what we studied in grain boundary where across the grain boundary the 2 crystals were differently oriented, but here across the stacking fault there is no change in the orientation crystal cross the stacking fault.

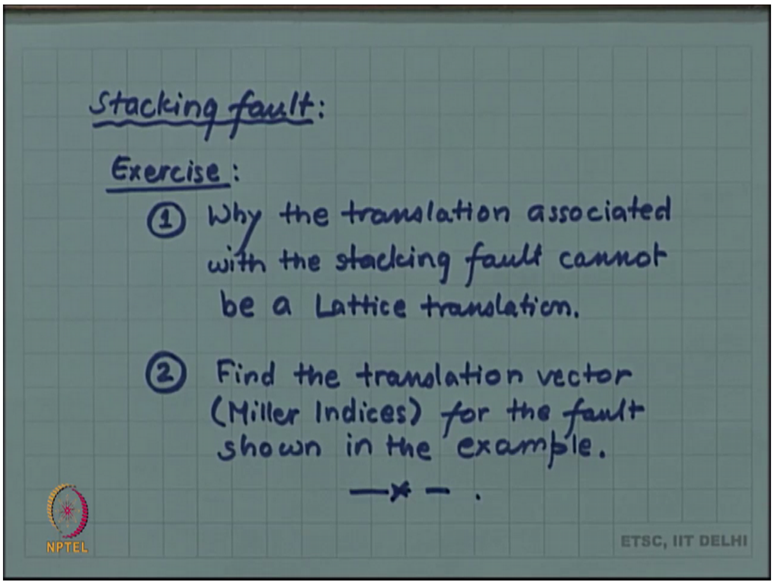
So, they are in the same orientation this means that this is a kind the difference between the 2 crystals is in this stacking and we can produce one side the crystal on one side of the fault with respect to the other side by a simple translation. Since they are in the same orientation the only difference can come from translation. So, we can write crystal on one side is shifted by a non-lattice translation with respect to crystal on the other side.

So, essentially let me try to write the sequence for unfaulted crystal. So, A B C, A B C, A B C this would have been an unfaulted crystal. So, you can see below the below the fault plane unfaulted sequence and the faulted sequence is the same. Fault begins from the fault plane where instead of C plane we now have a plane. So, the shift which you have is what takes you from a C plane to A plane. So, a translation which makes C plane to a plane will also make A into B and B into C, and the same thing will continue C into A, A into B and B into C.

So, this is the translation. So, the entire block of the crystal entire block of the crystal above the fault plane is shifted by a single translation vector to give you the crystal on the other side of the fault plane and make this plane as the fault plane. So, grain boundary is maybe had noted this grain boundary is a rotation boundary where as a stacking fault is a translation boundary please note this comment here that a non-lattice translation.

So, I leave these 2 as a exercise questions for you.

(Refer Slide Time: 13:26)



Why the translation associated with the stacking fault cannot be a lattice translation, why am I emphasizing a non-lattice translation, in the second i claimed in the last slide that one part of the crystal was translated with respect to the other part. So, you can try to find the translation vector when i say find the translation vector i mean the Miller Indices of the translation vector for the fault shown in the example.

So, with this we finish the discussion on a stacking fault.