Introduction to Materials Science and Engineering

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Lecture – 59
2D defects: Surfaces or interfaces

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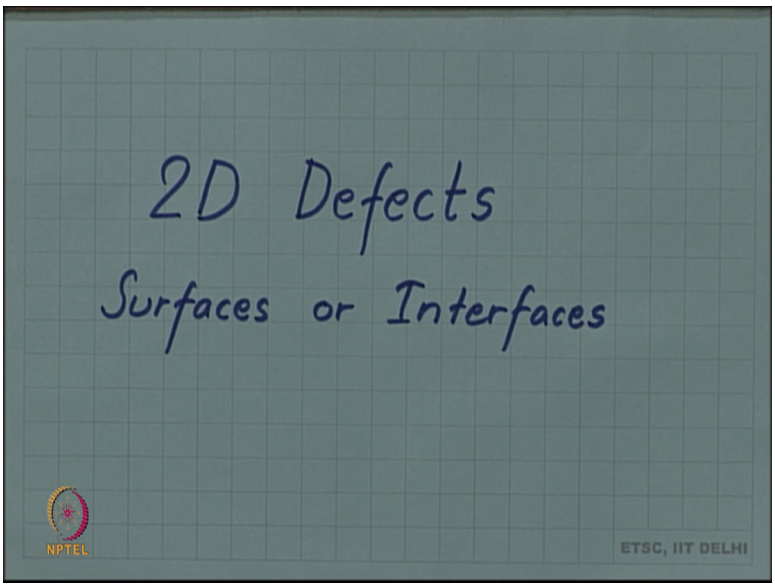

We have been discussing the defects in crystalline solids and we classified them on the basis of dimensionality. And we discussed 0-dimensional defect which was vacancy or interstitial. We also discussed 1 dimensional defects which were the dislocations and we a spend quite a bit of time on dislocations. Now the time has come to discuss 2 dimensional defects in crystal and these are surfaces or interfaces, these also play a very important role in determining the properties of crystalline solids and we will spend some time on discussing surfaces and interfaces.

So, let us first have a classification.

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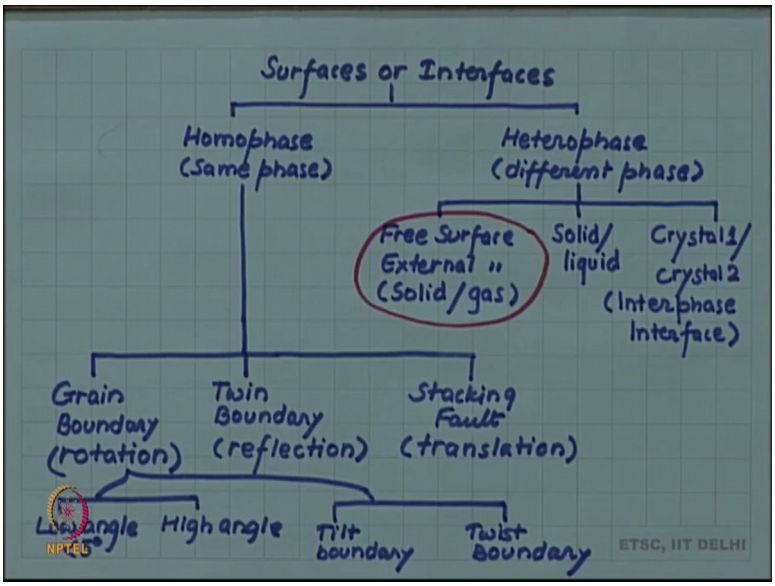

So, of surfaces and interfaces in a crystalline solid. So, I will give you a classification a scheme surfaces or interfaces. So, initially let us divide them into homophase. Homophase interfaces or heterophase interfaces, as the name suggest homophase means they will be across the interface same phase will be there. Whereas, in heterophase across the interface different phases will be present. So, for example, the free surface of the solid is an example of a heterophase interface because on one side you have a solid so free surface or external surface. So, one side you have solid and another side you have gas or vacuum.

So, it is a solid gas interface so it is a kind of heterophase interface because across the interface you have one side a solid another side gas. Another example important example of heterophase interphase is a solid liquid interface very important in casting. So, we have a solid liquid interface and we can also have a solid heterophase interface in which one side we have crystal one and another side you may have another crystal 2. Sometimes this kind of interfaces can also be called interphase because you have 2 different phases interphase interface. So, it is an interface across which you have 2 different crystalline phase.

For example, on one side one can have a body centered cubic a structure and another side one can have a face centered cubic a structure. So, that will give us an interphase interface. So, interphase interface, solid liquid interface an external surface of a crystal in which one side you have a crystalline solid and another side you have gas it all are example of heterophase interfaces, but another important class of interfaces in the crystalline solid is homophase

interface in which on both sides you have the same phage a still there is some difference on the 2 sides and that is why you create an interface there.

So, in this kind of interfaces one of the important class is what is called grain boundary, grain boundary then you have twin boundary, you also have stacking fault all these are special kind of boundaries and across these boundaries the phage or the crystal structure does not change. What changes in the case of grain boundary? The orientation changes and this is a rotation type. So, one side the crystal on one side of the boundary is rotated with respect to the crystal other side in the twin boundary it is a reflection boundary the crystal on one side appears to be reflected or a mirror image of the crystal on other side and this stacking fault is a translation boundary.

So, the orientation of the 2 crystals on either side of the stacking fault is the same, but a still there is not perfect matching because on one side the crystal is translated with respect to the other side. So, that causes a stacking mismatch or a stacking fault grain boundary can further be classified by there are 2 ways of classifying. So, on one way we can talk of a low angle boundary, if the rotation angle is small we call it a low angle boundary or if the rotation angle is large we call it high angle boundary.

Usually less than this is a low angle high angle classification of course, is a rough classification. So, maybe let us say less than 5 degree we can call it low angle boundary and higher than 5 degree we can call it high angle boundary. Another classification is scheme is to classify them as tilt and twist boundary. So, one kind of boundary can be called a tilt boundary another kind of boundary can be called a twist boundary.

So, we will have something to say about all these boundaries in the subsequent lectures. So, we will discuss in particular we will begin with the discussion of the free surface or external surface of the crystal is an important one, and then we will also discuss on grain boundaries and twin boundary stacking fault. So, the, these are the topics which we are going to discuss in the coming videos.