Introduction to Materials Science and Engineering
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Lecture - 43
Defects in crystals

So, today's topic is the Defects in Crystals. It is a very very important topic in material science because what we have discussed till now is ideal crystal, but the defects in crystal also control the properties of a the crystalline materials.

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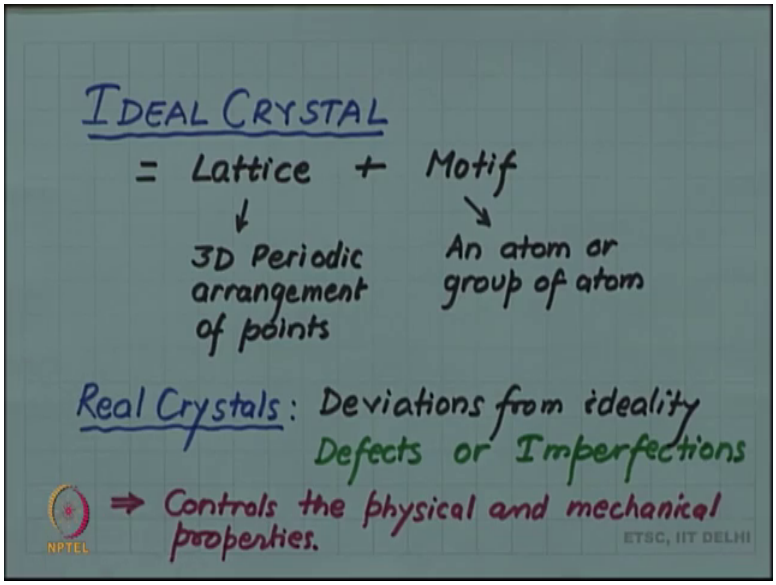

So, what we have been discussing till now is the ideal crystal which we discussed in terms of lattice and a motif and we said that the lattice was a 3D periodic arrangement of points, 3 dimensional periodic arrangement of points and motif then on each of these points we put an atom for a group of atom, atom associated with each lattice point.

So, this was the theme and we developed this theme in great detail with the several examples we have seen. All those examples till now was of ideal crystal these crystals were not supposed to have any defects. But then real crystals we will show deviations from ideality real crystals will exhibit deviations from ideality, these deviations are what are termed as defects or imperfections and they are very important topic in material science because these defects or imperfections control the properties of material. So, they

are very important in controlling both physical and mechanical properties, chemical properties.

So, it is important to have a serious study of defects in crystal of course, to study the defect why we spend considerable amount of time in ideal crystal is that defect can always be with respect to deviations from ideality. So, we have to know what ideal structure we are talking about then only we can talk about the defect or a structure defect.

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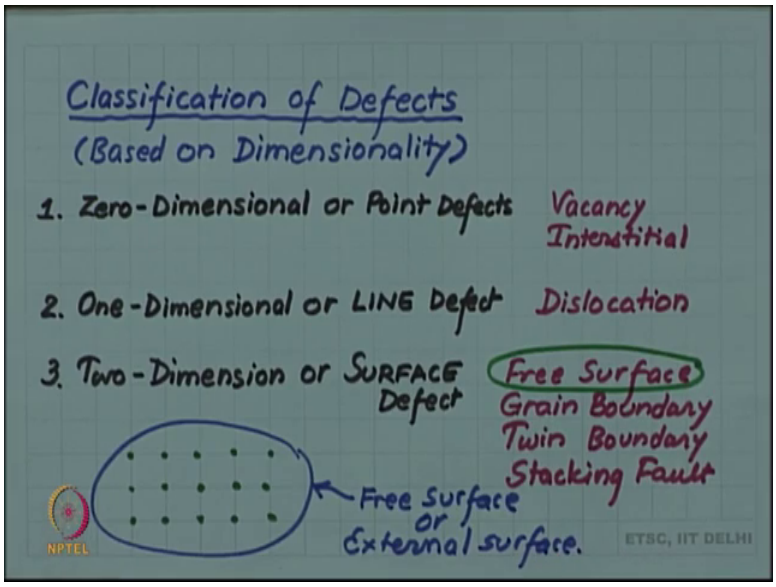

In the structure defects can be classified in one way of classification is based on the dimensionality. So, this classification which we are going to give you is based on the dimensionality.

So, we can have 0 dimensional or can also be called point 0 dimensional or point defects an example of such defects will be vacancy, another example can be interstitial we can have one dimensional or line defect and the example will be dislocation. We can have two dimensional or surface defect and some examples will be free surface grain boundary, twin boundary, stacking fault, all these are examples of surface defect. So, we will look at all these whatever examples are listed here we will look at them in detail one by one.

One may think that why the crystals are not ideal why do they have defect first of all one defect this free surface will always be present in the crystal because our crystals are finite

and the definition of periodicity requires an infinite crystal since all lattice points have to be identical there cannot be any surface. So, the very fact that the crystal is bounded by a surface because our real crystals will always be a finite crystal it will have a boundary line and that boundary or the external surface that is why we are calling. It is defect because it may appear that why should be a free surface a defect.

But a free since by definition of periodicity of ideal crystal the requirement is of an infinite lattice, so on your infinite lattice can be an ideal lattice any boundary will break the periodicity and free surface breaks this periodicity and so the free surface or sometimes called external surface will always be present in any crystal. However, perfect it is internally this external surface will always be present in a real crystal. So, we will now look at a one by one these defects as we go along.