Introduction to Materials Science and Engineering
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Lecture – 115
Strengthening mechanisms

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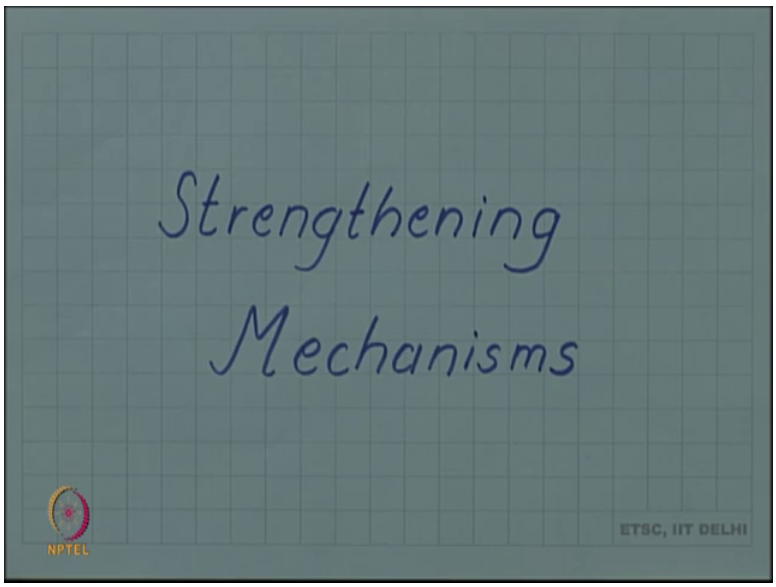

Let us discuss an important topic in materials engineering called Strengthening Mechanisms.

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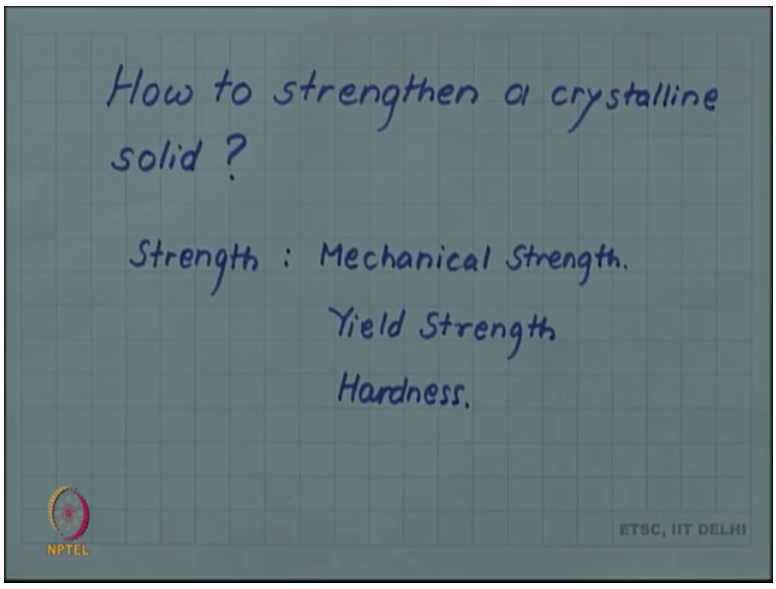

Essentially the question is how to strengthen a crystalline solid by strength. Here we mean the mechanical strength as measured let us say by uniaxial tensile test which will give yield strength, or an indentation test which will give us hardness. So, these are measures of mechanical strength.

And in many applications higher the strength better it is because it can carry more load, or it can be used for reduction of the weight because a smaller cross section of the material can carry the desired load. So, how to strengthen materials?

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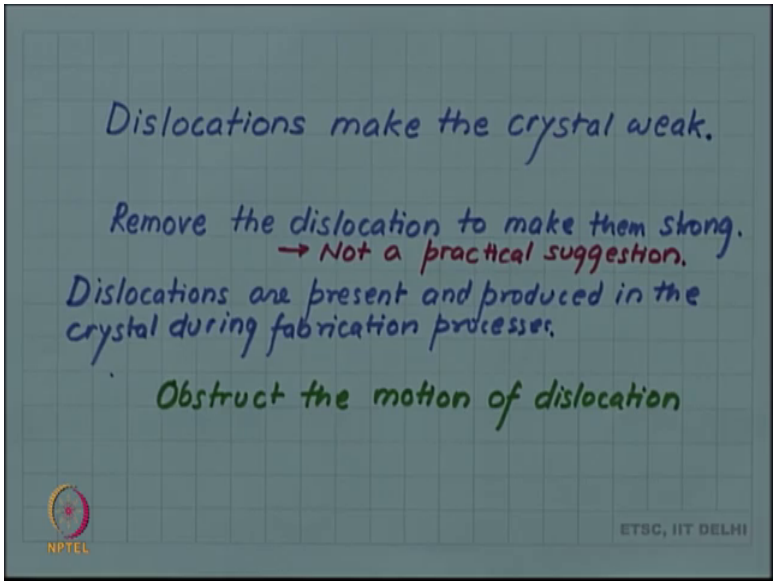

Now what we have been discussing now that dislocations make the crystal weak this was the content of the last video. So, one can think of a way of strengthening as simply to remove this dislocations. Remove the dislocations to make them strong only this is not a very practical suggestion because in most cases the dislocations actually appear in the crystal during production, and fabrication processes. So, dislocations are naturally present in the crystal present and they are produced in the crystal during fabrication processes.

So, this suggestion is not very practical because you cannot really make a dislocation free crystal making dislocation free crystal is not easy. Careful experimental control can sometimes produce dislocation free crystal, but that is done on a laboratory scale and in a smaller crystals and it is not very practical. So, remove the dislocation is not a practical suggestion.

So, if we have to live with dislocations how can we make the crystal stronger? So, for that the other alternative is to the plastic deformation is happening because of the motion of dislocation. So, if we can obstruct the motion of dislocation if we can obstruct the motion of dislocation, because we cannot get rid of them then you can put obstacle in their path of motion. So, that their motion is difficult if their motion is difficult plastic deformation will be difficult, and the material will be stronger.

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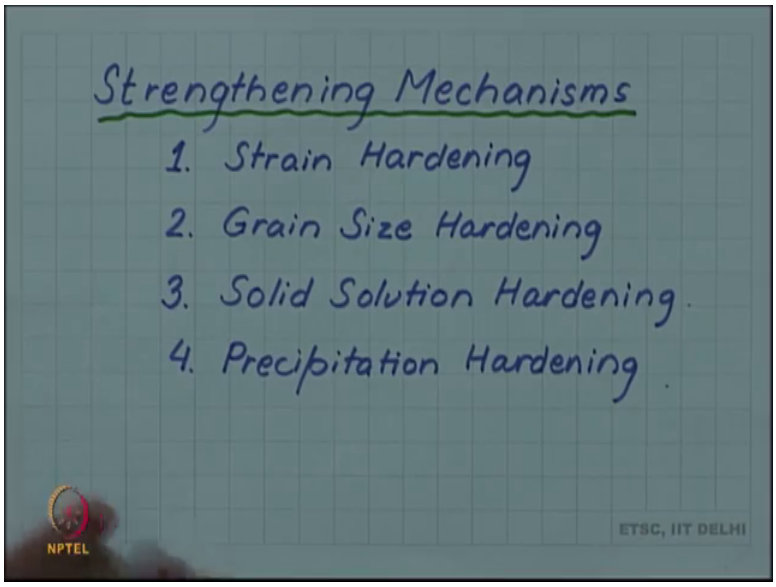

So various kind of ways various ways have been used are used in engineering to achieve such kind of strengthening, and they have been labeled as strengthening mechanism. So, I have listed 4 strengthening mechanism, 4 important strengthening mechanism. Here strain hardening, grain size hardening, solid solution hardening, and precipitation hardening. As we go along we will discuss these strengthening mechanisms.