Introduction to Materials Science and Engineering
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Lecture – 120
Dislocation interaction leading to strain hardening II

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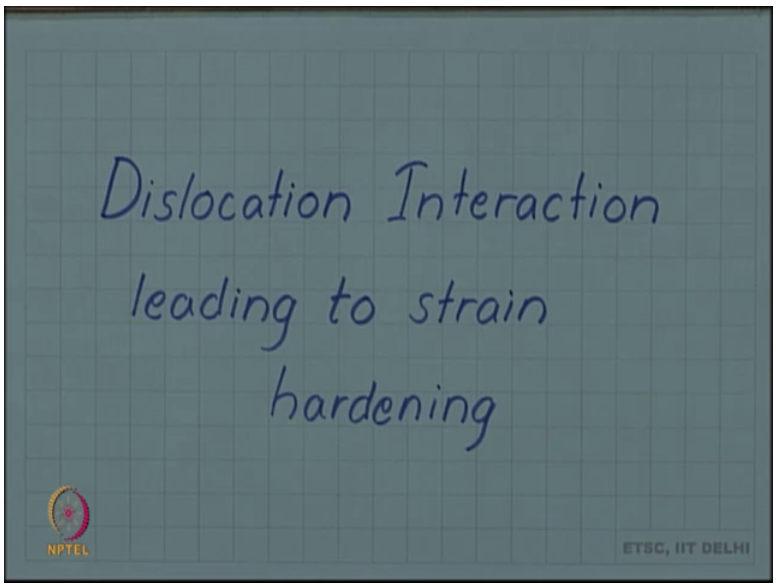

We have been discussing a strain hardening and we related strain hardening to the increasing dislocation density of the crystal.

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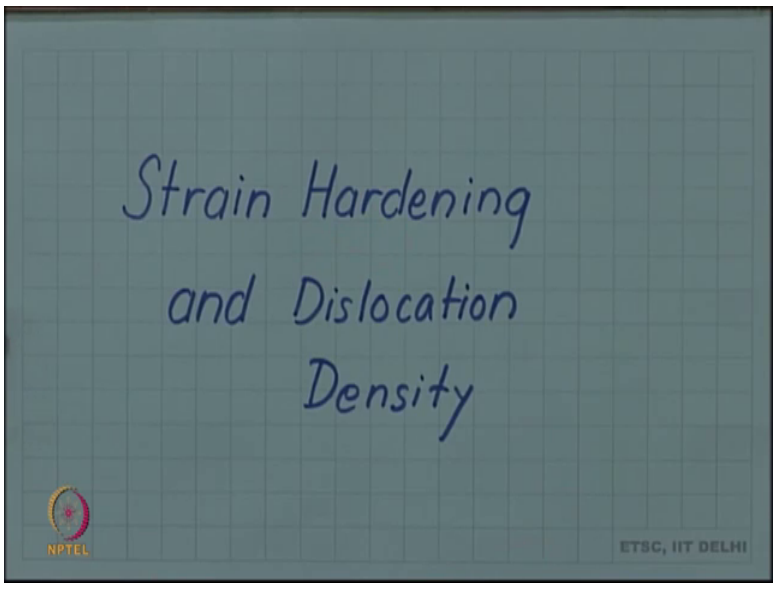

So, people have tried to establish empirical as well as some sort of theoretical relationship between strain hardening and dislocation density. So, let us look at one such relation. So, the relation itself is quite simple.

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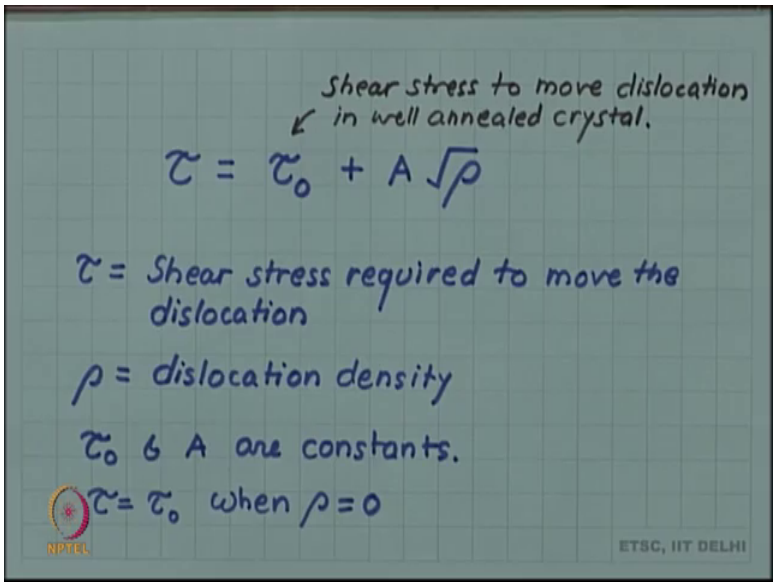

We can write the relation as tau is equal to tau naught plus A square root of rho, where tau is the shear stress required to move the dislocation, that is the critical resolved shear stress, which initiates the dislocation motion.

Rho is the dislocation density and tau naught and A are constants. You can see as the dislocation density will increase, the stress required to move the dislocation will also increase. We are not deriving this relationship a simple derivation sometimes is possible in terms of simple model of dislocations, but we will not go into that and empirically also sometimes such correlation can be established.

A meaning of tau a meaning to tau naught can be attached, because if you see that tau will be equal to tau naught if rho is d 0. So, tau is equal to tau naught when rho is 0. So, in a sense tau naught is the resolved shear stress required at 0 dislocation density

Now, as we have seen 0 dislocation density that is dislocation free crystal are quite impossible. So, for all practical purposes if you have very well annealed crystal with very low dislocation density, we saw that dislocation density varies by several orders of magnitude. So, if you have sufficiently well annealed crystal, it will have a rather low

dislocation density not anywhere close to 0, but it still for practical purpose that can be used as the tau naught. So, we can write tau naught as shear stress for well annealed crystal.