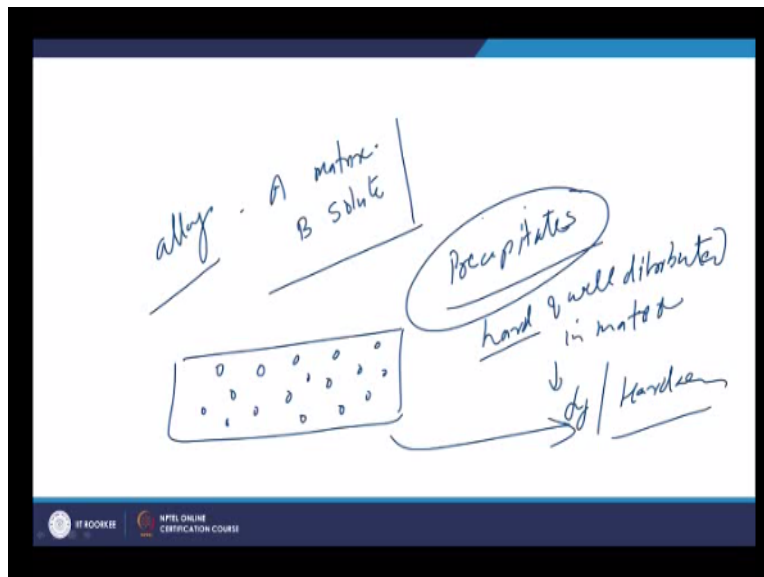


Weldability of Metals
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Lecture-06
Weldability of Precipitation Strengthened Metals

Hello, I welcome you all in this presentation related with the subject weldability of metals and so far we have talked about the weldability of the work hardenable metal. And now in this presentation we will be taking of the weldability of the precipitation hardenable metal or precipitation strengthened metal systems . So, let us understand first how does this mechanism work those metal systems.

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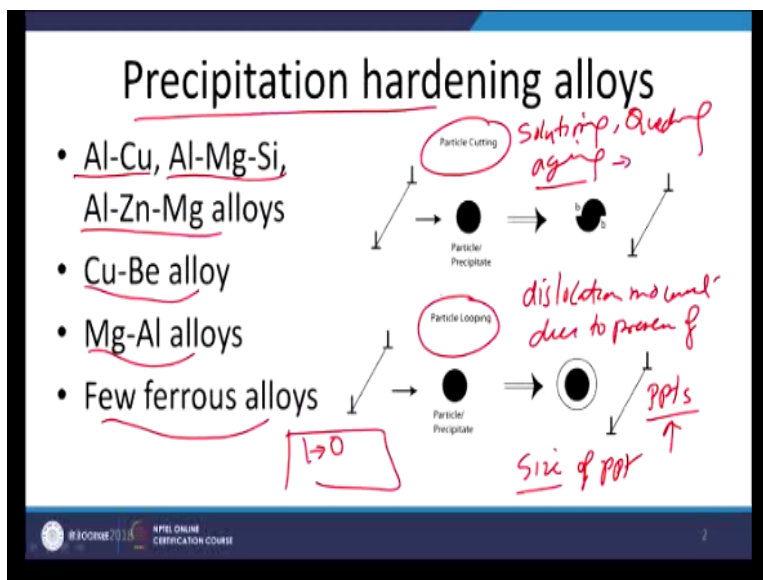


Like the alloys A is the matrix and B is there as a solute, if B is having the solubility in A which is changing as a function of temperature . Then it helps to offer the precipitation it helps to develop the precipitates and this precipitates if these are hard and well distributed in the matrix. Then these help significantly in increasing the yield strength and the hardness of the material.

So, the matrix having the fine well distributed hard particles in form of phases and precipitates . This kind of the fine well distribution of the precipitates helps in strengthening the metals . So, but these kind of the precipitates are formed in certain category of the aluminium alloys, ferrous

alloys, copper alloys and the titanium alloys. So, If we see the details of the metal systems which can be strengthened by the precipitation strengthening.

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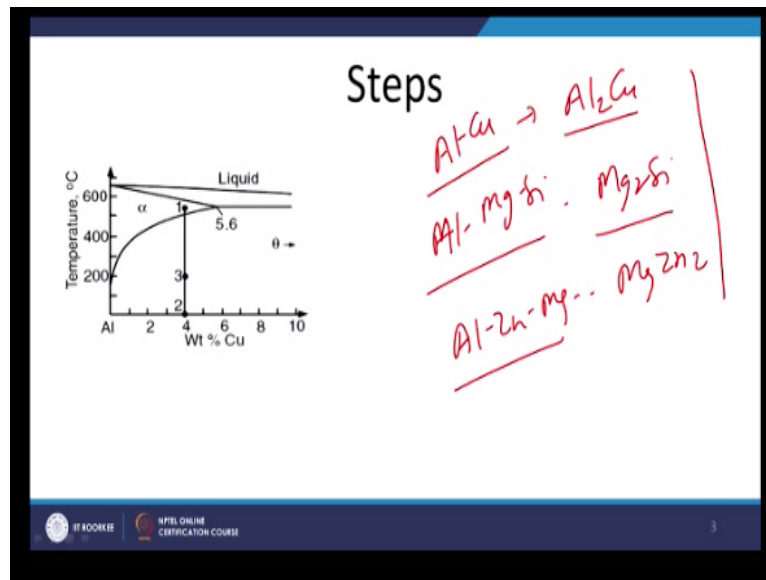
These are the aluminium copper alloys, aluminium magnesium silicon alloy, aluminium zinc magnesium alloy, copper beryllium alloy, magnesium aluminium alloys and some of the ferrous alloys. And whenever we give the controlled heat treatment of solutionizing followed by quenching and then aging. Then these fine precipitates as per the metal systems are formed and which in turn helps in increasing the strength and the hardness of the metal system.

Whenever these precipitates are formed basically the mechanism which is helping to increase the yield strength of the metal is the increased barrier to the dislocation movement due to the presence of these precipitates. The mechanism of the strengthening depends upon the size of these precipitates like in a material if the dislocations are moving.

Then the dislocation barrier to the movement of dislocation will be offered by these precipitates. So, if the precipitates are well distributed in the matrix then there will be lot of resistance for the movement of dislocation and which in turn will help in increasing the yield strength. There are 2 mechanisms which are there in which play a big role in strengthening of the metal strengthened by the precipitation hardening.

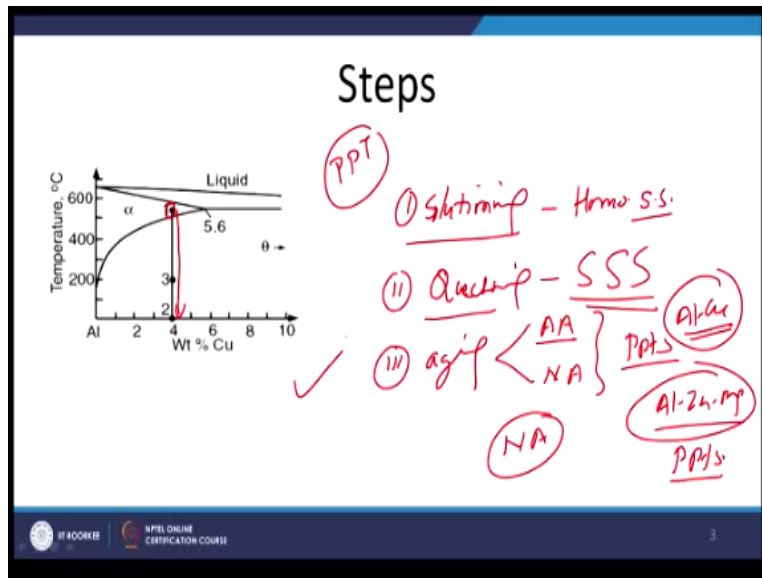
One is the cutting of the precipitates and another is the going down around the precipitates. So, both these mechanisms contribute to the strengthening of the material as per the size of the precipitates. They are different types of the precipitates which are formed as per the type of metal system. For example aluminium copper is one precipitation strengthening metal system where Al_2Cu is one of the typical precipitate which is formed.

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In case of the aluminium, magnesium, silicon, alloy Mg_2Si is the precipitate which is formed and similarly in case of the aluminium zinc magnesium it is the MgZn_2 precipitate which is formed. And when these precipitates are well distributed in very fine size in the matrix then these contribute in big way towards the strengthening of the metal system.

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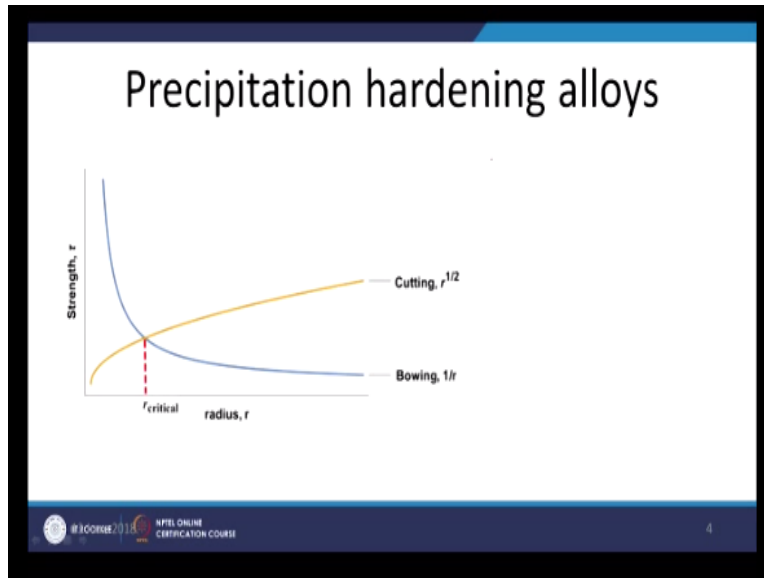
For development of these precipitates there are 3 steps which are used one is called solutionizing where the alloy is heated to the temperature high enough above the solvus line. So, that the homogeneous solid solution is formed thereafter from this after the heating it is quenched rapidly. So, that we get the supersaturated solid solution after the quenching we get the supersaturated solid solution where alloying element will be present in the quantity.

Or in the amount or in the solid solution much more than it is ability to get dissolve that is why it is supersaturated solid solution. And third step is the aging, now aging can be performed at high temperature then it is called artificial aging or it can be performed under the ambient condition then it is called natural aging. In both the cases precipitates are formed the few metal systems like aluminium, zinc, magnesium.

In this case the precipitates are formed slowly while in case of the aluminium copper systems, the precipitation is very fast. So, these respond rapidly to the heat being supplied during the welding or subsequently during the aging. This will be hardened rapidly as compare to the aluminium, zinc, magnesium system. So, aluminium, zinc, magnesium alloys why offers very good improvement in the strength and hardness even after the natural aging while response of aluminium copper system is somewhat less for the natural aging.

And that is why artificial aging is normally performed for strengthening of the aluminium copper alloy, so these are the 3 steps for strengthening purpose.

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And now will see what are the different precipitates are formed.