Introduction to Materials Science and Engineering
Prof. Rajesh Prasad
Department of Applied Mechanics
Indian Institute of Technology, Delhi

Lecture - 69
Phases present in the system

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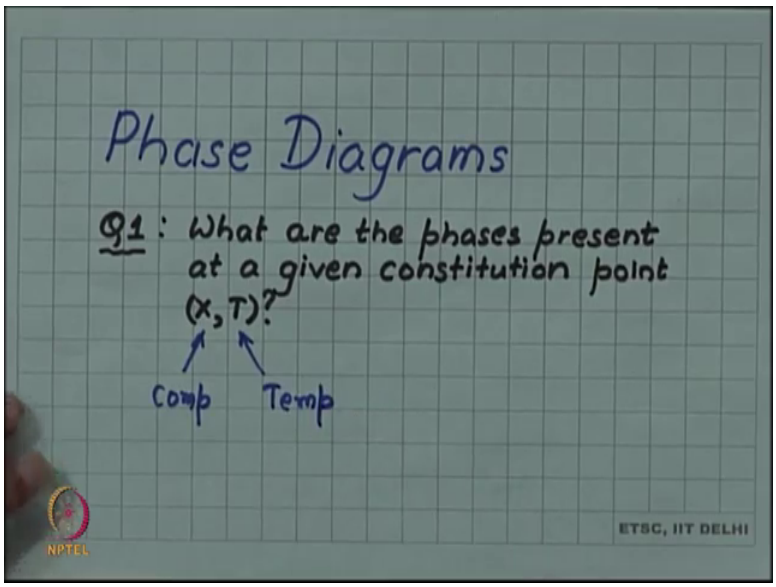

So, as we saw we had three questions which a phase diagram can answer and we are now going to take up these questions one by one. The first question is what are the phases present at a given point in the phase diagram at a given composition remember the x coordinate is composition and the y coordinate is temperature.

So, at a given composition and temperature what are the phase is in equilibrium. This is a very important and a very direct question and can be answered very simply by just looking at the phase diagram.

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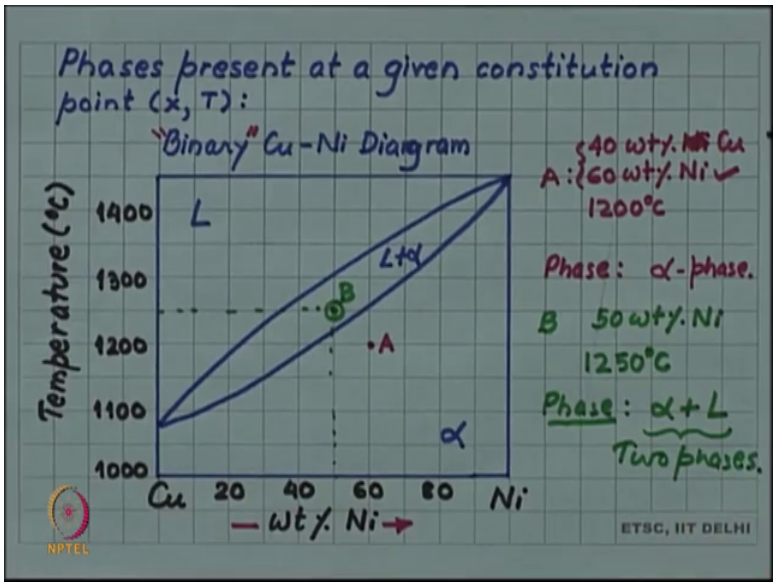

So, remember we come to our familiar binary copper nickel diagram. So, binary copper, nickel diagram you we have been using. In fact, we have introduced only this phase diagram as yet.

So, you are quite familiar with this now, binary copper nickel diagram and we saw that this region is the liquid phase, this region is a solid solution phase which we call alpha and this region is a two phase region. Then depending on where my constitution point is. So, for example, if I look at let us say this point. So, this point is let me call this point A. So, point A first of all if I look at its x component that is 60 weight percent nickel.

So, this means it is an alloy of 60 weight percent nickel and if I look at the y coordinate it is 1200 degrees Celsius. So, a 60 weight percent nickel alloy and I am only writing 60 weight percent nickel because we have binary alloy. So, this is the convention in binary alloy since the other component; obviously, will be 100 minus the component which you have given.

So, for example, 60 weight percent nickel automatically means that it is 40 weight percent copper. So, if you service you can write, but giving one component the proportion of one component it is sufficient to define the composition for binary alloy. So, we have 60 weight sorry 6 40 weight percent copper. So, 60 weight percent nickel 40weight percent copper. Either of them you can give, but we since we are saying that we are using weight percent nickel as our composition axis.

So, we will give 60 weight percent nickel as the composition of this alloy. So, this is my point and the alloy has been equilibrated at 1200 degree Celsius. So, the question what is the phase here? All you have to do is to see in which region it is falling. Since it is falling in the alpha region we will say that this is an alpha phase phases alpha phase.

Now, let us look at another alloy just look at this one alloy B or constitution point B. So, if we now look at its x component that is 50. So, the composition is 50 weight percent nickel there is a 50-50 alloy and if I look at the temperature I find that it is 1250 degrees Celsius. So, an alloy of 50 weight percent nickel, 50 weight percent copper is being headed at 1250 degrees Celsius.

So, what are the phases present? So, this time we get a little bit more interesting answer because now it is falling in the two phase region. So, we will find that two phases are present in this alloy. So, both alpha and liquid are present at this point. So, at this point if I take such an alloy and heat it to 1250 degrees Celsius and hold it in equilibrium at; that means, I wait for long enough time for equilibrium to be achieved then I will find that alloy is a mixture of two phase two phases.

So, this is a two phase structure, this is the basic function of a phase diagram and this is something which phase diagram can very easily answer you just have to look at. But plot the point of your interest on the phase diagram and read the phases present.

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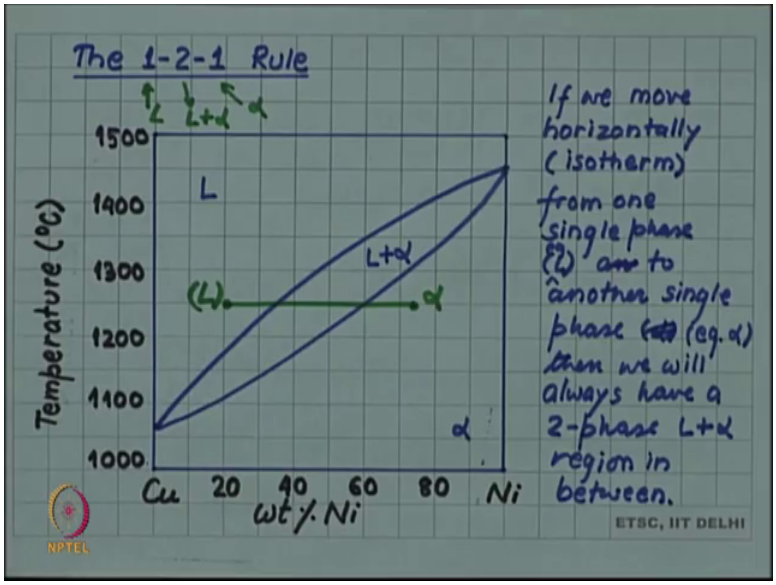

An interesting thing which happens when you let me draw the boundaries an interesting thing which happens when you look at a phase diagram if we have only looked at this phase diagram as yet, but you must notice that if I am dead on the left hand side is the liquid phase on the right hand side is alpha phase and in between liquid plus alpha phase is there this is not by accident, but this is always going to be true in a binary phase diagram. So, we write it as a rule. So, that is if I cross phase boundaries across a horizontal line such that at one end I have a given phase and at another end I have another single phase at one end I have one single phase that is what this one means that I have a one single phage in this case liquid.

At another end I have another single phase alpha, then in between there has to be a region where mixture of these two phases should be present. So, liquid plus alpha. So, this is always true in a binary phase diagram and we call this with a name one to one rule always this name is very not very common in literature, but we will be using in this course.

So, let me write this down. If we move horizontally means a since our y axis is temperature moving horizontally is moving along an isotherm. So, if we are moving along an isotherm from one single phase one single phase in this case let us say example liquid two to another single phase in this example alpha.

This is for example, it can be any phage example liquid example alpha, then we will always have a 2 phase liquid plus alpha region whatever that single phases were there. So, if one phase was alpha another phase was beta then the two phase alpha plus beta will be present. So, we will always have a two phase region in between.

So, this is important and in fact, many standard phase diagrams which you will come across in the literature many times they will list only the single phase region because the two phase regions always can be found as the combination of those two single phase regions. So, sometimes you will find in the phase diagram that the two phase regions are not labeled. So, this one to one rule is helpful from that point of view.