Solid State Physics
Lecture 3
Indexing of Crystal Planes

Now, we shall discuss about the Crystal Planes. (Refer Slide Time: 00:35)

So, there is a particular indexing system for crystal planes we will talk about that. The orientation of a crystal plane is determined by three points on a plane provided they are not collinear. Collinear points would make a straight line, so, if we need only three points. But there is a conventional way of indexing crystal planes that conventional way is called the Miller indices. How these Miller indices are found? So, there are certain steps to follow. The first step is to find the intercepts of a plane on the axis in terms of the lattice constant that is $\overrightarrow{a_1}$, $\overrightarrow{a_2}$ and $\overrightarrow{a_3}$. And then the axis may be those of a primitive or non primitive unit cell. So, if we have for example, FCC cell then we can consider the primitive one that is of lower symmetry or the cubic one. Anything is fine, but one has to mention that this Miller indices are in reference with the primitive or the fc the cubic cell whatever it is. And then the next step is to take the reciprocals of those numbers and then reducing those numbers to three integers having the same ratio. Usually the smallest three integers are taken and the result is put inside a parenthesis as (hkl), so (hkl) are the Miller indices. Let us consider an example to find to understand the scheme that I proposed. Let us consider that there is a plane that makes intercepts with $\overrightarrow{a_1}$, $\overrightarrow{a_2}$ and $\overrightarrow{a_3}$ as 4, 1 and 2. Then we will take the reciprocal of these inverses that is $\frac{1}{4}$, $\frac{1}{1}$ $that\ is$ 1 and $\frac{1}{2}$. Now, if we multiply this by 4 all of this by 4 if we do that we will get $(1, 4and2)$. So, the Miller indices of this plane can be written as $(1\ 4\ 2)$. It could be a part of your homework to identify planes in a crystal lattice give, when the Miller indices of that plane is given. Now, for an intercept at infinity; that means, if that plane does not have any intersection with the crystal axis then the corresponding Miller index will be 0 because $\frac{1}{\infty}$ will come to be 0. And if the intercept is negative then we will have a negative Miller index. For example; if we have a negative Miller index then we write like this here the intercept with $\overrightarrow{a_2}$ axis is negative. And that bar at the top means its negative Miller index and there is another convention say we write $(2\ 0\ 0)$ this kind of a Miller index it could have been written $(1\ 0\ 0)$. So, we have parallel planes $(1\ 0\ 0)$ planes and $(2\ 0\ 0)$ would mean a plane that is at half a distance to that plane parallel to $(1\ 0\ 0)$ plane, but at half a distance that is $(2\ 0\ 0)$ plane. (Refer Slide Time: 04:58)

Then we have directions in a crystal, directions are written as $(u\ v\ w)$, so, these directions are just along the. So, these are the components from the axis for example, if we want to represent the $\overrightarrow{a_1}$ axis corresponding direction in a Miller index would be $(1\ 0\ 0)$. If we want to represent the negative of $\overrightarrow{a_2}$ axis the corresponding direction would be $(0\ \bar{1}\ 0)$ and so on. Now, we shall look into some simple crystal structures.