Transition Metal Organometallics in Catalysis and Biology
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Lecture – 59
Bioorganometallic Chemistry

Welcome to this course on transition metal organometallics in catalysis and biology, we have been talking about all the types of applications of transition metal organometallics in catalysis so far and today, we are going to move on to a very interesting topics about the transition metal organometallics in biology and hence we would be covering the field of bio organometallic chemistry.

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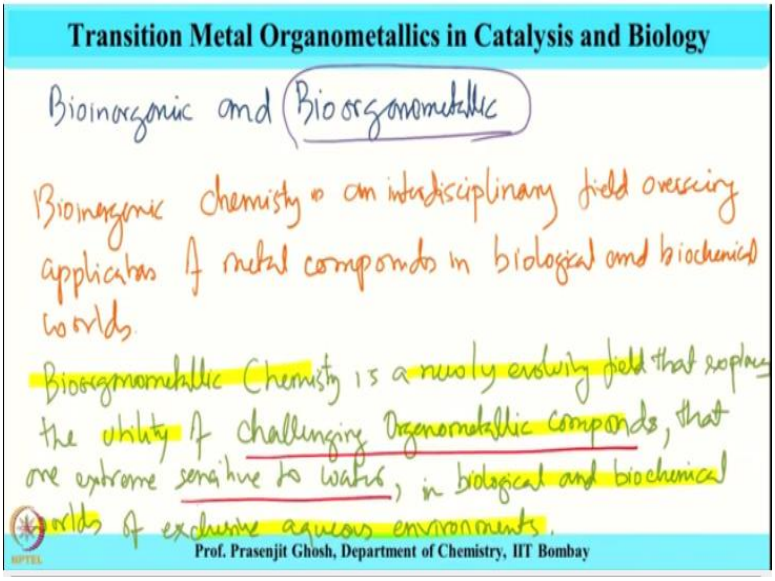

Now, bio organometallic chemistry can be seen in conjunction with bio inorganic chemistry, this is bio inorganic and bio organometallic, we are going to be primarily focusing on bio organic metallic part and there is a subtle distinction between bio inorganic and bio organometallic chemistry and let me elucidate that before we focus on bio organic metallic aspect of the chemistry discussion.

So, bio inorganic chemistry is an interdisciplinary field overseeing applications of metal compounds in biological and biochemical worlds. So, these consist of compounds which are inorganic organometallic and so on and so forth so, bio inorganic chemistry is a much broader field of applications of transition metal complexes which can be inorganic as well as

organometallic in applications complexes and their applications in biological and biochemical worlds.

Whereas, the one that we will be talking about and which is not often much spoken about is bio organometallic chemistry; bio organometallic chemistry is a newly evolving field that explores the utility of challenging organometallic compounds that are extremely sensitive to water. So, one aspect is the bio organometallic chemistry is explores the challenging organometallic compounds.

They are challenging because they are extremely sensitive to water in biological worlds, biological and biochemical worlds of aqueous of exclusive aqueous environments. So, this is sort of summarize the challenges that one encounters in bio organometallic chemistry. So, the field is newly evolving field that looks into utility of organometallic compound in biological and aqueous biochemical worlds of aqueous environments.

And the challenge over here arises from the fact that organometallic compounds are unstable in water, so this is a very exciting aspect by organometallic chemistry and that we are going to be focusing more on bio organometallic chemistry in this lecture, the applications of bio organometallic compounds in biologic; organometallic compounds in biological world. So, this is the focus of today's talk.

And nonetheless this field is evolving and growing into maturity and the biological organometallic chemistry has evolved in several directions and mainly I will summarize the different directions of bio organometallic chemistry.

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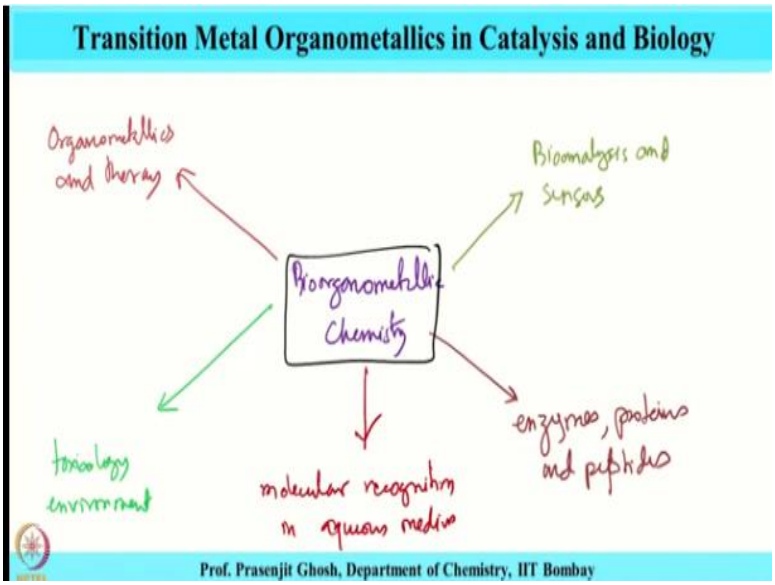

So, these has been used for therapeutic purpose, so this involves organometallic compounds which are used for therapy, so that is one directions in which organometallics is currently evolving, then the other in is in bio analysis and sensors also, there is a considerable amount of; not considerable but notable amount of organometallic compounds in enzymes, proteins and peptides.

This is what arises from the presence of organometallic compounds in biochemical world also, bio organometallic chemistry in molecular recognition in aqueous making medium, this is an expanding important area of work and last but not the least, these are also used for toxicological; toxicology environment. So, what one can summarise from here is that given the fact that organometallic chemistry is quite a new nonetheless the field has spread in several directions.

And we are going to be reviewing some of these great applications of organometallic chemistry, a bio organometallic compounds in all of these or some of these areas, so the transition metals to begin with transition metals has a wide utility in several purposes, medicinal values and maybe here is I am going to present a summary of various metal and their applications.

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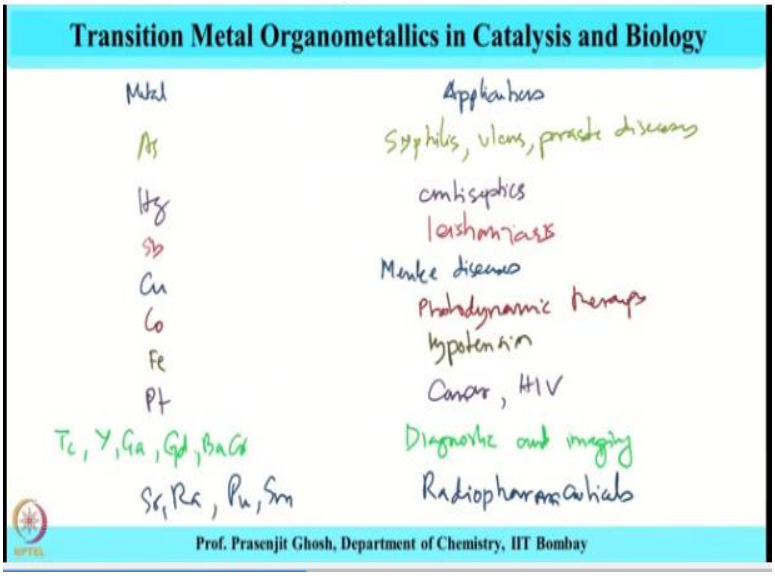

For example, silver is used for; arsenic sorry, for syphilis, ulcers, parasite diseases, mercury; mercury is for antiseptics, antimony for this is called leishmaniasis, then copper; copper for menkes disease, cobalt as well as photodynamic therapy, a photodynamic therapy, iron hypertension, hypotension, platinum cancer, HIV, then a branch of metals; technetium, yttrium, gadolinium, gallium, barium, chromium; diagnostic and imaging.

And strontium, radium, polonium, samarium; radio pharmaceuticals, the least sort of expand beyond to other metals, we will see.

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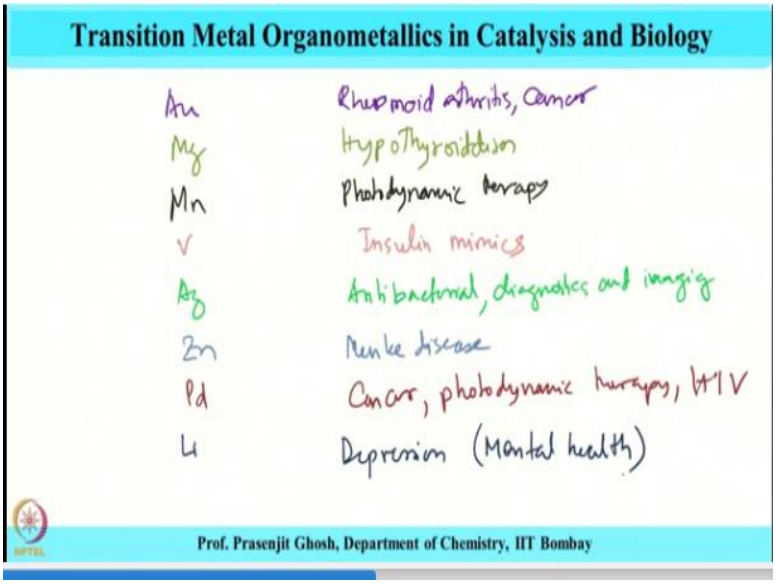

For example, gold in rheumatoid arthritis, cancer, then magnesium; magnesium in hypo thyroidism, then manganese photodynamic therapy, vanadium insulin mimics, then silver antibacterial studies, diagnostics and imaging, zinc Menkes disease, palladium cancer,

photodynamic therapy, HIV and lithium depression, mental health. So, what we see is that there is a great utility of various transition metal compounds.

Some of their inorganic, some of their organometallic, in the pharmaceutical world and they sort of have beneficial effect in treatment of wide range of diseases. Now, focusing on bio organometallic chemistry, we are going to look into organometallic compounds of these metals, which are either existing in biological world or they have utility as pharmaceuticals in medicinal chemistry.

So, these are the 2 main focus that we are going to look upon during this course of this lecture and to start with, we will talk about organometallic molecule, which is present in biological world and this is this vitamin B12, so vitamin b12 is an organic molecule which is a part of vitamin particularly, one specific vitamin called methyl cobalamin where there is a metal carbon bond present within a cobalt, within a prosthetic group containing cobalt.

And this is a molecule which is occurring naturally and hence it is kind of wonderful to see an organometallic compound being present in a biological world where the predominant exclusive environment, medium is an aqueous medium.

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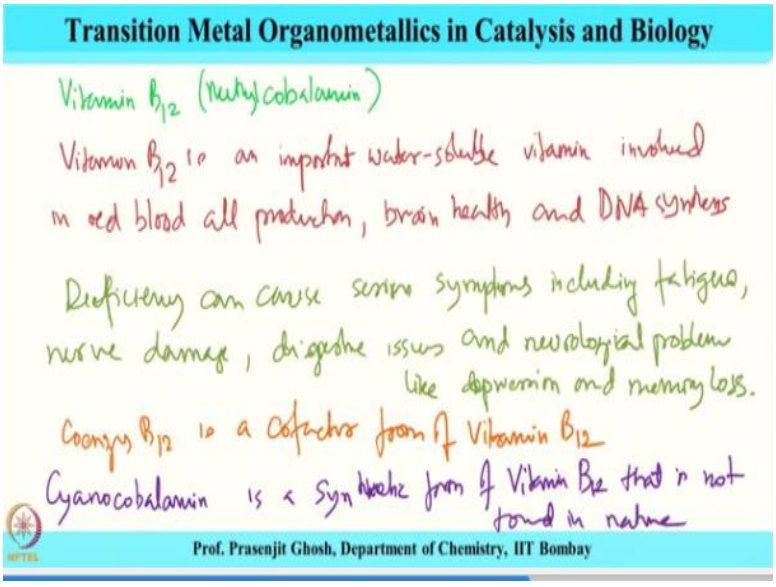

So, in terms of bio organometallic chemistry, the first name which comes to mind is vitamin B12 or methyl cobalamin. So, vitamin B12 is an important water soluble vitamin involved in red blood cell production, brain health and DNA synthesis. Deficiency of vitamin B12 can

cause serious symptoms including fatigue, nerve damage, digestive issue and neurological problem like depression and memory loss.

So, this is very important, vitamins are molecules you know which cannot, body cannot create and there has to; the required minute amount of quantities and they have to be supplied by some from the food chain, so co enzyme B12, another form of vitamin B is called coenzyme B12 which is a cofactor form of vitamin B12. So, another instead of there is another known form which is called cyanocobalamin is synthetic form of vitamin B12 which is a form during the isolation cyanide group is bound to cobalt instead of a methyl.

And that is not found in nature, so what nature contains is these methyl cobalamin which contains these methyl cobalt bond, so let me just draw the structure of methyl cobalamin.

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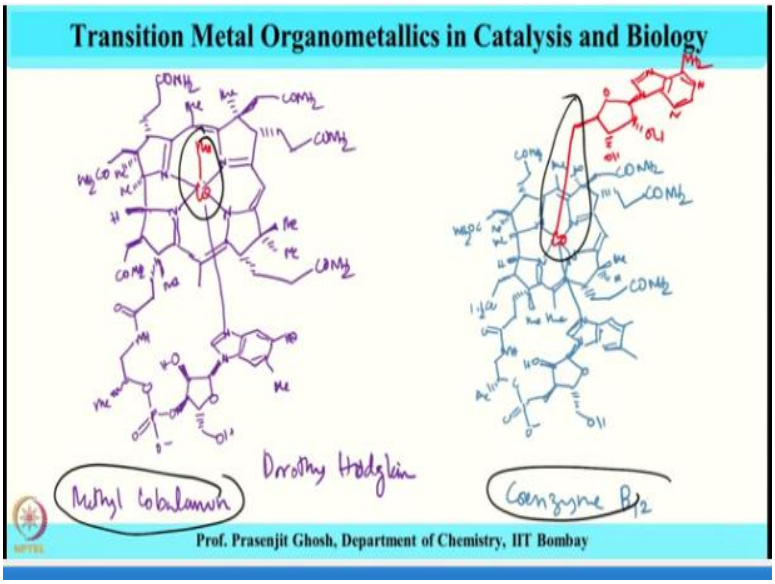

CONH2 and this is hydrogen, CONH2, NH, methyl, OH, OH, methyl, methyl and methyl cobalt and methyl, so there is a organometallic group and this cobalt is coordinated to these adenosine moiety as is shown over here and this is called a methyl cobalamin. The structure was solved by Dorothy Hodgkin in which the cyanide methyl was replaced by a cyanide group.

Then there is another bio organometallic molecule which is known, which is shown over here, this is coenzyme B12 and the structure of it is; methyl, CONH2, CONH2, methyl, nitrogen, hydrogen, is a double bond, CONH2, CONH, methyl, oxygen, OH, nitrogen,

methyl, methyl, here also is a methyl which is missing and methyl, then nitrogen and CONH2, methyl, methyl, nitrogen, this CONH2 methyl, CONH2.

And that also has a metal carbonyl bond with cobalt being bound to adenosine moiety, OH, OH, N, N, so here we have 2 molecules; 2 organometallic compounds, one is methyl cobalamin and the other is coenzyme B both containing a metal carbon bond over here as well as over here that are present in a biological world and is very crucial. So, with this we come to end of today's discussion where we are exploring the various facets of organometallic chemistry.

And we have looked into the utility of the field of organometallic; bio organometallic compounds in terms of medicinal purpose as well as of their presence in biological world and to start with, we have looked into the structure of 2 molecules; one is methyl cobalamin as well as coenzyme B12, these are derived from vitamin B12 which are organometallic compounds find in nature.

And this is supposed to be the first organometallic compound to have been discovered in natural system in aqueous environment. So, with this more on this discussion about the organometallic compounds in biology, as we continue in the next lecture till then goodbye and thank you.