Nanotechnology in Agriculture
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Lecture-36
Multifunctionality of Nanomaterial Water Purification, Waste Disposal and Energy

Welcome back to the lecture series in application of nanotechnology in agriculture. So as of now starting from the synthesis of nanomaterial to the basic characterization and formulations we have moved to the application of nanomaterials in the plant kingdom followed by their application in animal kingdom well, while meandering through this journey of last 100 years of the eyeball being modern agriculture.

We realize several point that modern agriculture is an energy intensive and technology intensive process unlike the past where the ecosystem itself took care of most of the progress and the emerging technology which is coming in the forefront to counter the drawbacks of the previous technologies which includes use of excess fertilizer and subsequent water pollution and soil pollution are now being countered by the use of precision agriculture.

So in next few lectures we will discuss some of the other technologies which are under the spotlight in order to repair the damages which is occurred due to the last 100 years use of excess fertilizers and industrial pollutants which have damaged or which has kind of disbalance the ecosystem of our water bodies. So one of the challenging problem is the need for quality water, both for drinking purpose, agricultural purpose, animal feeding purpose as well as several other applications.

So water purification is one, second is swig dispose, if you walk through the cities you will say like if you walkthrough Delhi, Delhi has an open source system, there is a big train or unalike you can call it which is rolling through the city and kind of carries most of the waste, but then this waste is dumped into a river. So that needs to be processed that way because if you are keep on dumping the stuff in the river what will happen is that in the river.

You will have Island which will be from all over, and eventually the river will shift it goes, and that may lead to flood and not only that the river eventually die, so how you really can handle organic waste.

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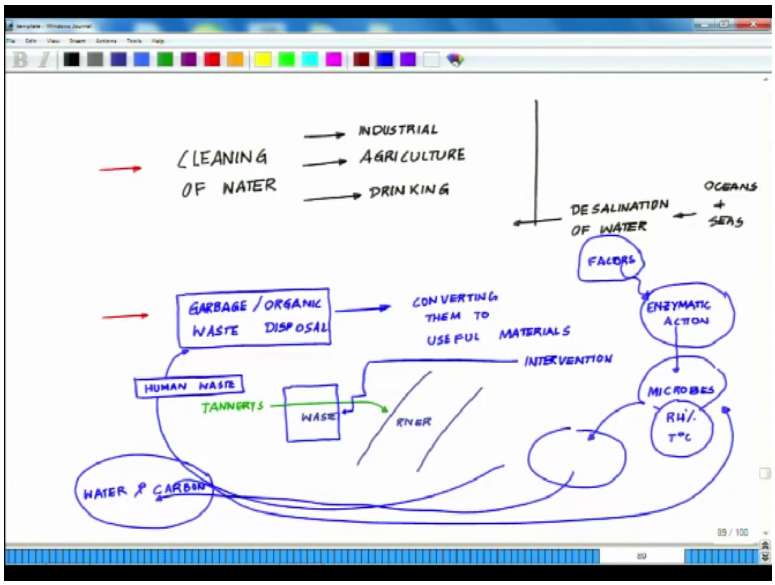

So there are 2 emerging aspects what needs to be address. So one aspect what needs to be addressed is cleaning of water because this has a direct impact on agriculture and food production ok, for agriculture industrial see every kind of water you are purifying to realize there is a level up to which you needed to go depending on the requirement drinking, though we know that other option is cleaning of water, second is desalination of water.

This is what they do in places like Dubai and other places where they have huge desalination plants where they are continuously desalinating the water in order to meet the requirements. Similarly if you go to Israel they have some of these units of water cleaning plants all across the country taking care of much of the need for freshwater ok. So desalination of water this is from ocean and seas.

Simultaneously there is ambled area which needs tremendous attention is garbage or organic waste disposal and sometime even converting them to useful materials. These are some of the pertinent problem what civilization needs to address at this juncture, post industrial revolution if you look at the journey of mankind. Say for example if I take the example of Kanpur. Kanpur was known for its leather industry.

Now the problem is that leather industry consumes lot of water, which is not an issue, water can be made available but then from the tanneries the polluted water was dumped into the Ganges. Now think of it a tannery water coming out just as a case study if you look at it. So

here you are by the outskirts of the city of tanneries. Now this water is getting into your major water body of the country which is the river ok tannery waste.

Now you are basically contaminating the river, now the future lies if some or other we have created a intervention here, we process this waste, so there is a need for now introducing some kind of innovation, intervention, design and ensuring that yes indeed the water goes there, but it is no more away filled with all sorts of harmful chemicals. So if you look around your city you will see many, many such situations where we really need to figure out how to get rounded.

Similarly the other thing which is very critical is the human waste how to handle human waste. So when we talk about garbage and organic waste this includes the human waste. So if you look at some of these design of if you travel in the train you will come across that there are these green toilets, what those are essentially or you will even come across in some these high altitude places like Ladakh Leh if you travel through you will see for the defence personnel whose may have been using toilets.

So the idea is fairly simple which this was one of the technologies which developed by a Defence Research Development Organization of Government of India what they did is so they know the feces matter. So there are microbes, so the way it works is something like this you have human waste this and there are microbes which work on them and these microbes over a period of time given the right set of relative humidity and temperature.

In a right set of time they will convert this human waste into water and some form of carbon, much of these carbons are again taken up by the microbes. Now these microbes what they are doing they are either acting, they have some specific enzymatic action which ensures to take care of these kind of waste ok. Now this enzymatic action could be further fine tune by factors what you have studied in the course.

This is one approach where there is lot of efforts which are being made to see how the microbial growth could be further optimized, could be further strengthen by using nanomaterials because most of these microbes are very very well equipped at revolutionarily much more strong to handle these kind of small particles. So in terms of these 2 there is

another aspect what I wanted to introduce today is the need for multifunctional sustainable material.

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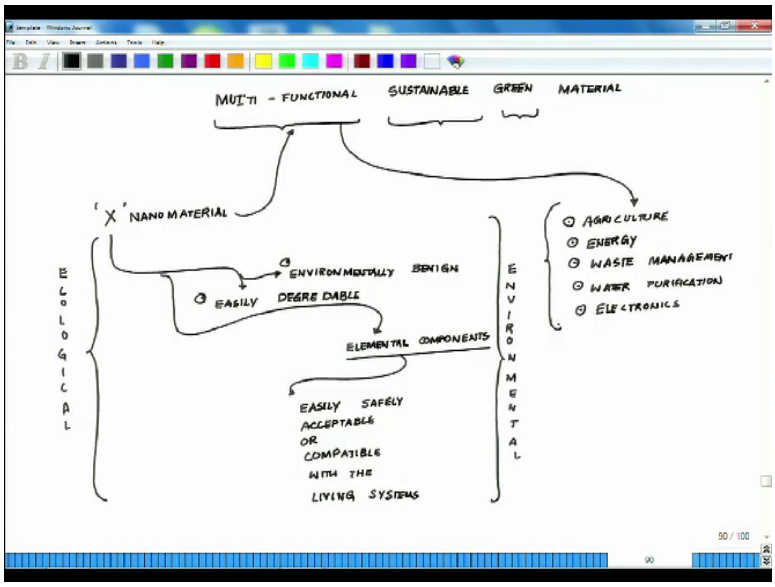

So what does that multifunctional sustainable green material ok. So there are 2, 3 words here, the word called multifunctional, word called sustainable, is word called green ok. Now when we talk about nanomaterials, so if we go back and if you look at the kind of nanomaterials you have dealt with but it is one example where that we have chitosan.

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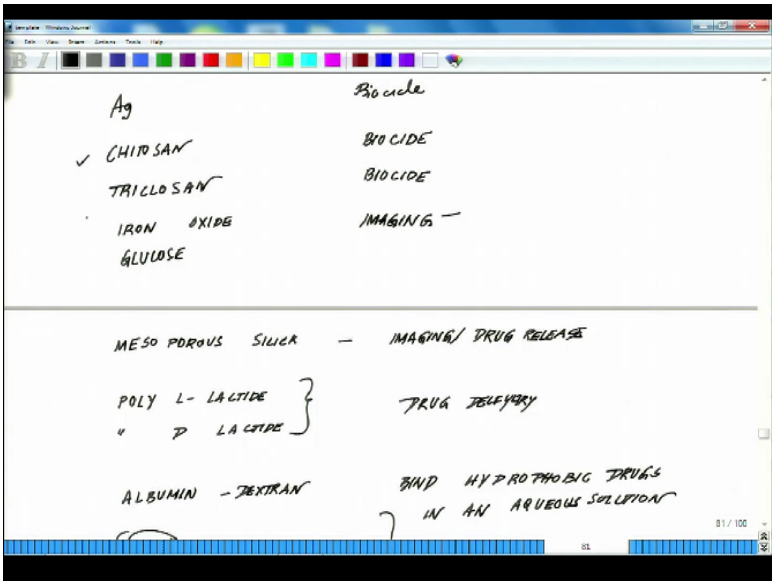

We have triclosan, have iron oxide, mesoporous silica, polylactide, D lactide, albumin dextran ok.

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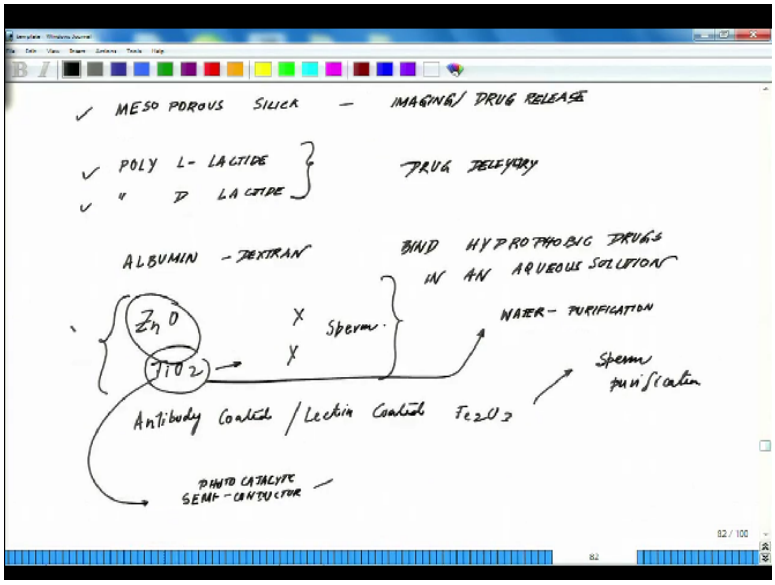

Zinc oxide, titanium oxide look at the range like.

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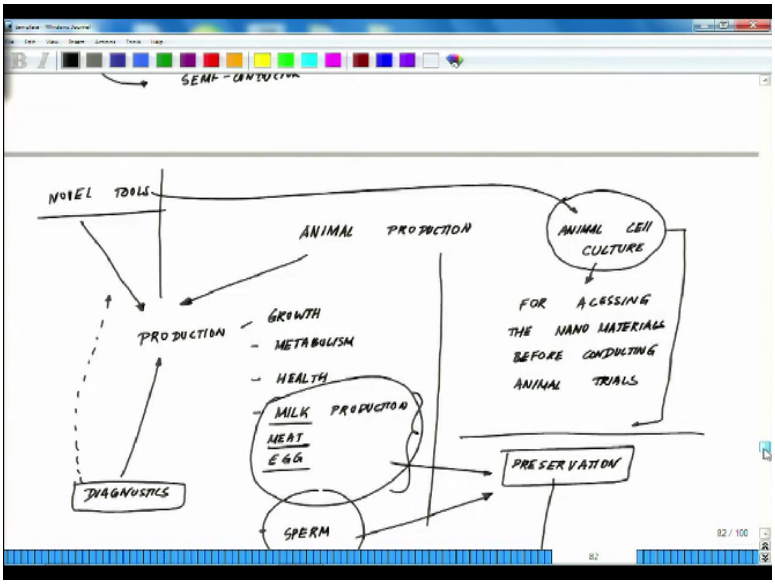

And this story can go on and on if we go further up into our previous lectures.

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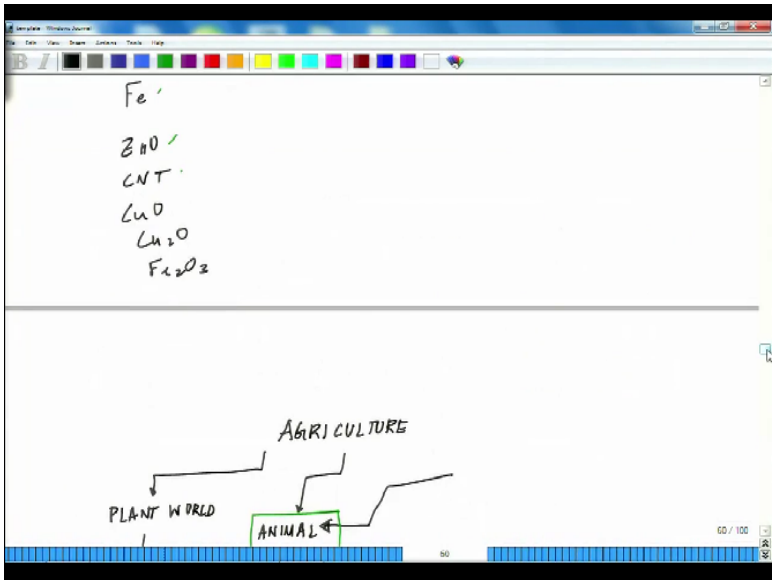

Iron, zinc oxide, carbon nanotube, copper oxide, iron oxide.

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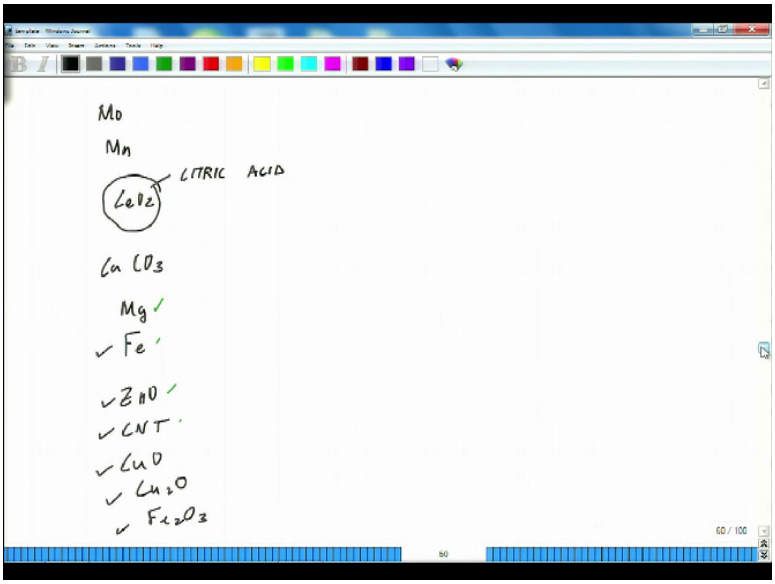

Molybdenum, magnesium, cerium oxide, calcium carbonate, magnesium.

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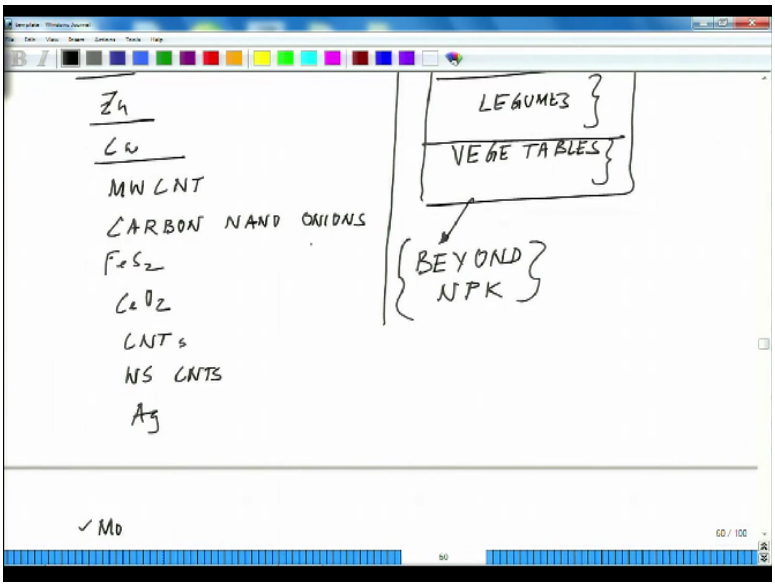

Further, carbon nano anions, iron pyrite, cerium oxide, water soluble carbon nanotubes, silver. So this list can go on and on.

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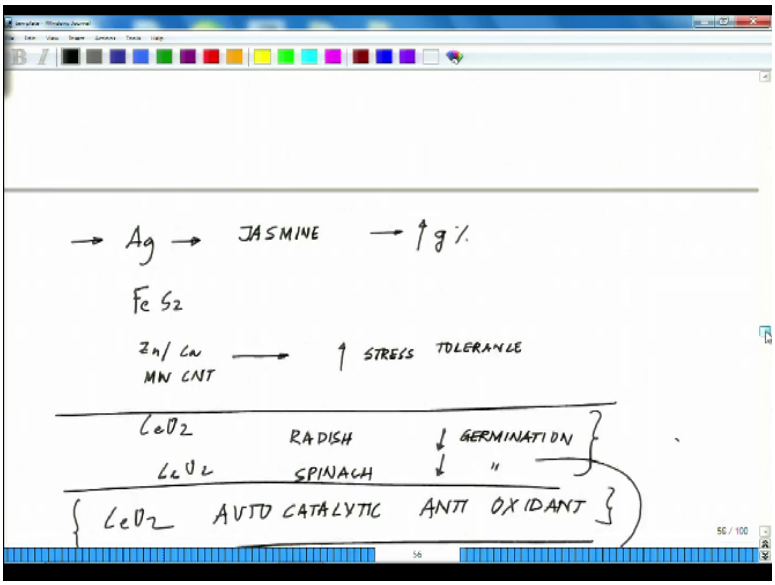

But what I wanted to highlight is not that huge less, but an emerging concept, say for example one material say x, this is x say x nanomaterial, what is desired of it when we talk about so the first thing this material should be easily degradable or if it is not that or at least it should be environmentally benign ok easily degradable or environmental benign. Second the components of it, so when we talk about degradability so that elemental component are easily or safely to be precise acceptable or compatible with the living systems ok.

Further if these are the concerns of environmental aspects or ecological aspects then there is another site environmental and ecological, we want these kind of materials to have

multifunctionality, say for example assay material could be used for saying agriculture, same material could be used in a different form or say energy, the same material could be used for a waste management, same could be used for say water purification.

And if to stretch it for the same could be used for say electronics, so what is needed is though there is lot of research on multiple nanomaterials, the one of the ideas which is emerging is multifunctional sustainable green materials. So in the next class we will continue from here how the world of nanomaterial is going to shape up in last 5 to 10 decades to come, thank you.