Physical Modelling for Electronics Enclosures Using Rapid Prototyping
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Lecture – 27
Future 3D in Biology

And it does not melt at all. That from 140 to around 200-250 degrees, you know, still it will become sticky and stingy and so on. A little like some of our photo materials we see. So calling it resin, I am not very, what do you call, comfortable with it because all plastics are resinous plastics only. Then now if you see here multiple options I have given, white, black and transparent.

So this picture here now, he has printed that thing, logo there and then you see here, I think, it is a clip of some sort, I am not very sure.

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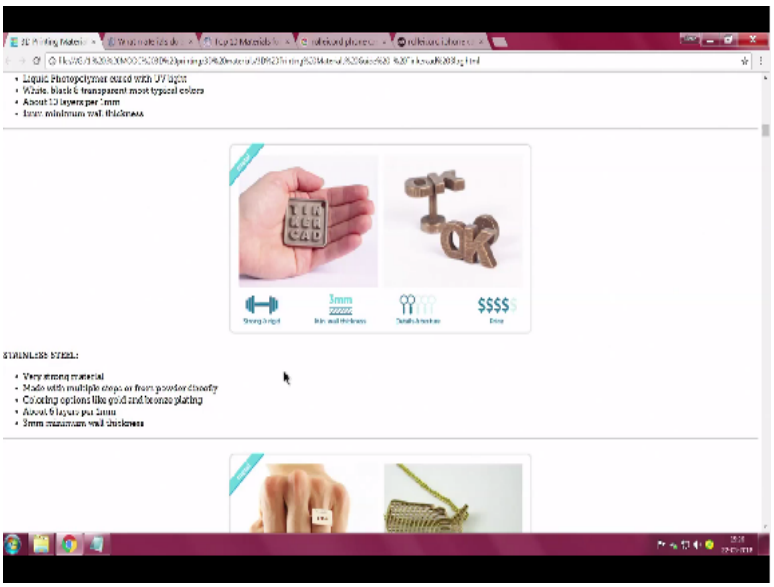

We come to shocking thing, saying made of stainless steel. Now can we actually print things in stainless steel? Is it a wire that is, you know, woven or, what is it that is done? This I was telling you it looks like the military, you know, uses directly a powder in metallurgy or sintering process by which, you know, they are able to make things absolutely, you know, but, you see then what is 1 dollar there, it is 4 to 5 times here. But you have, you know, beautiful things.

It looks like a branding stick or of course here it is actually a cufflink. So made with multiple steps, colouring option like gold and bronze plating, 6 layers for 1 mm and very thick.

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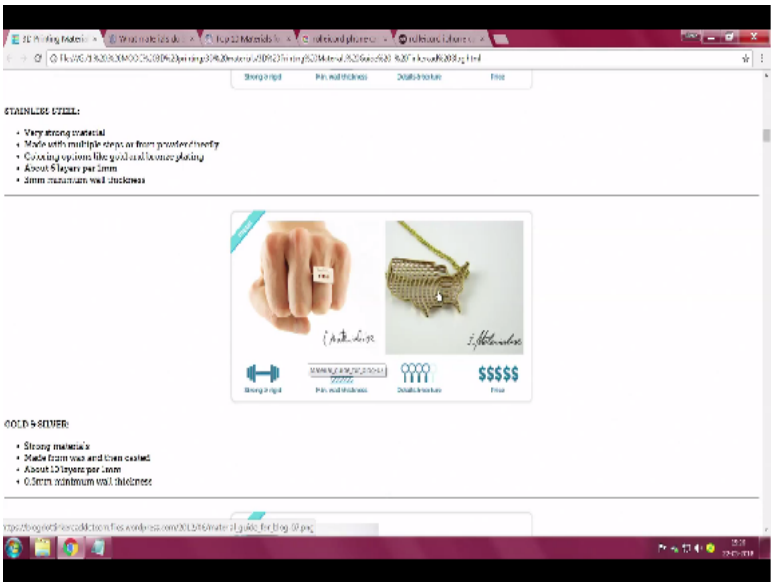

As we go down, now they say even gold and silver can be, you know, printed. So right you have a nice map of the United States and you see where the thing is, you know, radiating from. That is may be where there company is situated or where the world power is situated or anything. So you see here made from lost wax process. So I am not very clear how it is used in this 3D printing but this lost wax, you know, is traditionally how jewels have been made. So I will skip this and just leave it there absolutely.

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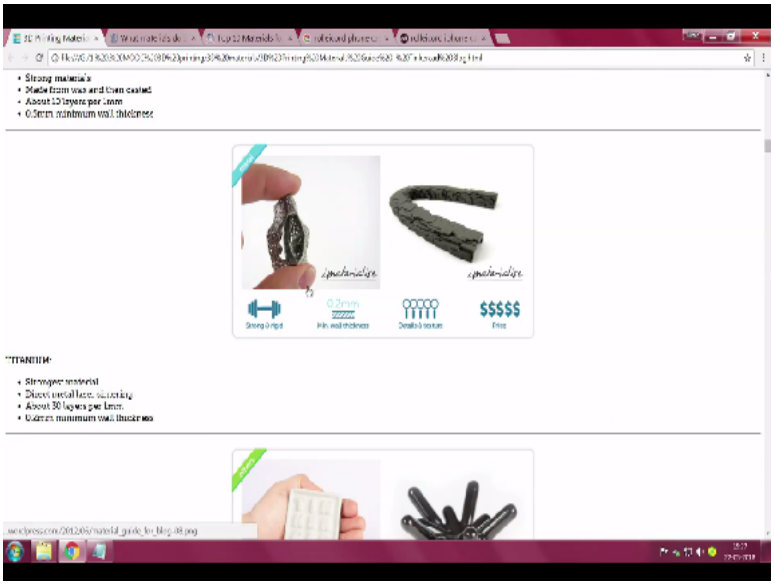

Similarly, we have titanium direct metal laser sintering, that is you have a powder and then a laser, now prints everything and then you have beautiful objects like this which are printed here.

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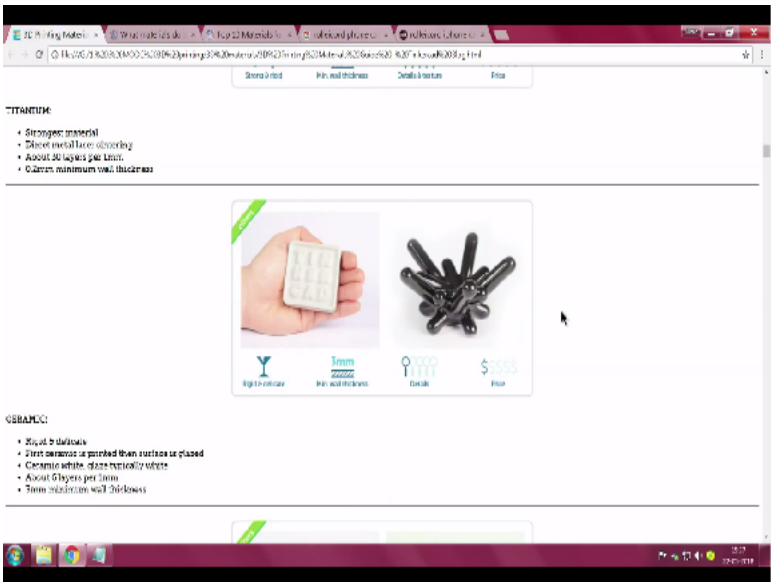

And as we go down here, ceramics are also available. First ceramic is printed then surface is glazed. So expect the ceramic also come as a, what do you call, is a filament. I am sure some of you have noticed it in it. Ceramic can also be 3D printed by, it will be extruded as a round this thing all around like this. This is not exactly a 3D printing. I will see if I can locate the, what do you call, thing here.

When I tried to look at it a little while back, I could locate it. Now please look at this, this thing. Unfortunately, I have no audio. (Video Starts 03:25 - Video Ends 10:36). Just watch the video of it as it comes. So when you get a chance, please go back to your computer and, you know, try to see whether you can see this. This whole thing is printed by using a 3D printer. Just like in our case, it is a small, what do you call, oh sorry. Yes. It is actually ceramic.

After printing it, any texture, anything. This of course is an old this thing. I understand now these days several people especially, what do you call, hackers have been trying and creating really beautiful objects. The thing here is you work on the 3D model and then somebody else does everything and then what you want is automatically done. So 3D printed ceramic ware outside the table are all very good. In, probably after them, you know, after the, this section is over, I will

try to come back to stuff used in medical, including teeth, including bones.

Probably we have, you know, which are very much possible for us. I suggest you just go to the; so as I said, it is expensive but in the end, you know, less talking and you are out with beautiful 3D printed objects. This is the one. (Video Starts 10:37 - Video Ends 10:52) (Video Starts 10:53 - Video Ends 14:21). This is what I was waiting to show you this. It is a little commercial item but still I feel it is worth, that you should watch.

Like all other 3D printing, it starts with a, a base except this small thing here is, if you see carefully, you see how the x and y, you know, stuff is moving. Full table does not move. They just have to, I do not know whether it is a castor or actually they are special wheels and the clay extruder extrudes at a constant pace and only z axis is controlled by it and it rises slowly. Have a look at it.

We have full-fledged ceramic tray being printed. Can life be better than this? So I will just, what do you call, advance it a little and then after that at your leisure, please go and, what do you call, see what best you can make out of it and see anything you can think of, can make it. So what I will do is, I will probably now stop here for a short while. I have introduced you to most of the materials including, you know, all the, what all certain things there are.

Engineering objects meant solely for an engineering purpose including if you remember I showed you the oscillating mechanism, the fan you had the gears and all that. Then I had shown you a sample of a small box which fits on a very tiny printed circuit board and this is used for a DC-DC converter. Then I showed you a potential, the things like this fans, can be made. And of course, I did a goof in showing the wrong direction of the fan blades. So if you have to take a fan like this. Let me show something which is easily visible.

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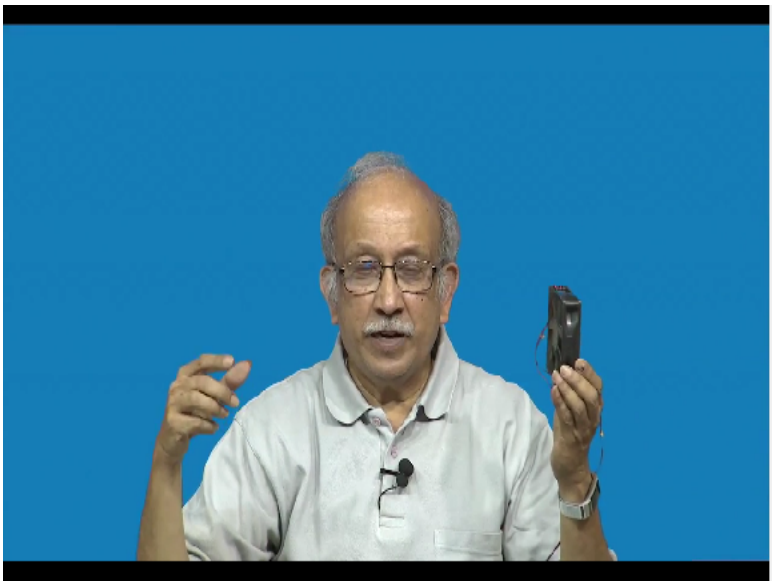

Kindly show it. If you take a fan like this, this is not, if you just reverse + and -, because the direction of this when it gets reversed, it is not at all efficient. So in those cases, probably if you want to make a fan which is there, obviously the easiest way is to reverse the fan. Alternatively, you have to make a fan profile which, you know, has some attack angle. And all that which is symmetrical, works on both directions.

Alternatively, where such things come, let us say I have a fan which has a common axis. I have one fan here and one fan here. Both are rotating in the same direction. You understand? Common axis, impeller here, impeller here. The impeller rotation is same.

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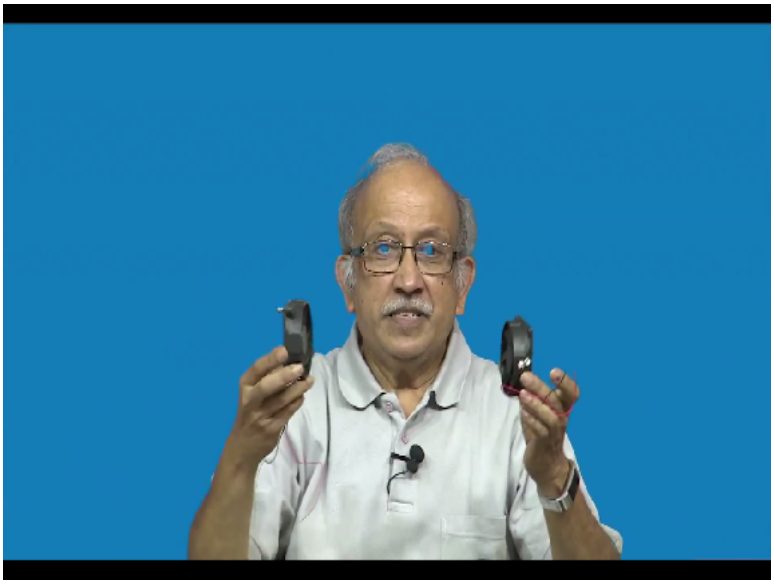

and why I cannot afford to use 2 fans like this. Problem is, if I put 2 fans like this, they will not ever ever run at the same speed. So they usually have a common axis, a motor or something like that. Now the common, what do you call, the rotor is rotating at one direction. So I need one where the air is being sucked in here and from here, now the same thing. The air is being sucked in here and has to be, you know, blown together.

That makes sense but things like exhaust and then maybe your, I mean, more sophisticated thing. Typically, where you cannot afford to have 2 fans running independently. Usually, have a common shaft and then you have this running and in the case of a large thing like a turbine, if you take a huge turbine. The, it runs in, you know, 13-14 stages. Each of them does a small thing about it. In between, you know, they have got some correction and all those things.

Those things, models can easily be printed using our, oh, nothing I am fascinated by this. I will close it, otherwise, I will get stuck in these prints.

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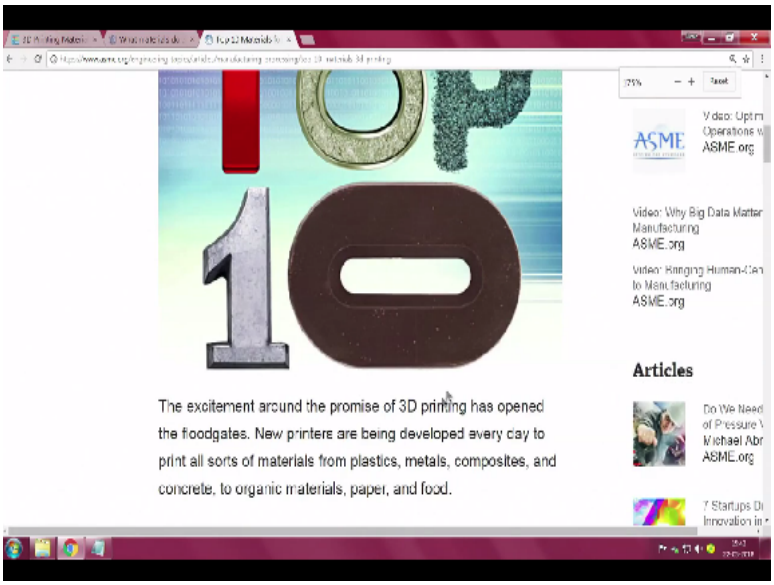

Just before I wind up for this particular thing before I go to the medical or the bio stuff, I want you to suggest, I mean, have a look at these things which I am continuing.

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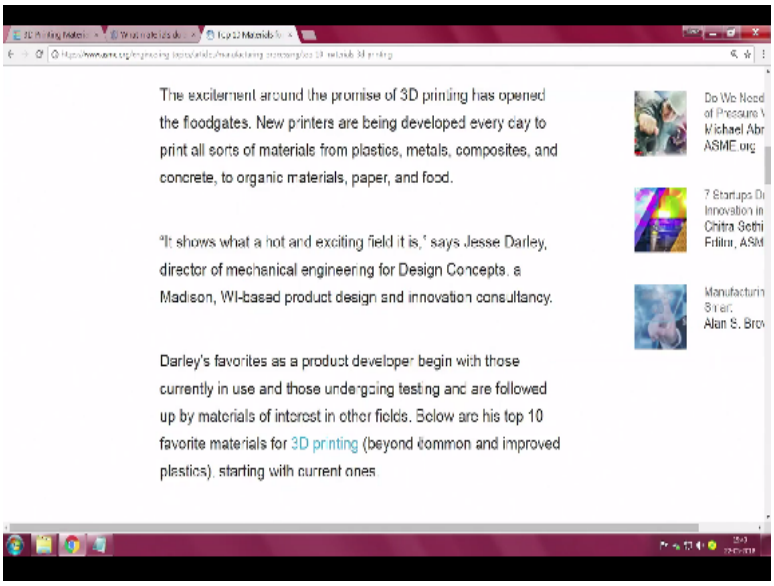

You see here, this is, I do not know whether it is hype or the future. Honestly, I do not think food is yet ready for that. Printers have been developed everyday to print all sorts of materials from plastics, metals, composites, concrete to organic materials, paper and even foot. Last part I will, you know, avoid because somehow it does not, you know, test the same. But in some conditions, probably it does make sense.

Let us say you are making decoration for cakes or usually that sugar molds or sugar candy from which most of the cake exhibits are made, such things are best printed by 3D. Nobody needs to, you know, go on taking all that, you know, sugar and trying to make sheets and stick it and all that. The whole cake decoration can probably be printed using some, you know, sugar thing and printing a cake decoration especially starting with your name, your means not yours, your dear child's or here, what do you call, partners or your good friend's name using biologically, I am sorry digestible materials, is not very far away.

It is easy. If you remember cotton candy. Cotton candy is nothing but molten sugar. Molten sugar when it is, you know, it is whirled at very high speed, that strands come out and, you know, they feel like cotton and it is, you know, what do you call, woven around a stick and then you have it. It is a little like that. Instead, instead of the strands coming at high speed using centrifugal force, you can probably extrude those things and print anything which is typically a cake decoration or any cookie decoration or anything.

Now coming back to cookies, cookie dough can easily be printed. Is it not? You need not take all the trouble of first rolling it flat and then taking a cookie cutter and making various shapes and all that. Instead, imagine you have a 3D printer at home and then you want to, whatever it is, you can make a decoration and you can actually print it, later on you put it in the oven and then you have cookies of any shape you like.

And so it is real. You can think of the various options. Now if you kindly look at the, I mean, the thing here. First one the thing you will notice is now these days, "it is hot and exciting field." "Product developer begin with those currently in use undergoing testing and are followed by materials of interest in other fields." First is, so "below are his top 10 favourite materials for 3D beyond common and improved plastics starting with current ones."

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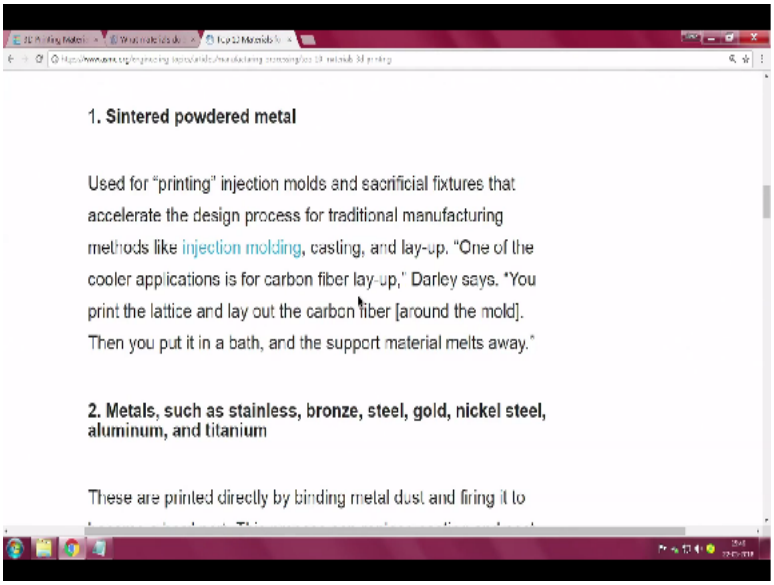

This is a very interesting thing, "used for printing injection molds and sacrificial fixtures that accelerate the design process for traditional manufacturing." You print the lattice and lay out the carbon fiber around the mold. Then you put it in a bath and the support material melts away. So you see here sintered powered metal is typically something which is used.

So it is a combination of part of the traditional workshop or the emission shop things are replaced by this type of options. Sacrificial fixtures that accelerate the design process, okay. One

of the applications used for carbon fiber lay-up to do the winding or anything, you know, you need a former. You make this former and then after that, you know, you do with it. You print the lattice, lay out the carbon fiber, put it in a bath, the support material melts away.

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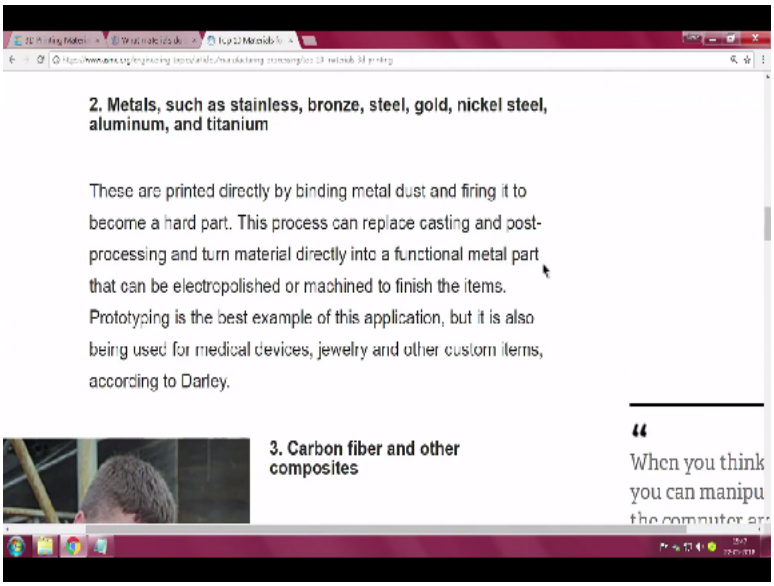

Next comes stainless rail, bronze, steel, gold, nickel steel, aluminium and titanium. Print it directly by binding metal dust and firing it to become a hard part. Process can replace casting and postprocessing and turn material directly into functional metal part that can be electropolished or machined to finish the items. Prototyping is the best example of this application, but also being used for medical devices, jewellery and custom items. So that you know, next lecture will contain.

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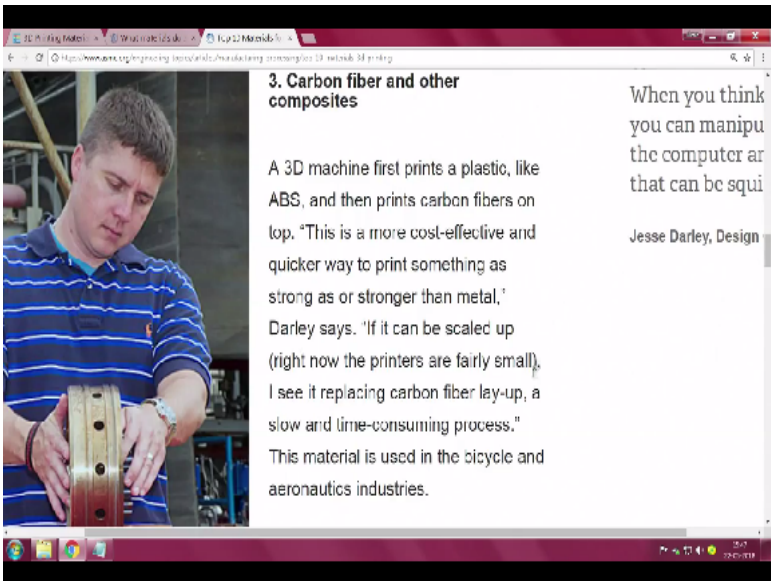

Then carbon fiber and other composites. A 3D machine first prints a plastic, like ABS and then prints carbon fibers on top. This is a more cost-effective and quicker to print something as strong as stronger than metal. Can be scaled up. Printers are small. I see it replacing carbon fiber lay-up, a slow and time-consuming process used in bicycle and aeronautics industries.

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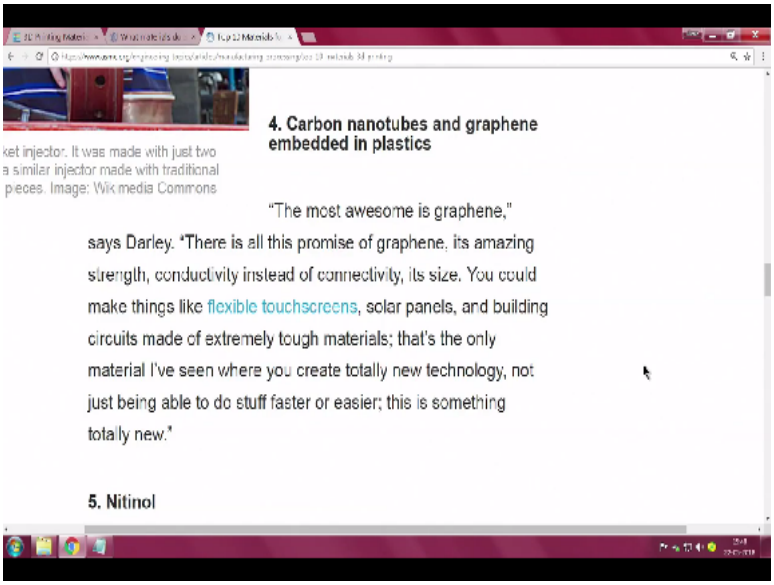

Then carbon nanotubes and graphene embedded in plastics. The most awesome is graphene. This is all promise of graphene, its amazing strength, conductivity instead of connectivity, its size. You could make things like flexible touchscreens, solar panels and building circuits made of extremely tough materials, that is the only material I have seen where you create totally new technology, not just being able to do stuff faster or easier.

This is something totally new. Said no, beyond this, I too have not done it and maybe there are, you know, publications and so on.

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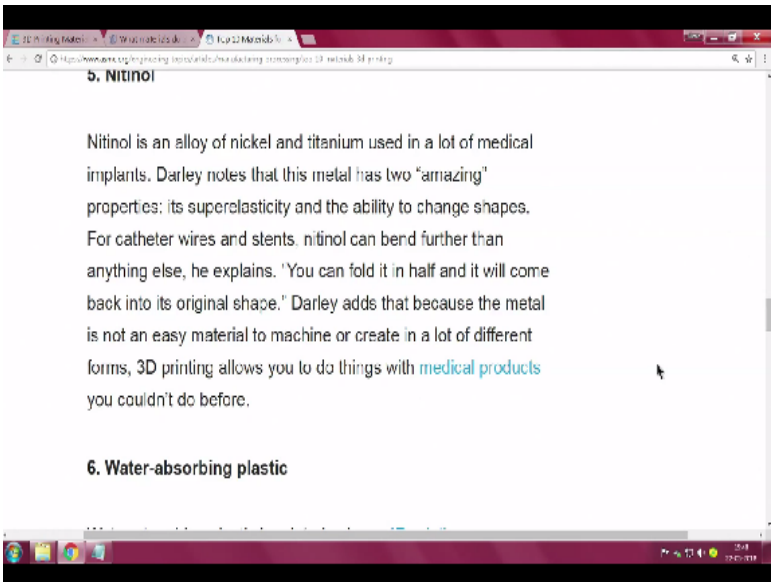

Next, I am reading it along with you first time. So your titanium-nickel alloy, they have called it nickel-titanium alloy. Lot of medical implants. This metal has amazing properties. Superelasticity and the ability to change shapes. For catheter wires and stents, can bend further than anything else. You can gold it in half and it will come back to its original shape. Because the metal is not an easy material to machine or create a lot different forms. 3D printing allows you to do things with medical products you could not do before.

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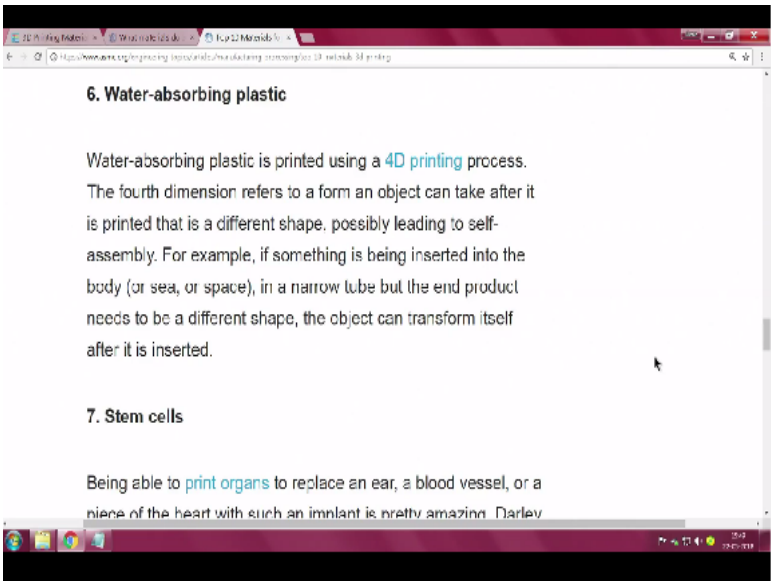

Water absorbing plastic is printed using a 4D printing. I have no clue what it is. If something is being inserted into the body in a narrow tube but the end product needs to be different shape, the object can transform itself after it is inserted. It happens often now, right now with several types of stents which are all inserted into. You too must have seen the, what do you call, the, naturally it is a simulation. I do not know if it is a real or, it is just an animation.

You introduce something into artery and then at the end, you know, it expands in the artery and then it breaks up all the, whatever, you know, sclerosis that happens and all the material is sucked out using a vacuum like device as such that device, the tip is probably made with these water absorbing plastics. So as you insert it, probably, you know, the material is held together but after it is, you know, put in place, it will make it. So if you click on this, we will do it later.

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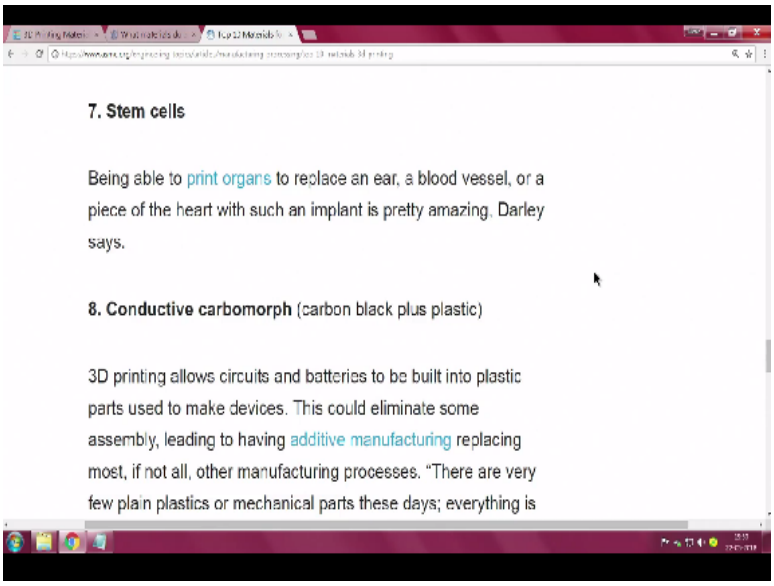

Then being able to print organs to replace an ear, a blood vessel, or a piece of the heart, is not just amazing, is a pretty amazing dream. So right now, there are, you know, 1 or 2 start-up companies which are doing it. If with their permission, maybe I will be able to show you something later. So there they claim that they are able to print cells like what you have. So I too am impressed by what they can talk about.

So after I pause this up to, after I finish this time, I will come back to this. I have the link on my mobile. I will show you. 3D printing allows circuits and batteries to be built into plastic parts used to make devices which eliminates some assembly, leading to additive manufacturing replaced if most, if not all, other manufacturing processes. There are very few plain plastics or mechanical parts these days. Everything is electomechanical.

See the critical thing. If you have a shape memory alloy, imagine you give a voltage and, you know, things change shape and so on. It is a little slow at the moment but in the large time, this morphing can easily be done if it is conductive.

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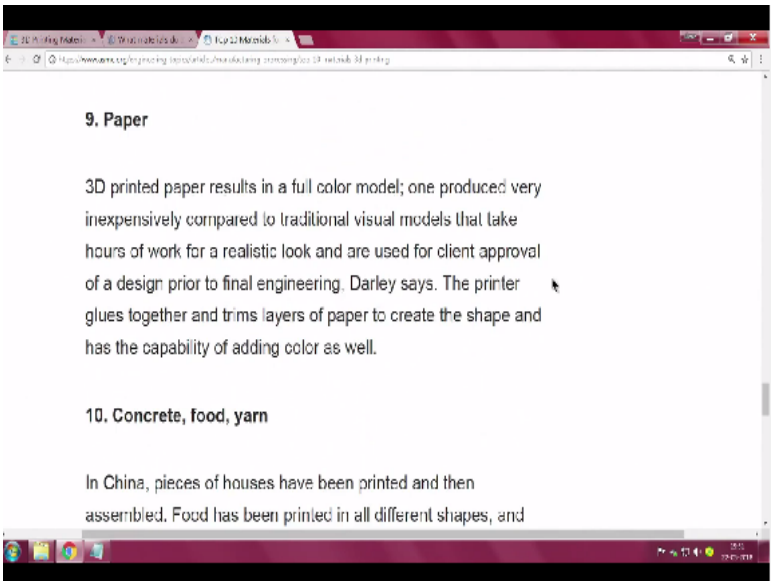

Next paper. Seen this? Not long ago, if you remember, if you see the, a map, a map has small lines which is printed over it with some numbers printed on it. They are all, what do you call, a trace of points of the same height. So surveyors used to plot these maps. Now if you take any of those, what do you call, isolines and then cut cardboards according to it. And then print one over the other, very easy to make what look like regular landscape models.

So this material information which is already available was used to make layered things. So right now, layers of a paper are very thin. Those things are made with usually foam cardboard and in case, you can cut paper, very beautiful things can easily be made.

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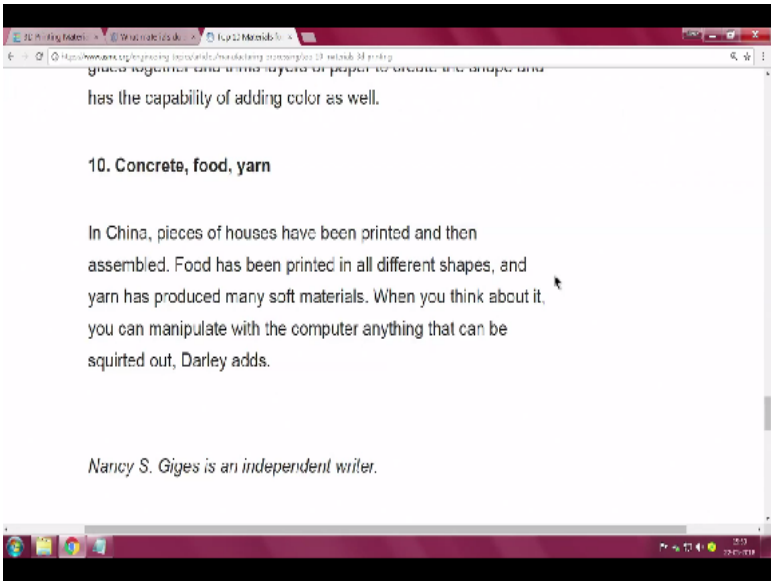

Now the last one which tops here is, so you see there. So you have really really interesting things here. Just keep reading it. I am searching on my mobile for the link of one of the start-up companies here which, yes, it is called nextbiglab.com.

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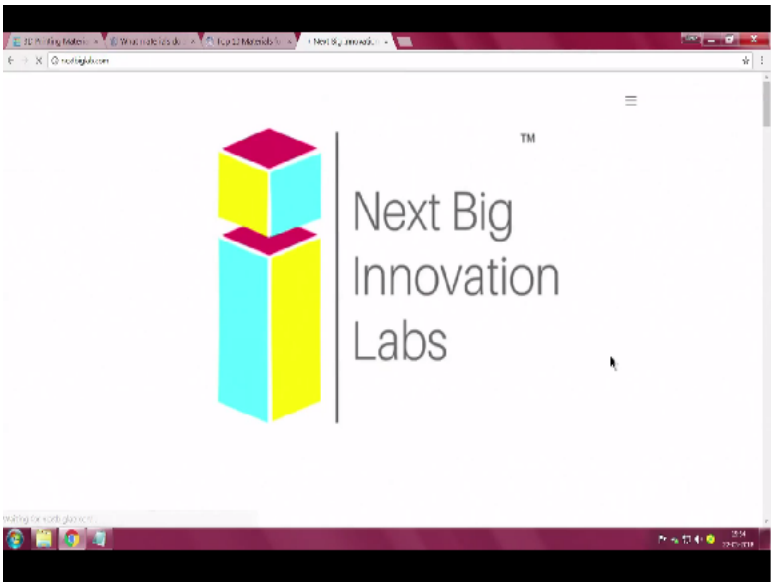

Let me try. If it works, I mean, there servers and all are a little slow. This is right now, since there is public information and it is directly hosted, I have not taken any special permission from that. So if it, what do you call, if it comes. Seen this? Next big innovation, if you go down, we are a 3D bioprinting company based in Bangalore.

We proud make in India, used to create organs within laboratory using something something about 3D bioprinting. Expertise in 3D printing biotechnology and pharmaceuticals. So I want you to have a look at it yourself. It is not yet ready. So I still feel, now it is still in the, you know, incubation and so on. So at your leisure, we have surgical models. Have a look at it here.

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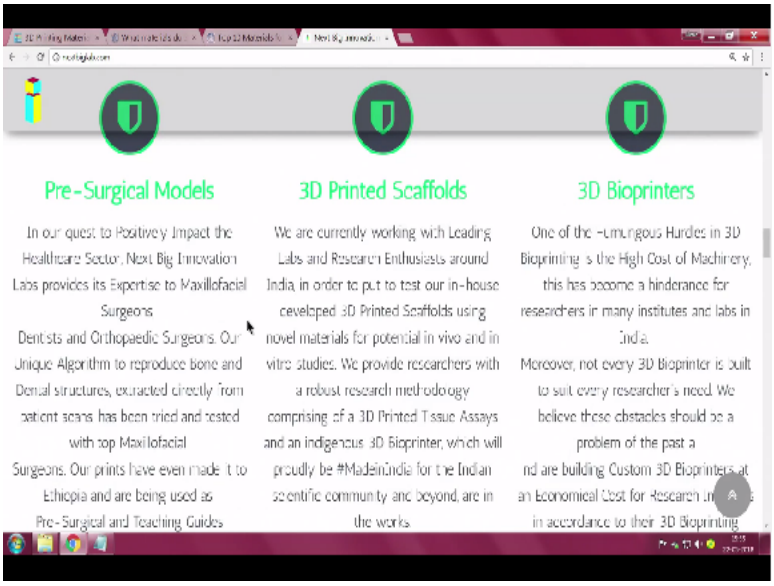

And then we have, you know, scaffolds using novel materials and then bioprinters. So this stuff presurgical models. This is considered the next innovation, a big innovation to get, you know, maxillofacial surgeons, dentists and orthopaedics people. Not long ago, orthopaedics only considered, I mean, on 2 different, you know, completely different thing. One is purely structural, meaning you have these, what do you call, I mean, various type of stirrups and things which are used to see physically deformed people.

They are (()) (29:10) or anything. So what are called callipers, you know, are seen. You would have seen children wearing callipers and people accident victims have somethings which are holding this jaws and all that. Now it looks like this company in, probably in collaboration with somebody out there which I do not know, okay. So it is now offering these things, okay. Including 3D printed tissue assays, okay.

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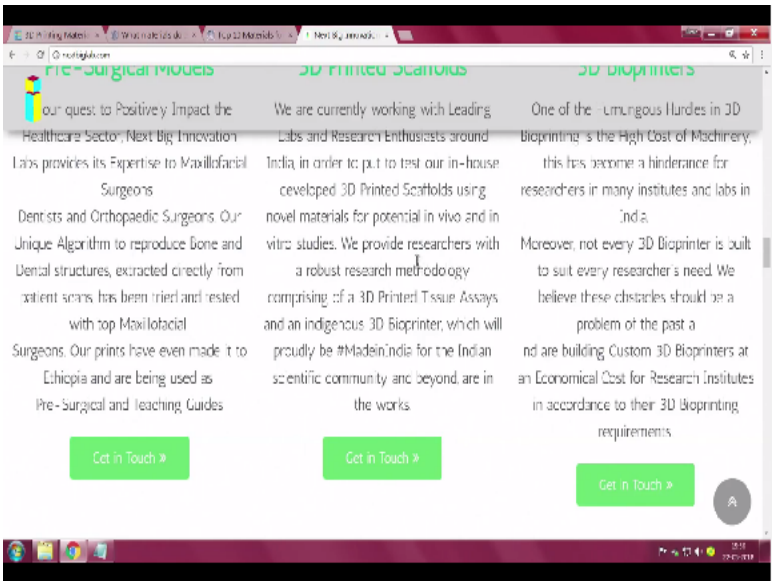

We provide researchers with a robust research methodology comprising a 3D printer tissue assays and then indigenous bioprinter, so on and so on.

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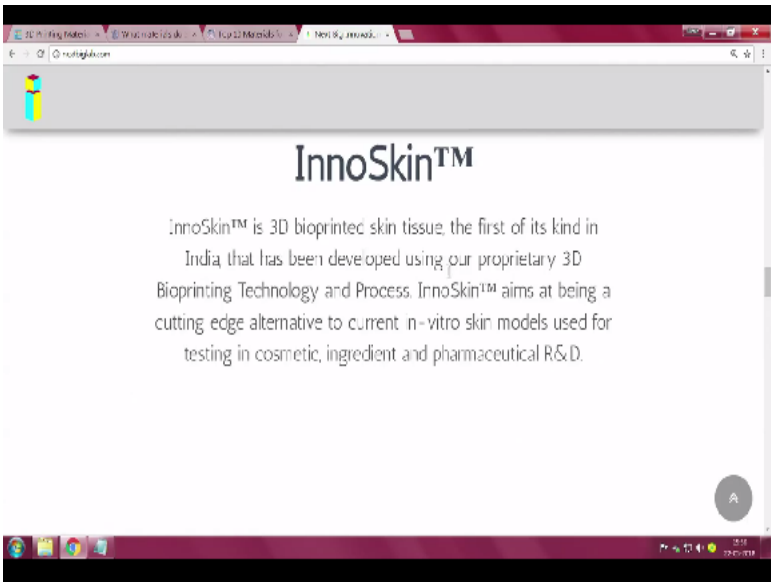

So I expect skin tissue, first of its kind has been developed using and so on and so on and all that. So it is possible now whatever you want, you can, you know, do it. But right now, do not take, you know, too much of it. Now I will not show you the people. Have a look at it. It is not very far away in which time we can create stuff in printing. So the issue is about 2 parallel things. One is how to adopt the technology in the case of ceramics, when we are printing the formers and all that and directly firing them.

And in the case of these, what do you call, biomaterials, it is slightly different. So next, one full session I would like to take only on biomedical and biology related things. So thank you. As of now, thank you. Let us see again and see if I can get back and if I can get my, what do you call, contacts there in that lab to, at least give a presentation probably we are better off. So thank you.