Andre Simpson interview

Don Campbell [00:00:17] Yeah. So I went through the paper last week and then I just give my notes a quick read through before the interview. But I'm gonna have to ask a lot of silly questions just to get a lot of the details out of the way, I guess. No, Ari. Yeah.

Don Campbell [00:00:36] Yeah, it sounds pretty straightforward. It sounds really interesting, too. So, like, I was kind of wondering, you know, before we get into maybe sort of the process in describing the process in non-technical terms, in terms of converting, you know, the cooking oil into a 3D printing resin, I'm just wondering where the idea originated from for this research. Like it sounds like a really sort of ingenious way of way of approaching it. So I'm just wondering, you know, where the idea sort of originated the features

Andre Simpson [00:01:14] So I guess I got a 3-D printer about two, three years ago and I was just playing with all features, I did at home for a few months. First, I could learn the ins and outs of it before I took it into the lab to use it, I realized that the for all the molecules that they were using in the commercial resins were sort of similar to fats.

Andre Simpson [00:01:37] Then I started to wonder, well, can we actually use real waste fat? And it was just a summer student idea, like an underground idea. Sometimes they turn out to be really big and sometimes they just turn out to be nothing.

Andre Simpson [00:01:50] And I mean, we just tried it. The hardest thing was getting the oil. We we contacted every single major chain restaurants and nobody would give us any oil.

Andre Simpson [00:02:01] And in the end McDonalds was the only one letter to give us any oil, I guess, that were terrified or, you know, find an oil or something or other or worried about stuff like that.

Andre Simpson [00:02:09] So basically, that's what happens. And then which in chemistry itself is quite simple. And we just did it and I put it in there and I put it in the printer and it printed a cube and I was like, OK, we got to do a paper on this.

Andre Simpson [00:02:25] I guess really just I don't know, it just sort of develops over time. I just looked at the chemistry of what was being done commercially. And I sort of set up, I guess in simple terms I can make you more exciting for a paper if you like. Is that it's the double bonds. You have the paper in front of you at all.

Don Campbell [00:02:47] I do. Yeah. Yeah.

Andre Simpson [00:02:48] If you look at figure 1a. they are double bonds that a set of things labeled D right there that they called unsaturated fats. So that's the healthy stuff in our diet. And they're healthy in our diet because the body can break them down because of those bonds. They can do chemistry on them.

Andre Simpson [00:03:07] And if we'd gone back 20 years and it was like unsaturated fats or the unhealthy fat that we used to eat Mexican, the chemistry in the body could've done the chemistry. That's how would store them as we used to treat each day with a healthy fats. This amount allows us to do something with those double bonds and that's

allowed us to do some chemistry on them, which in turn allowed us to make these resinds from it.

Andre Simpson [00:03:29] So in many ways it's because we've come healthier as a human race that allows us also to become potentially more healthy for environment, too, if you like.

Don Campbell [00:03:38] Okay. That's interesting. Yeah, I guess one of the things, too, is, you know, maybe I like what I read is the existing resins that are used against her are expensive to to to. I guess the base materials are pretty expensive. Is that right?

Andre Simpson [00:03:58] Oh yeah. Expensive. They don't be derived from oil, right. They theyare all like to have fossil fuels and all that sort of conventional oil that our plastics are coming from now. They'd be super expensive.

Andre Simpson [00:04:10] The ones we use in the papers. The most expensive one we have in the laboratories. Five hundred dollars a liter. They make those from the actual building blocks. Nothing would be recycled at all Would be like brand new stuff derived from oil, which would not be ideal. And of course, the 3D printing sort of taking off many, many more people getting into this, including manufacturing people.

Don Campbell [00:04:33] Right. OK, so the other I guess the other question, too, is a lot of cooking oil we. I'm pretty oblivious. I don't really know what happens. We should quit waste cooking oil does get storage. Does it get dumped? I know most of it ends up, you know, or not more so, but a lot of it ends up being just sort of flushed down the drain, right, Mike? Through residential. Some commercial. I know commercial. One of the a lot of the oil is is having. Get a fast food restaurant, remember the oil being stored and then shipped somewhere. But I don't know what happened to it after that. Like, are there processes involved with recycling cooking oil, do you know?

Andre Simpson [00:05:14] Yeah, I know a little bit about it. But again, it's not really my area, this is sort of a side project. So what I do know is so McDonald's will take that oil and they'll convert that oil into the biodiesel they use to run their trucks. I went that in the news that starts about five years ago.

Andre Simpson [00:05:33] That's really, really cutting edge, like McDonald's, I think that's why they were willing to share that oil with. The fact that have an interest in reducing their fingerprint.

Andre Simpson [00:05:41] But smaller restaurants for other chains wouldn't be able to do that. Or put it another way, there are recycling plants for oil. But if you're a remote restaurant and you are say hundreds of miles from that plant, the cost of transporting that that waste to it makes it like cost negative to do it, because I think we're getting somewhere around a dollar, I think for now, I wouldn't put that in the fact that a lot less money than for light for generating soaps or biodiesel. I think we've got the paper somewhere right on.

Andre Simpson [00:06:19] Yes. That waste cooking oil demand the price of seven hundred fifty to one hundred dollars per ton. So if you now calculate what it would be worth if we made that printing resin at 500 dollars a liter, I guess that would be half a million dollars a tonne.

Don Campbell [00:06:36] Yeah,.

Andre Simpson [00:06:36] It's A lot, alot than a lot more than it would be right now.

Andre Simpson [00:06:39] Which of course then makes it viable for a restaurant to transport it across distances. Even if there's any three processing plants in Canada, you could even truck it out there or train it out there a long way and still make it commercially viable for the company. And that would mean there would be nothing to go down the drains.

Andre Simpson [00:06:57] But you are right, I can households I think people putting down a drain are not meant to. Yeah, restaurants are, But of course, there's also, you know, developing countries that don't have the same rules that would go down the drain.

Don Campbell [00:07:08] Right. The sort that we're not looking for ways to use old cooking oil, essentially like there's there isn't a demand out there for recycling, for cooking oils.

Andre Simpson [00:07:24] Yes and no. we're desperately lacking on ways that produce a high commodity product. Something that makes it economically viable. So you can turn your oil into something and say we're doing from environment friendly. But I think it would still be way cheaper for McDonald's to put normal gasoline into their trucks, but because they recycle as if they can say they're doing something environmentally friendly.

Andre Simpson [00:07:48] But if you do this, it actually makes it commercially viable as well as environmentally friendly. Which would be a massive difference? You're talking about 500 times more money per ground material

Don Campbell [00:08:01] OK. Got it. OK. That's that's interesting as well. I'm just trying to think like maybe I mean, you talked a bit about sort of the science behind converting, the cooking oil into the reason I read here. I'm just trying to sort through some of the technical term. So in the in the abstracts that cooking oil was, is it act related or correlated and really calculated through one step chemical reaction? Yeah, I'm just wondering. And then and then I guess afterwards of a photo inhibitor, was there? Was that it? I'm wondering if you you just sort of maybe in very broad strokes, just describe what that that actually means, I guess.

Andre Simpson [00:08:42] OK, yeah..

Andre Simpson [00:08:51] OK, so for the printing process to work, the final product has to interact with light. It has to cure or say that after we put it in light or even sunlight, this resin will become rock solid. And that's what we call a UV curable resin. It comes from the UV part of the spectrum, sunlight will do it also like like a bulb, for example, from a projector. We do it as well.

Andre Simpson [00:09:15] What makes that react with the light is the acrylate. These special groups we put on the double bond. OK. And these will cross link with each other. But join together to form of polymer like a solid plastic rather than a liquid. And they'll do that under light.

Andre Simpson [00:09:34] So What we're doing is basically putting these acrylic groups on these double bonds to make them interact with the light when they're exposed to it. OK. That's what the acrylation does.

Andre Simpson [00:09:44] The photoinhibitor, so a little bit of bounce and power did like production printer work or DLP printer. I imagine You're in an lecture theatre and you're projecting a slide on the screen and you see the pixels in projects a picture. If you now take that screen away and put a sheet of our liquid where the light hits it, the bright white light that's going to become a solid where it's black No light hits, it's going to remain a liquid.

Andre Simpson [00:10:14] So as you flash that projector onto the liquid and that's exactly what we do in these print these things, you actually use a real projector as well. You project the lights onto it, the shape builds up.

Andre Simpson [00:10:26] So basically what we're doing with the photo inhibitor, if you don't put special inhibitor, actually shoot that line onto the screen. It's going to spread out inside the resin instead of forming the pixel you want it to form, it's going to spreading to, say, the 10 pixels around it and form a blob. So if you don't use an inhibitor, which sort of stops the chemical reaction just makes it happen just to be very bright parts so it doesn't spread out, blurred the image, if you like.

Andre Simpson [00:11:08] But we don't actually have any photoinhibitor. The reason we don't have to say it's a back up again. What are photoinhibitors ... normally dyes and dyes are very bad for the environment . Really problematic people trying to clean up dyes includes clothes dyeing and everything. So we don't want to use them.

Andre Simpson [00:11:25] But interestingly, the brown stuff from the cooking oil, like just the whole idea of cooking for like two weeks in McDonald's restaurants produces a slightly colored oil. And it just happens that those background sort of contaminants that you want to call them that are in color, if you like, it absorbs the UV light just that's just the same way photoinhibitor does.

Andre Simpson [00:11:48] So normally we add this little orange dyes, a photoinhbitor, these happened for in natural cooking process makes it even need to do that. OK. Which means you don't have to add your dyes, which means that even easy to use.

Don Campbell [00:12:01] Yeah. Sort of like is that sort of explained a little bit and figure it's on the oxygen that basically it shows the butterfly digital modeling us where.

Andre Simpson [00:12:18] Yes. You can see theMcDonal's oil go out and see that it's kind of orange and that there's nothing you add to that. That's just an actual orange of the oil from McDonald's.

Andre Simpson [00:12:28] So D is essentially quite similar oil. But that's actually made from like the pure oil we bought from like a company. Not recycled or cooking oil. And you can see how this sort of centers are filling in. Yes. But that's because it doesn't have the same photoinhibiting properties idea what I was lucky things. That works out well.

Don Campbell [00:12:55] You know, the acrylation. Did you do in your lab? Did you do all this?

Andre Simpson [00:13:00] Yeah. Yeah. We did it all. We just followed the publishing approach that some said the chemistry is not that exciting in some way. We modified it a little bit and we just brought this up.

Andre Simpson [00:13:10] But now one pot basically means you put it in. I mean,it's like a reaction chamber, kind of thinking like a cooking pot and you just have to do one thing. Most chemical reactions involve like many, many different steps and is super complicated. And that's why products are so expensive.

Andre Simpson [00:13:25] So if you can do everything in one big pot, you throw in that, boil it up and then take it out. You get your product straight away, which makes it more commercially viable.

Andre Simpson [00:14:45] we base it at a cost analysis on this floor.

Andre Simpson [00:14:48] And we basically said if we assume that the oil is essentially free, which would be for most places, if you, especially if you counted transport costs, and we can recycle the catalyst, which is sometghinca called BF3, and we can recycle the solvents. They've already been published. They can be recycled.

Andre Simpson [00:15:09] ONLY cost comes down to this thing called acrylic acid, which is the acrylation agent and that's 300 dollars a tonne. If you compare that to the cheapest plastics available, that's actually cheaper than any plastic on earth. And if you then put it into perspective, this stuff would actually solidify on site. So imagine you have a worksite, and this is this is more hypothesizing. I think in a news article you could mention this threat. If you just pour this out like concrete, it would set automatically in the sun so it become liquid on on thing and he could form shaped of stuff. Actually out on the worksite, you wouldn't need to premake parks, which is kind of interesting. I took it out the chemistry paper because I didn't want to say it was to wade into environmental. I do have a section written which I can send to you, which might be of interest, to give you some more perspective on it.

Andre Simpson [00:16:01] But I think there's many, many different things beyond what we talked about here at the printing press. I just want to keep it focused. This journal.

Don Campbell [00:16:08] Okay. Go ahead. Okay. In the in the abstract to it. I mean, the resin that was produced was able to create high resolution prints, right? So, it's a high resolution resin. It also says in the prints themselves showed considerable thermal chemical stability and morphological homogeneity. I'm just wondering if you could. I don't know if you touched on it already with the thermal chemical stability, but I'm just wondering if you could describe what that actually means. I was having a tough time trying to figure.

Andre Simpson [00:16:42] Yeah. Again, I'm not a huge expert on this, this is some form of analysis. my postdoc did. basically just when these journals when you produce something, you have to. prove The thing is sort of useful. You have to characterize enough to say, hey, this thing is not like a butterfly that's going to melt in three seconds. So we showed that it basically had just the same properties or better than some of the commercial resins on the market.

Andre Simpson [00:17:05] So it would be useful to make things products out of like, you know, making Lego blocks or things like that.

Don Campbell [00:17:13] So it's not going to crumble. It's not going to melt. Not a crumb.

Andre Simpson [00:17:16] Yeah it won't melt just above room temperature and stuff like that. So. Okay. Makes useful products, but it could potentially make lots of useful products.

Don Campbell [00:17:23] Okay. Got it. Okay. And then I'm wondering if we could talk a bit about the bio degrade ability, because I think that's a really important interesting aspect of it.

Andre Simpson [00:17:32] Yeah, that's something we didn't really expect. And and I have to make some guesses with that in terms of why I think it's happening, but that we basically buried under soil and we found We lost about 20 percent of its weight, which means about 20 percent of degrades In about two weeks under foil.

Andre Simpson [00:18:23] So we don't see that in the product. We need the product in the lab. It doesn't fall apart on its own but if you bury it under soil the microbes start to break it down. And why we think it's breaking it down, because it's essentially just fat, in fact, is something that microbes like to eat and ingest anyway. OK.

Andre Simpson [00:18:40] And in some of the bonds that are remainsing in the fat, like the glyceride bonds, so fats come in two sorts. That's a long chain sort of normal fats you buy. And then there s tricoglyecerides, which all the facts and sort of biology. And they also have glycerol units. And if you look at figure A here.

Andre Simpson [00:19:02] B, see the oxygen is there in middle of the things that's called the right, left or right unit.

Andre Simpson [00:19:13] oxygen is there. So that unit that is called a ttriglycerides, is the most common fat would be at the all like every sort of fat in an animal would be made a tricyglycerides. And then microbes, of course, are good at breaking those down, especially in soils, because they break things that are dead. So they are better at break those bonds because they can break those bonds. They can break down the plastic. You know, that can be formed from that, which, of course, makes it kind of nice because it's very environmental.

Don Campbell [00:19:41] Yeah. Yeah. I was just wondering because like I mean, a lot has been made recently about micro plastics, plastics coming up in the ocean. So even plastics that do break down into smaller pieces, they remain and they remain micro plastics and they don't, you know. Exactly. So I'm wondering how that this would like I guess you didn't test how you would break down one or. Right. You're just doing soil.

Andre Simpson [00:20:06] Yeah. We didn't we didn't test that. But I guess what you could say is.

Andre Simpson [00:20:09] But essentially what this is is lipids, what is going to break down to its fat, it's going to eventually break down back into something that nature can eat f.

Andre Simpson [00:20:18] the Reason The plastics, are so problematic if nature hasn't evolved to deal with those manmade chemicals. But because we're using essentially a natural thing here, that nature can deal with it better.

Don Campbell [00:20:30] OK. Got it. OK. That's OK. Yeah, that's easy enough to explain. I'm just trying to think. Yeah. I'm wondering if we could just in general terms talk and we we you just sort of touch on a bit. But I think the importance of finding, you know, cheaper resins, but ones that are biodegradable was I'm assuming, you know, 3D printing is it's been around a little bit, but I'm assuming costs are going to go down. People are going to be printing more and more. We're probably creating more plastics, which which is which is an issue. Why is it important to have, you know, these resins that are, you know, that are economically feasible, but also biodegradable as well?

Andre Simpson [00:21:12] Economically feasible is really important because right now it's a competition between traditional manufacturing, where everything's always being done, and smaller companies, sort of saying, can I 3D print parts of the commercially viable amount of funding costs for 3D printing right now. are nearly way higher in all cases than traditional manufacturing.

Andre Simpson [00:21:32] But it's that we have to bring those costs down to make it more viable. And of course, if you do that, it makes it possible to small runs and small companies can come out with small amounts of products that without having to make, you know, 100000 units to bring the cost down that can make one and have the same, you know, at the same price. That's when to bring the cost down.

Andre Simpson [00:21:52] Biodegradability just comes down to if we're going to use more and more plastics, we want it to break down, you know not staying in the environment for a million years. And ideally, when it breaks down, it's into something that will recycle all the way back to CO2, that could be used again.

Andre Simpson [00:22:07] so we don't really want to stick around forever. I don't think there's that much to my knowledge, that thing is any work being done or I don't know of any work that's been done in the resin-based printing.

Andre Simpson [00:22:20] So there's two sorts of 3D printing. And if you've ever played with one, that's the one that uses the filament. That's the most common ones. thats's when you have rolls of plastic, they have something called poly lactic acid, which already is relatively both degraded. But the problem with filament 3D printing is the resolution really sucks. So it's like lines all over it and it kind of makes it really unusable for commercial applications.

Andre Simpson [00:22:47] So the resin based printing, what we're doing where we cure it with light that has a much higher resolution. In fact, some of the really cutting edge stuff is really, really high.

Andre Simpson [00:22:56] So that can be kind of a future, where they have to bring the prices down. It's just so expensive right now because making those resins rUV curable, this is one of the limiting factors.

Don Campbell [00:23:08] OK. OK. Yeah. I think most of the ones I've seen are film and like. I know.

Andre Simpson [00:23:12] Yeah. Yeah. Those are the common ones you'll see in houses and stuff

Don Campbell [00:23:17] I think Mary. So Cox's lab has said that's really the only printer I've seen in a in a lab so far. Yeah. I think. Yeah.

Andre Simpson [00:23:26] You want some photos I can arrange. Right. Students to desktop and maybe make a video there. We have the whole prints from my lab.

Don Campbell [00:23:33] Yeah. Yeah. I'm going to get to that too young guy on a sec. So the one thing in terms of funding it looks like there are quite a few sports and so on and Cirque as so many acknowledgements. But CFI Criminal Foundation and the government Ontario earlier early researcher award. Yeah. So that's all correct. It's all there. Yeah. Yeah. I don't think I would have an issue with mentioning that you've got the oil from McDonald's. Right. Like know. In the paper.

Andre Simpson [00:24:02] It's in the title, I got permission from McDonald's headquarters to do it. I didn't want to do it without getting permission. Got an e-mail from them. Basically, they said, we don't really care. Go ahead. You've got to find a restaurant that let you have it at all. All the restaurants are what franchises

Andre Simpson [00:24:20] So all the other places that are set. No other replies at Burger King. I mean, don't mention this, but all the big chains, they either said no or just ignored me.

Don Campbell [00:24:28] Right. Right. Yeah. But so you I guess you got that e-mail from corporate. Then you had to go do things, right?

Andre Simpson [00:24:34] We had to go to about 15 stores. We find someone. Macy, we just kind of didn't know. Right. Sorry. We got online. We can't help you. Yeah. Other people. And eventually we found one. I don't even know which store it set yet for me and my students went, but. OK, well it's great. Someone's scarf but eventually said, yes, I do. And they had to stay late and they had to keep people on extra hours so that oil could cool and then we had to disconnect pipes and stuff and get it was a pain in the arse.

Don Campbell [00:25:02] That's great that they do it. Yeah. It makes it all right. Yeah. I was going to say it doesn't make this doesn't make McDonald's out in a poor light anyway so I don't think you know. No, not at all.

Andre Simpson [00:25:12] I know exactly the sort of positive things. But I think if they had mentioned them because I mean my stu was saying what should we just say cooking oil. Well, I said, look, I thought of making put the paper, put the paper. The fact we've got it directly from a McDonalds's and it's also exactly the same kind of I'd throw it out or put it back normal disposal pathway. Yeah. It made it more realistic Than normal chemistry range of do something on a fake thing, you know. I mean.

Don Campbell [00:25:36] Yeah. The other thing, I guess the properties of McDonald's cooking oil aren't going to be vastly different than what you can buy in the grocery store.

Andre Simpson [00:25:45] In theno they're going to be pretty much the same as far as I am. I'm sorry that the fat in the paper I think was hard to find. Oh, here you are. It's a fact almost all. It essentially is a mixture of canola oil, corn oil and soybean oil. Right. Okay. So that 's all ot says it's all 3 oils blends together. Right. And yeah, I guess the only and interesting about McDonald's itself is the fact that we didn't need the photoinhibitor because the brown color form during the cooking process. Right. Okay.

Don Campbell [00:26:12] Okay. Yeah. That's what that might be a little bit tricky. Yeah. That and describing the chemical brine. I'm probably just going to you know, I'm not going to get into the nitty gritty. It's skin. Really. Yeah. Like that. It's more just you know, the fact that you were able to figure out a process to to create the resin other than under the cooking oil. And then, you know, some of the benefits of it, the bone degrade ability that the cost in that type of thing.

Don Campbell [00:26:38] Okay. Yeah. So. Yeah. Before we talk about video and images, I'm just wanted. Was there anything else that you wanted to add at all? Anything that we didn't any. Like an important message or anything that we didn't cover, that you wanted a dad?

Andre Simpson [00:26:50] Like two things. And I think it's mainly covered in the paper. I venture to say that alternative conclusion that covers the cost to be better.

Andre Simpson [00:26:58] It might be worth mentioning because this material UV cures, it cures under the sunlight. Right. So I mean, I think that thinking really stupid things. I've not trying this, but, you know, of course, oil flakes on water. If It cures on top of sunlight. You might even let it just spread it on water it will form a bridge. I mean, these silly things he could potentially do with that. I don't know if you're about to mention stuff like that, but it would probably it I you know, I mean, I didn't want to go too far in the science papers because people get young. They're like, try it. But. Right. It would float, it would cure on sunlight.

Andre Simpson [00:27:32] So that does make it quite universal in terms of interesting applications.