CERAMIC TECH CHAT

Episode 62

Title – "Exploring unusual glasses and Indigenous thinking: Courtney Calahoo"

INTRO

McDonald: "I'm Lisa McDonald, and this is Ceramic Tech Chat.

Much of the scientific research taking place today remains heavily shaped by the dominance of Western scientific paradigms. But reliance on this historical bias means that knowledge from other sources, such as Indigenous communities, is often overlooked at the cost of myriad scientific, social, and economic benefits."

Calahoo: "I don't know how I ended up on this book, but I was reading the section about how Inuit process muskox horn into their tools. And the description of how they did it just struck me so much as being similar to how a glass blower would be doing it. It just made me realize that the people that are living in the Arctic, they were materials scientists. It made me feel that there's sort of a missed opportunity where we could put maybe even a fraction of the same interest or effort into investigating how Indigenous materials scientists worked with their materials, how they chose their materials."

McDonald: "That's Courtney Calahoo, research and development team lead at Genics, a chemical manufacturer in Alberta, Canada. She works with unconventional glass compositions to solve unique challenges, such as wood preservation in utility poles. During the International Year of Glass celebrations at the United Nations, Courtney talked about her experiences as an Indigenous woman glass scientist and the overlap between Indigenous knowledge and glass science, such as the muskox horn example in the earlier audio clip.

In today's episode, Courtney will share her journey to working on unconventional glasses, describe some of her current projects, and provide more examples of how Indigenous knowledge can benefit modern scientific research."

(music)

SECTION 1

Calahoo: "I think I was always interested in science as a kid. I was someone who would always be collecting frogs and like catching them and keeping them at home. My mom was pretty supportive and so were my science teachers in school. I would like bring the eggs into school and watch them hatch. So yeah, I think that interest continued in high school. I had good teachers there in both biology and chemistry.

And so, I decided that I would go to McGill University in Montréal for my undergraduate. And really honestly, it was just because I was told it was the best school in Canada. There's obviously going to be some arguments about that. But in my mind, I was going to go to the best university in Canada.

But funnily enough, because I wasn't super aware of how to get into university, I knew that I had to apply online, but I didn't really know when the deadlines were and all of that. So, I applied very late, and at the time, the only program that was open still accepting students was the agricultural program. And so I applied to the agricultural program and got in. And so then once I got there, then I just kind of kept bothering the registry office over and over, like the administrator's office, until they finally put me into general sciences.

So, I don't know. I was like thinking whether I should tell this story or not, but I guess it's just an example of maybe where if you come from a different background, you don't really know how things work and no one really told you, and maybe you just have to try anyway, and you'll end up at the right place.

So, then I did regular sciences at McGill University and then got interested in physical chemistry. So, then I finally graduated, and I did get honors at least so that I knew I could go to graduate school. At the time, I think I just felt that I liked school enough that continuing on to a graduate degree program made sense.

And so, I was shopping around for graduate programs in Canada, and I was interested in moving to Halifax just because I knew that it was a walkable city, it had a large student population, it was on the ocean, it's really beautiful.

Yeah, so I was shopping around for Ph.D. supervisors, and I met with professor Joe Zwanziger, who is a glass scientist, and I felt that he was someone that I could work well with and that we could get along. And the more that I thought about glass, I was just like, 'Well, wait a minute, it's like everywhere. How have I never noticed that it's everywhere?' So yeah, I really had never considered a career in glass before that, I had never heard of ACerS or ICG or anything like that. So, it was really just that I found this professor at Dalhousie in Halifax that I jived with and felt that the glass would be a good industry to be in.

Sometimes people ask me what was the topic of my Ph.D., and it's quite disjointed in the sense that I found like an old piece of equipment in the lab and I unearthed it and I made it work and I did some electrical conductivity measurements. And then I knew that we had access to a nanoindenter, so I suddenly became very interested in the ion exchange layer and using nanoindentation to investigate that thin layer on the outside. And then I also became interested in the mixed alkali effect. So, these were just things that I got interested in as a newbie glass scientist. The only overarching theme I think of my Ph.D. is that I love structural glass science. So, I love thinking about how the bonds and the atoms are all connected and how that's showing up in your different macroscopic properties.

So, after that, I didn't really know what I was going to do. I think I was just so happy to be finished with my Ph.D. that the idea of looking for another job seemed overwhelming. At the time, my partner, he got a position at Oxford in England, so I was like, 'Okay. Like, you have a job lined up there, you're getting paid, I want to move to Europe. Who doesn't?' So, then we went there, and for about a year, I was just TAing at what they call a sixth form college, which is kind of like somewhere between high school and university. We don't really have that equivalent as much in North America, I would say. But at some point I was just realized that I wasn't necessarily happy in the sense that I was seeing my partner do his research and I missed doing my research.

So, I had started to look for a job again, and I happened to email professor Lothar Wondraczek, who works at the Otto Schott Institute of Materials Research in Jena, Germany. And I just emailed him because on ResearchGate, I noticed that a lot of our papers were sort of citing each other, indicating that we were working on similar things. And so, I just sent him an email. I was just like, 'Hey, I noticed that we might be working on similar things. Do you know of any positions are open?' And he very quickly was like, 'Yes, I have one right now. When can you start?'

And that was super shocking and very serendipitous. So then I called my Ph.D. supervisor, or my former Ph.D. supervisor, to just be like, 'Hey, do you know this person? Like, do you think it's a good idea? I don't really know that much about him.' And my Ph.D. supervisor, Joe, he's like, 'I'm honored that Lothar would even consider hiring one of my students.' I'm like, 'Woah, okay. I guess I gotta take this job.' Having really no idea about Germany or Jena or the Otto Schott Institute, what I was getting myself into really.

But yeah, so then a few months after that, I started my job in Jena, and it was pretty shocking because in my Ph.D., there were literally two of us most of the time in the research group. So, we really wore all hats, you know, in the sense that you're the person that makes the experimental plan, you make the glasses, you polish the glasses, you measure the samples, whether it was mechanical properties or optical properties or spectroscopy. And you were the one that wrote the paper, like wrote the draft.

So, then going to Lothar's group, where I think there's like 30-plus members at any given time, you have a much higher degree of specialization, right? Where there's someone that just knows about mechanics or someone that just knows about electrical impedance. So, it was a bit of a struggle for me to kind of find my footing in the sense that I, and still to this day, although I'm getting better over time, I would say I'm still a generalist, where I know a decent amount about a lot of properties of glass, and I'm always trying to connect them to each other and to the glass structure.

What I ended up finding is that the European system is quite different than the Canadian system for Ph.Ds. Simply that they're only given maybe a three to three-and-a-half year window in which they're expected to publish three papers. And anyone who's done a Ph.D. can tell you that that is not a lot of time to learn the ropes, to do the actual measurements, let's say the experiments, and then to draft the paper and also go through all of the rigmarole of publishing. And so what I found is just that since I had actually developed those skills to write papers that that kind of became what my best skill that I could add to the group was.

So, it was very good for my CV because I am on a lot of papers, and I did learn about different aspects of glass. And also, Lothar was very supportive of me writing a huge review paper on ionic glasses. And that's when I started to get really interested in weird glasses because in my Ph.D., there were only like three glasses in our minds, I would say. They were like silicates, borates, phosphates. Done. But then Jena has this long tradition of really in-depth glass research. I mean, if you go to their basement, there's just like rooms full of glasses that different researchers have been making for decades. And it includes a lot of very, very strange glass formers that I had no idea you could make glasses from those compositions. So, things like fluorides, chlorides, sulfates, iodides.

So, I got super interested in like why can you form, let's say a potassium zinc sulfate glass that doesn't have any phosphates or borates or anything. And then that's why I wrote the review paper about it, and I tried to argue that ionic glasses are a separate class of glasses that have their own structure and their own properties that you can sort of identify them compared to other glasses. But I would say that because they tend to be vulnerable to water attack, there's not a lot of people that are studying them. And so, you feel like you don't have enough data necessarily to make a complete picture. So, I hope that people will make more ionic glasses and then we can go back to the review that I wrote and update it and hopefully prove that they are a unique class of glasses.

So, that's my time in Germany. Then, again, serendipitous, it happened that the father of my best friend growing up happened to talk to the CEO at Genics. And the CEO was like, 'I'd really like to have a glass scientist.' And then my best friend's father was like, 'Hey, I know one, and she grew up near here.' Which is true. The place that I work now, Genics, in Acheson, is like less than 10 kilometers from where I grew up. Which is crazy.

And then, the reason that I was hired was specifically to take a dissolvable glass rod for wood preservation and turn it into glass fiber. And so, back to the idea about ionic glasses and their ability to be attacked by water and hydrolyzed and dissolved, part of the reason that I was interested in this job and working on these dissolvable biocidal glasses is because I wanted to understand more about ionic glasses and give them a reason to be studied in the literature."

(music)

SECTION 2

Calahoo: "So, Genics is a company that for the last 40 years, they've been doing wood-related products. So, the slogan is 'Wherever wood is used.' And that just comes from the company starting as kind of a utility company or an auxiliary utility company. And then making different types of products for like power grids and railroads and that kind of stuff where wood is used.

So, yeah. So, wood preservative glass is a copper sodium borate glass, and the copper and the borate are biocidal. That means that they kill basically everything that's living, but most importantly for us, they stop fungus, because that's generally what rots wood, and termites.

I can talk a bit about how that rod works. So, if you have a power pole that you would like to treat, then the important part is that you treat it with this biocide a meter above the ground line and a meter below the ground line. And that's just because you need a certain amount of water and also oxygen for the fungus to really proliferate. And so, you drill a hole in the pole, and usually you drill like three to four holes for a standard pole, and you put the glass rod in that hole.

The glass rod's pretty short; it's probably around 10 centimeters, I'm gonna say 4 inches. And it's only about 20 grams. So, it's pretty small. And you put it into the hole in the pole. Over time, depending on the climate and the wetness of the wood and all of that, it dissolves somewhere between two and six months. And the copper and the borate proliferate, diffuse very well into the wood, and they really stay there.

Those two things are kind of the important properties of why this works so well. The first point is that you kind of want it to dissolve slowly. There are other products on the market that are liquids, and they tend to go into the wood very quickly, but then they also leave the wood very quickly. And so you're aiming for something that dissolves slowly. And then also the copper has kind of a unique and somewhat unexplained and unexplored synergistic effect with the borate, where it seems to bind the borate and keep the borate in the wood a lot more effectively than if you had just borate. And if you do this every 10 years, then you can triple the lifetime of your wood.

So, utilities are pretty excited about that because now they don't have to go out into generally the middle of nowhere and pull out their pole and put in a new one. And also only one out of 10 trees that's cut down is good enough to be used as a pole. So, it really has to be very straight and like defect free. So, I would say that good poles or good wood is an asset that you want to protect. And that's kind of what we're about here at Genics, I would say.

So, yeah, that has been a very nontraditional use of glass, I would say, because most people don't think of how you can preserve wood using glass."

McDonald: "But, you know, your point about how this can like triple the lifetimes of the poles made out of the trees is just so significant if we consider the vast expansion we're going to need in our electrical infrastructure in coming years. There is so much more demand on the grid, which means we're going to need more poles with more lines carrying electricity around the country, around the world. And if we can create this glass that preserves the wood to last a lot longer, that's just going to be so helpful as we're building out this additional infrastructure."

Calahoo: “True! And we’re also pretty proud that it is relatively environmentally friendly, in the sense that we’ve measured soil in the surrounding area of the pole and generally find that copper and boron leaching is pretty low. And that’s going back to the idea that the copper and the borate are really stuck in the wood rather than being released into the environment.”

McDonald: “We’ve talked about making these rods for the wood preservation, but what are some of the other applications of these nonconventional glasses?”

Calahoo: “As I mentioned, I was interested in taking the job because of dissolvable glasses. And we were making fibers, and I was kind of like ‘Hmm, like where else are dissolvable fibers useful?’ And I realized that in hydroponics, they typically use rockwool as a growing medium. So, rockwool is similar to glass wool that you use for insulation in your walls. The big issue there, though, is that after you’re done growing, it’s not easily recyclable; it tends to be kind of contaminated, let’s say, with the plant’s roots and maybe some algae or whatever other living thing.

In Canada, I know like in BC [British Columbia], it’s getting to the point that landfills are just saying no. And not because the rockwool is dangerous. I often get asked like ‘Well, is it poisonous or is it toxic?’ And not really. I mean, we all know that glass fibers or small fibers can be a breathing hazard. But in this case, it’s more just the volume. If you are growing these plants industrially, you are making like several hundreds of tons a year of this waste. And so landfills just don’t want to deal with the volume of that waste.

So, I wanted to try to create a growing medium that would last the life cycle of the plant but then afterwards be dissolvable and dissolve into a solution that was composed of the same nutrients that plants need. And so that’s kind of where that long name comes from, dissolvable glass fertilizer fiber, is because we want it to dissolve, it’s obviously a glass, and then it’s made of fertilizer components, and it’s a fiber.

So, I’m not a plant scientist. I love learning, obviously, learning new things and obviously learning how things grow in plants is a lot of fun. So, I just kind of looked at plant nutrition and was like ‘Okay, like plants need phosphates and calcium and magnesium and other nutrients.’ And I was like ‘Okay, I can make a glass out of that. Like I’ve made that type of glass before.’ And we made it into fiber and then we made some different collaborations with greenhouses, specifically Lethbridge Polytechnic, which is to the south here in Alberta, and then also collaborators in the Netherlands, Botany and Wageningen University. And they grew plants in our fiber, and surprisingly, it worked. I didn’t expect that my first try. I don’t think most innovations are that positive. I do think that there’s a lot of kinks to still iron out, but it was a really positive proof of concept. So, yeah.”

McDonald: “It’s just so exciting that you’re getting to work on these applications that are so helpful for the environment. But it’s also slightly ironic that you could have been a plant researcher if you had pursued the agricultural program that you were originally admitted for in undergrad.”

Calahoo: “You’re right, coming back.”

McDonald: “After all these years, you looped right back to agriculture.”

Calahoo: “True. And we have a lot of agriculture here in Alberta. So, maybe it just is in my blood.”

McDonald: “It was meant to be. You didn’t know it at the time, but those pathways that you thought weren’t for you, maybe they were, just from a different angle.”

Calahoo: “True. And I am really happy to be working with like growers and farmers. They’re extremely passionate about what they’re doing, very down to earth and willing to try new things most of the time. It’s nice to work with people outside of your field, and I think that’s the value of being a glass scientist, is just that it’s so interdisciplinary, even within the glass community, in the sense that you have, you know, artists and you have engineers and you have geologists. Anyway, it’s nice that we come from all different directions, for sure. One of the joys of being in the glass community.”

(music)

BREAK

McDonald: “The American Ceramic Society represents all people involved in the global ceramics and glass community. The Society’s ‘Promoting Full Participation in Science’ webpage provides the materials science community a readily accessible list of recommendations for cultivating an environment of fair access and opportunity for all. Visit the webpage at www.ceramics.org/fosteringequity.”

SECTION 3

McDonald: “The glass community is just so welcoming for people from all different types of scientific backgrounds but also people just from different backgrounds culturally, ethnically, throughout walks of life. And that gives us a good transition because you come into the glass science world as an Indigenous woman. That gives you unique perspectives on, you know, how we can use glass to help society, help the environment. Can you share with us a little bit about your experiences of going into science with coming from the Indigenous communities?”

Calahoo: “Thinking about how being Indigenous has shaped you as a scientist is complex, and I get asked this question a lot. So, I guess I’ll start with that there’s two types of indigeneity that I know about. In Canada, at least. I cannot speak for all Indigenous people. But in Canada, I would say there’s the Indigenous people that were raised in their culture, they’ve always known their culture, and they strongly identify with that culture. And I think they bring it through into their everyday, let’s say. In my case, I’m the second type, where a lot of the culture was lost and forcefully, violently, nonvoluntarily. And there’s a lot of people like myself that are this second type, where we're slowly kind of waking up and wanting to learn more and trying to sort of put the pieces back together.

Since I've learned more about Indigenous culture, I can say that there are a few ways in which I just happen to exist or happen to align with some of the Indigenous ways of knowing or teachings, let's say.

So, one of them comes back to my Ph.D. supervisor was very hands off and allowed me to make my own mistakes and also my own success. And I've been reading a lot of stories, Indigenous stories and legends and myths, you would say as well. And what's interesting is that when they're told, they're kind of ambiguous. So, they don't really come out in the same way that you might find more Western stories do, where it's very obvious what the moral is, the moral of the story. Indigenous stories tend to have a lot more grey. So, like Coyote, sometimes he does some weird stuff. Sometimes it seems kind of bad, sometimes it's good: You don't really know. And I guess that's the way that it's supposed to be, is that the storyteller or the elder is not supposed to tell, usually a child, but is not supposed to tell the audience or the listener what this story means.

And I think that is just a really different way of communicating knowledge or raising your children or interacting with students even, because you're like 'I'm gonna just tell you something, and you get to decide what is right, what it means.' And I think that if people are raised in that sort of environment, where that's what they've been taught, like to have their own mind, to have their own opinions, then I do think that is something that's really valuable to science. I mean, we need someone who's asking their own questions, that maybe isn't necessarily reading the current theories and agreeing with them all but maybe stirs up the pot a little bit and has kind of their own ideas and questions. So, I just have to say that in my Ph.D., being given that time and allowed to make mistakes, that ended up being really positive for my growth as a researcher. So, that's one thing that I think is kind of cool.

I guess the other thing that I've also learned is that at least in the Cree tradition, which is the local native in the prairies here, is that they always think in seven generations. So, that means that you think of yourself and you can imagine your grandchildren and you can also imagine your grandparents. And so that's seven generations. And I feel like that's kind of their way of saying that that's the maximum amount of time that you can imagine, where there's people that you know and that you care about. And I think that's where their environmental care or their stewardship, as we say, where that comes from. And so, I hope that I can adopt that.

I have been reading different books such as 'Braiding Sweetgrass,' which I'm sure lots of people know, and trying to understand what that actually means in the sense that she talks about how trees are people. And that's been really hard to actually mean that because she means that, I believe anyway, in the sense that if you always put trees below people, then you always have a reason to cut them down. Because you're like, 'Well, I need them, my children need them.'

So yeah, that's just something else I guess I'm trying to incorporate into myself, where I can imagine seven generations and how would I want to leave it for seven generations. Because I think that's something we're missing. We're missing that from our thought process when we start thinking as scientists, let's say, or engineers or yeah, so."

McDonald: "I think that's a really great viewpoint is, you know, what are we doing today is going to affect our kids, our grandkids, our great grandkids. And so really and also reflecting back on, you know, our parents, our grandparents, they're still here, too. How do we make it a good place to live for all of these different generations now and into the future. And the research that you're doing, you know, like helping to elevate the trees, have them live longer in their lives as poles is helping to kind of move toward that ideal."

Calahoo: "Yeah, yeah no, definitely. I appreciate you saying that. I think as scientists, we're just always doubtful, but I hope that comes through."

(music)

CONCLUSION

McDonald: "Science thrives when researchers account for different perspectives, and sometimes a simple email is all that's needed to open the door to fruitful collaborations.

I'm Lisa McDonald, and this is Ceramic Tech Chat."

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"Visit our website at ceramics.org for this episode's show notes and to learn more about Courtney, her research, and Indigenous materials science. Ceramic Tech Chat is produced by Lisa McDonald and copyrighted by The American Ceramic Society.

Until next time, I'm Lisa McDonald, and thank you for joining us."