CERAMIC TECH CHAT

Episode 04

Title – "Intercultural Collaboration Benefits Science: Tessa Davey (E04)"

INTRO

De Guire: "I'm Eileen De Guire, and this is Ceramic Tech Chat.

> Imagine you just graduated with your Ph.D., and you've applied for several post-doc positions. But instead of being offered a post-doc, one university offers you a faculty position. Would you take the offer? Now imagine that offer is from a university halfway around the world—would you still take it?
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> That was the situation Tessa Davey found herself in after graduating from Imperial College London in the U.K. when she applied for a post-doc position at Tohoku University in Japan."

Davey: "During my Ph.D., I had a lot of teaching opportunities, including like teacher training opportunities and a lot of management opportunities and that sort of thing. So when I sent my CV, they actually offered me a faculty position instead of a post-doc, which was really fortunate and very lucky."

De Guire: "Tessa said yes to the opportunity and has now been teaching in Japan for three years. And while she did experience some culture shock, it's not the first time she's experienced such a thing.

> (music)

SECTION 1

De Guire: "When many students study abroad, they often go with a group of friends or colleagues. Not Tessa."

Davey: "I studied abroad for the first time when I was 17. I went to a German language school in Vienna. And that was really amazing for me because my family originally comes from Austria. And suddenly I was there by myself and I was only 17 but I was living by myself and taking myself to school. And being so independent, because I was very shy, but suddenly I had to be so independent and that was really sort of, I guess, pivotal moment in my life where I kind of decided that I was just gonna off and do all these things by myself.

> But I also had the opportunity then during my master's to study in the Czech Republic very briefly. But that kind of gave me another perspective because I didn't speak any Czech apart from being able to order a beer, which is very limiting if that's all you know.

And that was really exciting. I was doing some experiments at a university there, and I was really out of my depth, both in terms of what the experiments were and in terms of the language. And that it was so, it was kind of liberating to not really know what you're doing and just be thrown into it. That was like a very steep learning curve but an exciting one.

And then during my Ph.D., I studied in Germany learning CALPHAD method because there weren't many people in the U.K. doing it at the time. And again, I was kind of there by myself, I was completely thrown into this and having to sort of get to know people in a lab where everybody was not British, and it was completely different to the environment I was used to.

But I think what I got from all of these was an appreciation of how to kind of communicate and to work with people in all different countries. Because every single lab has a different sort of work culture, but particularly if you go to a lab in a different country, you find that they work in completely different ways and also they socialize in different ways. And I think what I found was that it's a really important skill to be able to kind of not only work but to be able to socialize with people sort of everywhere you go. Because I think collaboration is really key in a career these days. It's important, at least for early stage career people like me, to have collaborations all over the world. And being able to feel comfortable in environments where you don't know anyone, you don't know what's going on, I think is really kind of crucial and I think not enough people kind of take the time to develop that kind of skill. And you learn a lot about yourself being in a completely different environment where you're the different one. And you suddenly see everything you do from a different angle. And I found that I really learned a lot about myself, and it's been really sort of interesting journey."

De Guire: "Do you think it's made you more sensitive to situations or environments where you aren't different, but you know, you observe people who are different?"

Davey: "I think I'm much more sensitive to people being treated differently. So I think I'm now very aware if I see somebody, maybe even if I'm in an environment where everybody is like me, if somebody who isn't comes in and somebody else reacts to them differently to how they react to me, I feel like I do really notice that now. And I, like I mentioned before, I'm always quite aggressive and outspoken, so I think I'm very willing to challenge that. And I think a lot of it comes from, it's awkwardness and fear when you meet someone who's very different. But I think we all kind of owe it to ourselves to try to treat everybody with as much sort of empathy and humanity as possible and really strive for equality."

De Guire: "So, because you've been in materials science and especially as young as you are, you've been a lot of places compared to other people your age, how do you think we're doing, as a materials science community, to promote diversity and inclusion and cultural awareness?"

Davey: “I think there’s a lot of steps being made, and I think the work that’s being done is really exceptional. I’m lucky to have been on ACerS Diversity & Inclusion Subcommittee, and that was amazing to see from the inside perspective how people like in a professional society are tackling this. And I’ve done similar things in departments, both with Imperial and in Japan.

And I think a lot of strides are being made, but I think a lot of them are related to gender, and other sorts of diversity issues fall by the wayside. And that’s not to say I don’t still think there’s a huge gender problem. Because, I mean, everywhere in the world there’s still an inequality in the number of men and women. But I think it’s more comfortable to talk about inequality when it comes to gender than it is when it comes to other kinds of diversity, perhaps. And I think one thing that we need to do in the future is make the effort to shed that discomfort and really try and work out how we can tackle these problems, even by sort of tackling our own prejudices and our own sort of unconscious biases.”

De Guire: “I think one of the challenges is getting at what our unconscious biases actually really are.”

Davey: “Yeah, exactly, that’s a huge first step. But I think as well convincing people, even if they know what it is, that they have to change as a result of it. Because not everybody wants to. A lot of people, particularly those in power, are really happy with the way things are, and they don’t want to give up some of that power or give up some opportunities just for the sake of equality. And I think convincing people that actually a diverse environment flourishes compared to an environment that’s not, even in terms of company environments, like manufacturing outputs, and everything is so much higher and creativity is greater, and you get better results. Everything is better in a diverse environment. And just because we’re used to it being one way, we shouldn’t resist that change when we know it’s going to bring us a lot of benefits.”

De Guire: “I couldn’t agree with you more.”

(music)

SECTION 2

De Guire: “Tessa mentioned that she traveled to Germany during her Ph.D. to study the CALPHAD method. But what exactly is the CALPHAD method, and how does that fit into her larger research?”

Davey: “I work primarily on phase diagram modeling. So, I use something called the CALPHAD approach, which basically is a method of combining all kinds of data. So, experimental and theoretical data relating to phase diagram calculations, thermodynamics, crystallography, mechanical properties, sort of everything. And it ties it together into a single model. And this is really powerful because it allows you to find inconsistencies in measured data and it allows you to extrapolate that into regions where there is no data. So,

you can use it predictively as well. And it's been an immensely powerful tool in materials design for decades now."

De Guire: "And did you use some of that in your ultrahigh-temperature ceramics work during your Ph.D.?"

Davey: "Yeah, so in my Ph.D., I was applying CALPHAD modeling to the zirconium-carbon system primarily, trying to develop methods to model phases with extremely high number of point defects, so a lot of vacancies or sort of interstitial atoms. And actually, the methods for doing this are relatively underdeveloped, so it's a really exciting opportunity to come in and improve these methods using all of the available data."

De Guire: "And so I've heard that one of the challenges working at ultrahigh temperatures is that it's very difficult to measure properties at high temperatures. So, can you comment a little bit on how you resolve that modeling but how you do you verify and validate your models?"

Davey: "That's actually one of the biggest challenges that I faced. So, when it comes to these ultrahigh-temperature ceramics, there's huge discrepancies in the data, the uncertainties are really large. And a lot of the time the samples that they're measuring have sort of unknown quantities of impurities. And that can really affect the data that you get out, if you don't know exactly what you're measuring, it really affects your analysis of the result. And a lot of the data to directly characterize these materials and create phase diagrams is very old, and since then, we're developed all these new methods.

So, I was very lucky to have access to some experimental data using new methods to kind of improve the phase diagram and sort of create a new one adjusting to all the new data that we had. But it certainly is a significant challenge in the field, that it's so difficult to experimentally verify and test these things.

But I think one advantage of being able to use modeling… so, I also do first principles calculations, where entirely atomistic simulations, even up to extremely high temperatures. And one advantage of this, and it's a relatively new technique to be able to do this with such high accuracy. So, one advantage is we can predict what would happen in the perfect case with no impurities. And so that can kind of be fed back into characterization and it can help us learn more about the real materials that we're making and be used together to find out which areas of the phase space still need more careful examination."

De Guire: "So when you're working in the CALPHAD, are you starting with first principles and working your way up? I'm not sure how that works."

Davey: "So, within CALPHAD, primarily you use experiments. But I also do a lot of first principles calculations to complement that. So, coming from a physics background, I really want to make sure the models have as much physics as possible because if you're more consistent with physics, then you're going to get better models out. So I do a lot of

first principles calculations to kind of double-check that they're fully representing the physics correctly and to add data where maybe there aren't any experiments to give us some idea and then hopefully someone later on can go on and do that experiment and let me know.

I think first principles calculations are really good way to guide experimental investigations. As well as like recently the accuracy has been improving, so eventually it will be possible to use them as sort of stand-alone data. But for now, I really believe that they're a really good way to guide experiments and sort of reduce the number of experiments that we need to do. Because experiments are really expensive, and comparatively calculations are cheap. So I think if you really take advantage of the theoretical tools, not only first principle calculations and CALPHAD but also data science and various informatics tools that you can use to understand all this knowledge, then we can really save a lot of money for experimentalists, and then we can learn a lot more and build things a lot faster and really hopefully achieve these materials goals that we all have in mind."

De Guire "Had you always expected to be a faculty, or to have an academic career?"

Davey: "I mean I didn't think I would have a faculty job this young. I thought there would be a lot more steps in the way. And I'm extremely grateful that this kind of fell in my lap. I know that doesn't happen to many people. But when I was applying for university, it was sort of on my radar. I wanted to study something really in depth, I wanted to do a degree and then a Ph.D. And I guess I like explaining stuff to people. So, it was always on the radar, but I've never been, I guess, married enough to the idea that if it doesn't work out or if I don't like it, there's always other options."

"But I think another thing that I'm really surprised by is how important the teaching aspect turned out to be to me compared to the research aspect. So, as I said, I always wanted to do a Ph.D. and delve really deep into research, but… and I always liked teaching, but I didn't think that I would be so passionate about ensuring everybody has the opportunity to learn. I mean, of course from an equality perspective it's always been important to me, but I didn't really understand how important the social sciences aspect of learning methods and sort of teaching techniques, I didn't realize how pivotal that would be in my development as a faculty member. Because I really think taking into account the way the students learn makes a huge difference, and I think having good teachers really inspires students to be the best that they can be. And inspiring them is actually my favorite part of my job, and I really didn't expect it to be. I thought I would enjoy it, but I thought the research would always be what I like the most. But, I mean, it's worked out well. I'm so happy that I get to teach in such an unusual teaching environment as well. I really learn so much from my students."

De Guire: "And you teach in English."

Davey: "Yes."

De Guire: “And so what is it about Tohoku that makes it such an unusual learning environment? Besides the English in Japan. You’ve been several other places now, so what is it about that that makes it so unusual?”

Davey: “So the classrooms I teach in are really, really diverse but the rest of the university is not at all. So, there’s very few international students apart from the ones in this Feature Global Leadership Program. And I think from that perspective, the students there are really immersed in this really homogeneous environment. And as well for me, I’m immersed in this extremely homogeneous environment where I rarely meet anybody who’s like me. And that is kind of an additional challenge, both for me and the students, I think. Like for them, they’re able to build this really tight community, but also, they really take advantage of being able to get to know Japanese culture and be in a Japanese university, I think that’s the main draw for them. But I think having this tiny patch of extreme diversity is such a homogeneous environment really is quite unique. I haven’t seen anything like that anywhere else in the world. I’m sure it exists, but I haven’t come across it.”

(music)

SECTION 3

De Guire: “In addition to serving on ACerS Diversity & Inclusion Subcommittee, Tessa has helped encourage international diversity in ACerS during her time as chair of ACerS student leadership organization, the President’s Council of Student Advisors.”

Davey: “I was the first international chair, which was an amazing opportunity. The PCSA brought me so many opportunities, it was such an amazing group of people. And I thank all of those people that I interacted with through that for my entire career, really. I think I developed so many skills through it and so many connections, and I think it really changed me as a person in a really positive way.

But of course, this is The American Ceramic Society, and so the majority of people in it are American, and so there were some challenges being the first international chair. I think we had to kind of had to work together a bit at first to make it accessible to people outside the U.S., but we did a really good job of that and everybody was really motivated to do that. And I think as a result, a lot more international students felt really welcomed into the Society and were able to have the opportunities that they didn’t know that they could have, and that was something really special that I sort of really value, in being given that opportunity.”

De Guire: “So in terms of other opportunities for young people, especially in the field of materials science, where would you guide that 18-year-old in Wales right now who’s trying to decide math, physics, chemistry, materials science. What kind of future would you kind of offer to a person like that in the area of materials science?”

Davey: “I think in the field of materials science there’s so many different avenues to explore, whether you are particularly interested in sort of experimental stuff, so doing stuff with

your hands, or whether you like more computational stuff, or if you like theory more. I think for anybody who has an interest in science and in learning, there's a place for you in materials science, and I think it's a matter of finding which avenue you want to go down. There's so many materials challenges, from biomaterials to ceramics to metals, there's so much. And we use materials for everything, everything's a material, so I think it can apply to any interest. So, I think if I had a young person who showed any interest in science, I would help them find what material that really inspired them to learn more about it. And I think that's a really good way in for young people."

"But I think there is still challenges for students, particularly if like me you come from outside the States and having access to opportunities. Because everything is kind of based in the States, right? So as sort of the world expands, I'd love to see everything become more global and opportunities really be available for everyone, not just like in ACerS but in everything. And I think because of the nature of science and the way things are funded, it does tend to become clustered. And it's kind of my dream that one day everything will be so global that we can share everything."

De Guire: "I hope that we get there."

CONCLUSION

De Guire: "In a world increasingly connected through technology, not only will ceramic materials play a large role, but ceramic scientists will as well. Tessa's experiences show us how truly international a career in materials can be. But a main pillar in cross-cultural collaboration is bringing together local areas of specialty. Listeners may recall that Dana Goski, vice president of Allied Minerals, made a similar observation when we spoke to her in episode two of Ceramic Tech Chat.

I'm Eileen De Guire, and this is Ceramic Tech Chat."

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"Visit our website at ceramics.org for this episode's show notes to learn about Tessa and her research and the President's Council of Student Advisors. Ceramic Tech Chat is produced by Lisa McDonald and

Until next time, I'm Eileen De Guire, and thank you for joining us."