CERAMIC TECH CHAT

Episode 18

Title – "Building cross-border research communities: Olivia Graeve (E18)"

INTRO

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

> When students think about their pathway following graduation, many focus on how their choices will affect their personal goals and desires. These choices affect the person involved, but also the larger community that that person will become a part of—which makes community an important thing to consider when building life goals."

Graeve: "When building life goals, build those goals around the concept of compassion and community. Compassion brings a whole bunch of other effects that are positive, like justice and understanding and peace. All of these things come with having compassion towards the other person. And so, build goals that are organized around community. That will change the world. That will bring down walls."

De Guire: "That's Olivia Graeve, professor of mechanical and aerospace engineering at the University of California, San Diego. Olivia is director of the CaliBaja Center for Resilient Materials & Systems at UC San Diego, which is home to an education consortium that coordinates several international programs to build bridges between students in Latin America and the United States.

> Why is it important to have diverse representation in materials engineering? And how do the programs that Olivia coordinates help support this goal?"
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> (music)

SECTION 1

De Guire: "Olivia, how did you get interested in a career in the sciences?"

Graeve: "Well, it goes back to probably junior high school. It's an experience of positivity with respect to the kinds of teachers that I had when I was in junior high, especially in chemistry. So my chemistry teacher was truly outstanding. My math teacher was also outstanding. The chemistry teacher was a female; the math teacher was a male. And these are people that I looked up to. For me, they were examples of commitment to students and the capacity to just be in a classroom and make science fun. And so, once I finished junior high and went into high school, I think that the interest in science and engineering was definitely set. Not that I knew what specific field I was going to go to, by any means, but I did know that that was the route for me."

De Guire: “And, at that time, did you start to think about how far you might go with it? You have a Ph.D., so, when did that idea start to germinate and when did you start down that pathway?”

Graeve: “Yeah, no, not in high school. I don’t think I knew about Ph.Ds. in high school. I didn’t actually even know that that existed. That was not in my social framework. I grew up, born and raised in Tijuana, Mexico, and so I never had any kind of interaction with people that had advanced degrees, like masters and Ph.D. degrees. And so, if you don’t know something exists, then how can you even envision yourself doing something like that? That just was not for me. And so, the experiences that I had in life, in terms of going here and then reorienting somewhere else, is what led me to the Ph.D. You know, in high school, I knew that I wanted to do something science or engineering related. Somebody at some point told me that I should be an engineer, and I thought, ‘Okay, that sounds like a good idea.’ I didn’t know which one. I went to community college after high school. I did two years of community college, and I think that that was very useful for me to figure out which engineering field I was interested in. And I ended up in structural engineering. So my undergrad degree is in structural engineering.

And, it also is impacted to a significant extent by the fact that I grew up at a time in Tijuana where we had a lot of refugees coming into the city. Not from other countries, but internal displacements of Mexico, which were very serious in the 80s and 90s. And so, these people were basically just showing up and not having anywhere to go and they started like building little houses on the hills of the city. That’s where the Tijuana slums started building themselves, almost in a sense. And I went and I helped in those places, and I saw that housing was needed, so I think for me that structural civil engineering was sort of a motivator.

In undergraduate, I started doing undergraduate research. And that’s when you discover the Ph.D. And so I had a professor that I worked for that you know, Eileen, professor Joanna McKittrick.”

De Guire: “Oh yes.”

Graeve: “And she took me in her lab. I did undergrad research with her for two years and, of course, I wanted to be like her. So that’s it. I ended up in a Ph.D. program because of that.”

De Guire: “Well, those are wonderful footsteps to follow in. Joanna was an outstanding scientist and just a great person.”

Graeve: “Yes.”

De Guire: “As a research professor, you do have to focus a little bit on a certain area. So, can we talk a little bit about your technical areas of focus, and what your research topics are, and what the common threads are that you’re looking into?”

Graeve: “Yeah, this is obviously exciting. I love doing research, otherwise I wouldn’t be doing it, right? My area of research is the design and development and manufacturing of materials in extreme environments. And so what that means is materials that can withstand very, very high temperatures in jet engines, for example, in reentry vehicles from space, satellites. Also, not just very high. It’s not just those extremes, but also on the other side. Very low, low temperatures, like 2 Kelvin in the depths of vacuum in space, for example. Materials for those kinds of applications. Extremes of radiation, so very high radiations that also are applicable for Earth situations like a nuclear reactor, but also in space applications where you’re talking about gamma rays and solar wind and all the things that happen in space that we would be exposed to and materials are exposed to when they’re out there in space, outside the protective ionosphere of our planet. And also extremes of impact. Ballistic-type applications.

So we have a variety of projects that we’re running to support the development of these kinds of materials. I have a research group of about 30 students at the moment, and it’s really exciting to see them start thinking about not just implementation of the ideas that I have when I meet with them, but their own ideas and their own vision about materials in extreme environments.”

De Guire: “So that’s a pretty wide range of extreme environments. Are there any commonalities in either the materials or the microstructures or the processing that these materials have to have?”

Graeve: “Yeah, so that’s a great question. Indeed they do. Materials that can withstand extremes have one thing in common. And that is that if they’re going to be able to withstand those types of environments, they have to have really strong chemical bonds. They can’t break up. So, if you start thinking about what brings them all together, it’s like, ‘Okay, the chemical bond.’ What type of chemical bond would be the most common one that we would be playing with in trying to develop these materials? And that is covalent bonding. What are the covalent bonds that you find in these materials that is going to in fact keep them together in spite of radiation, in spite of temperature, in spite of impact? All of these things come down and end up being basically the bonding in the material. What keeps atoms together, and how can we modify bonding—which we can, there’s a variety of things we can do to modify bonding—that would allow us to say, ‘Okay, we have now made this bond stronger so that it’s not going to break up during radiation or it’s going to somehow withstand, for example, higher temperatures.’ That’s what brings them together, and that’s the fundamental science of this, right? The bonding and the crystal structure and the crystallography of these materials is what sort of brings the whole topic all into one umbrella. Meaning we have to understand bonding, we have to understand the crystal structure in order to modify it and make these materials better for these types of applications.”

De Guire: “And how hard our materials with strong covalent bonds to densify and sinter?”

Graeve: “So that’s another interesting question that most ceramic engineers are interested in when they’re working on processing of materials. When material has higher melting

temperature, which means that they have stronger covalent bonds, stronger bonding between them, those kinds of materials are more difficult to produce because, in order to produce them, in order to manufacture them, in order to do sintering on them, you are going to need higher temperatures. And so the field of ceramic science in so many ways is built around the concept of materials manufacturing for ceramics in such a way that you can apply those higher temperatures or apply those higher pressures or whatever conditions that are going to be more extreme, in fact, than typical, say, metallic materials. And so yeah, we certainly work on that."

(music)

SECTION 2

De Guire: "You were the first Latina engineering professor hired at UCSD, correct?"

Graeve: "I was. Before me, there was a, there still is a wonderful professor from Spain. I suppose it depends on our definition. Latina means from Latin America, and if that's the case, then yes."

De Guire: "Okay. And are there others now?"

Graeve: "There are! There's three of us. After myself, we hired Daniella about three years ago, and just this year we hired a new one, Sylvia, so it's really awesome."

De Guire: "That is awesome, yes. So, in general, what do you kind of see as the current situation of minority faculty hiring in engineering colleges and universities, particularly in the United States?"

Graeve: "I think we still have a long, long way to go. I published a paper in 2018 on the number of Latino and Latina, of course, male and female, engineering faculty in the United States, and I am in the process of updating those numbers so that this coming year I can have an update to that paper. The numbers are not great and they're not changing. So, I am not just saying this based on hearsay or what may be said in the popular literature. I can confirm that I have actually done the numbers analysis. And back in 2017, 2018 there were approximately 600 or so, and 2021, there are approximately 600 or so. The numbers have not changed. And this is Latino engineers in the United States. I haven't done any analysis on other minority groups. I would hope that some people may be motivated to do so.

In my case, I have a very specific interest in the Latino community because that is my own background and because I actually have worked a lot with this particular populations through the Society of Hispanic Professional Engineers. And so, I've been working on gathering them and figuring out where they are and getting them together. And so naturally that led to an actual publication, right?

One of the things that I found in looking at these numbers and analyzing them is that the great majority of Latino engineering faculty in the U.S. are immigrants. And that's

wonderful. We are a country of immigrants. Only approximately 10% of the total are born and raised in the United States, and that says something very, very difficult and very serious. It says that we are not educating the locals, in a sense. Very few Latinos in the United States that are born in this country managed to get through the undergrad and Ph.D. and eventually become engineering faculty. It may be different in the sciences, I'm not sure. Maybe in biological sciences and in other areas, it's not the same situation. But in engineering, it certainly is. And I would hope that we can put effort into not just allowing immigration in the most positive way for people that are going to be educators, but also educating the people here in this country, the Latinos in this country."

De Guire: "So, you've actually been a leader in bridging those gaps with some of the programs that you've put in place at UC San Diego. I'd like to talk a little bit about some of them, and let's, if you don't mind, I'd like to start with the program called ENLACE in English and ENLACE in español. So can you talk to us a little bit about what that program is, what its goals are, and some of its outcomes."

Graeve: "Yeah, that's great. So I've had this program for eight years. It's a summer research program, and so I think many of the listeners will be extremely familiar with summer research programs. It is not only an undergraduate summer research program. It goes beyond that. It is also a program for high school students and for researchers. So the program is now in its eighth year, and it brings together to the UC San Diego campus a cohort of approximately 150. This next summer, I think I'm going to go up to 200 of high school students, undergraduate students, and then researchers, as in professors and researchers from Latin America, into the program. The program is binational so far, but I'm expanding it to the whole of Latin America this coming year. Previously, when I say it's binational, because it was a program for U.S. students and researchers and Mexico students and researchers.

And so, the program has as its main goal to eliminate borders, to bring down walls, and to promote cross border relationships and friendships. I believe very strongly in that message. And I put this front and center because, for me, this is even more important than the actual research that they're going to be doing, which is, of course, very important. But beyond and before we think about the research experience, which is outstanding in the program, we have to think about the human aspects of what this program is about. And the human aspects is the formation of binational friendships. I believe in this very strongly because at a young age when you make friends, they are friends for life. When we become adults, you know, life gets in the way and it gets more complicated. But when you are friends at 17 years old, that is such a beautiful friendship that you're going to have for the rest of your life.

And so my goal here is that I'm going to be training and giving these experiences to 17 year olds. Let me just say that as an example, a 17-year-old high school student that is going to become the president of Mexico, and 17-year-old high school student from the U.S. that is going to become the president of the United States. And they've known each other since they were 17 years old, and they are dear friends. That destroys walls to me. That's what this program is all about."

De Guire: “I agree. And science is also a good topic to build a friendship around. You’re really trying to work towards a common goal that doesn’t have baggage connected to it.”

Graeve: “Absolutely. It’s like bringing people together through science, and I love that concept.”

De Guire: “Yeah. So, eight years you’ve been doing it, pretty much since you got to San Diego. Have you heard at all from some of those early cohorts?”

Graeve: “I do. I actually know where all of them are. I have a good track of where things are. I started the program, the first four years of the program was strictly high schoolers, and then for the fifth year that’s when I grew it to college. And so, the goal was always for these students to eventually get into Ph.D. programs. And so, if you look at the initial cohorts in 2013, 2014, 2015, they were high school at that time. So then by the time they finished high school, they had one more year to go and then they went to college, and they finished college. We’re starting to see the fruits of that. Many are in Ph.D. programs now, all over the U.S. and in Europe and in Latin America.”

De Guire: “Wonderful. Have they stuck with science for the most part?”

Graeve: “For the most part, yes. A few here and there decided that they were going to go do law school and things like this, but yes, it’s okay.”

De Guire: “You’re always going to lose a few. That’s wonderful. So is the ENLACE program for girls and boys, men and women?”

Graeve: “Yes. It is for both genders, but I spend a lot of time recruiting girls in particular. And so, if you look at the total now of all the students I’ve had in the program over the eight years, 60% have been women.”

De Guire: “That’s fabulous.”

Graeve: “So majority women.”

De Guire: “Wonderful, wonderful. Congratulations, that’s really an outstanding outcome. Okay, you’ve done some other work too. The CaliBaja Education Consortium is one, maybe we could talk a little bit about that.”

Graeve: “The CaliBaja Education Consortium is basically the framework that we developed in the CaliBaja Center for Resilient Materials & Systems, which is our research center that I lead. I’m the director of this Center at UC San Diego. And so the CaliBaja Center has both research activity and educational activity. The ENLACE program falls under the educational activities of the CaliBaja Center, so that management-wise, that’s how we run it. And the CaliBaja Higher Education Consortium is basically the organization that we developed in order to have direct connection to a lot of students all over Mexico, particularly. And so, we have a representative in a variety of institutions all over Mexico,

and that's basically the point of contact to make sure that we can keep students involved and informed about the programs that we've developed. And so this education consortium took a while. It's like baby steps for me. You go to one institution, you establish a rapport, you establish trust, and then to the next one, and then to the next one, and then to the next one. And now I see it as an extremely robust entity that allows all of the educational programs of the CaliBaja Center to really thrive. Because the ENLACE program is not the only educational program that we run. We have other ones. Webinar series programs, for example. Programs for preparing students to go to graduate school, what we call grad school prep, for example. The connections to all those are through this education consortium. It's been very effective."

De Guire: "Who are some of the organizations that are part of the consortium?"

Graeve: "Oh, it's all universities and high schools."

De Guire: "Oh, okay."

Graeve: "And so everything from the national University of Mexico to the State University of Baja California to bunches of high schools that are a part of it. It's been great. It's a community, really, it's a really great community."

De Guire: "Sounds wonderful."

(music)

BREAK

De Guire: "As part of ACerS' commitment to cultivating a diverse, inclusive, and equitable environment for all in the ceramics and glass community, the ACerS Diversity & Inclusion Subcommittee curated a webpage to give members a transparent account of all our DEI initiatives. Visit the webpage at www.ceramics.org/diversitycommitment."

SECTION 3

De Guire: "When did you join the Society?"

Graeve: "So The American Ceramic Society is my primary society. I love The American Ceramic Society. I just, I enjoy, and I always have, and it's like that's my home. I joined in 1997. I was a graduate student then. The Society has had a gigantic impact in my career. I can't even begin to describe. I mean, as a student, the Society allowed me to join a variety of conferences where I got to meet people, so the networking aspects of it are very important. And I would not have had the possibility to do that if I hadn't received financial support. So I did receive financial support from the Society at key points through the local in the sections. The sections had scholarships and had opportunities for the local students. And so I think that the work of the sections is very important in The American Ceramic Society because they're very on the ground, right, with the students that are in

that region. And so I was part of the Northern California Section, and I had a great time with those folks as a student and then as a professional, now a faculty member. And then the opportunity to get involved with NICE [National Institute of Ceramic Engineers] to start thinking about the future of ceramic engineering and glass science education. That was really great and a career builder for me as well.

The Society also has, in fact, directly supported through the Foundation my ENLACE program, and I am incredibly grateful for that financial support. And so, they've done it for a few years. The very first year the Foundation started, the gift was very significant, actually, in size. It allowed me to support quite a few of the students in the program. And I think that that support some years, financial, and some years, sort of, suggestions and the availability of advice, has always been there."

De Guire: "Great. Well, I know the Foundation was really happy to be able to support your program. It marries up exactly with the goals of training and developing a workforce for the ceramic and glass industry, attracting young people to the sciences and engineering. That's step one."

Graeve: "Absolutely. It has been great."

De Guire: "With all this work that you're doing to really just expand the world of engineering to a wider range of people, how would you say that gender and cultural diversity make the workplace that these people will land in better?"

Graeve: "That's a great question. I have given this some thought. What I would consider the easy or typical answer, not that it's really, truly easy, but the one answer that one hears often is that diversity brings different points of view so that eventually, let's say it's a company, because of the different points of view and the different approaches, you're going to end up with a new, better, improved product. That innovation improves because of diversity, because of the different views.

I'm sure that's true. I certainly have lived it; I have a very diverse research group myself with all my students. And so, I'd like to take it beyond just we're going to improve innovation and our bottom line is going to get better because of it. I think that a diverse environment and a diverse business, a diverse university, a diverse community is going to promote more compassion. It's the human aspects of being in a diverse environment where you see the points of view of people that are of a different skin color than you. A different, you know, different heights, different, some of us wear glasses, some of us don't, some of us wear skirts and some of us wear pants, and all of these varieties. When you interact with people that are different than you, and you get to know them and you get to understand them, and you get to connect with them, that is going to make the world a better place. That is compassion.

When you have a workplace that is not just about innovation and the bottom line, but you build an environment in which we're all getting along and being compassionate and understanding towards each other, that will make the world a better place. So for me a

diverse environment, a diverse company, a diverse community is all about building compassion and understanding between us."

De Guire: "I like that. And I've seen that myself too."

(music)

CONCLUSION

De Guire: "While increased innovation is a desirable outcome of a diverse workforce, the compassion and understanding that arise is what will truly help us break down walls and build a better world.

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 and to learn more about the CaliBaja Center for Resilient Materials & Systems. Ceramic Tech Chat is produced by Lisa McDonald and

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