

## CERAMIC TECH CHAT

Episode 09

Title – “Ceramics in the family: Greg and Ashley Hilmas (E09)”

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### INTRO

De Guire: “I’m Eileen De Guire, and this is Ceramic Tech Chat.

Science, with its array of jargon, symbols, and diagrams, can be a difficult subject to understand. No wonder, then, that many people compare science to a foreign language, especially when they encounter these topics for the first time.”

A. Hilmas: “But it was funny. I remember even one time when I was little, I was sick and my mom had just started a new job as a school nurse. So my dad took me into work with him and had me sit in the back of his classroom while he taught, I don’t know what he was teaching, thermal properties or mechanical properties. And I remember after the class, I was maybe, I don’t know, 11, 12 at the time, and after the class he was like, ‘What did you think? Like, this is what I do, you know, twice a week, I teach the students.’ And I was like, ‘Yeah, it was great, you seem like a fun teacher, but you teach Chinese.’ And he was like, ‘What? What are you saying?’ And I was like, ‘Literally everything you wrote on the board looks like just a foreign language.’ I was like, ‘I don’t understand what you’re doing.’ And then seven years later, when I’m like in a chemistry class and we’re doing some things in chemistry, he was like ‘This is what I was teaching that day in class, just more advanced level.’”

De Guire: “That’s Ashley Hilmas, research materials engineer at the Air Force Research Laboratory in Dayton, Ohio. Ashley and her dad, Greg Hilmas, are both ceramic engineers, though they work in different sectors. Ashley works for the government, while Greg is a professor at the Missouri University of Science and Technology in Rolla, Missouri.

So what’s it like to pursue the same degree as your parent? And likewise, what is it like to have your child working in a field similar to yours?”

(music)

### SECTION 1

De Guire: “To understand how Ashley found her way to a career in science and ceramics, we need to start at the very beginning. And in this case, that means going back to before she was born.”

De Guire: “So, Greg, this all started with you. Can you tell us how you discovered ceramic engineering and what attracted you to the field?”

G. Hilmas: “Yeah, that’s a fun story. So I was at the University of Minnesota, doing my undergraduate degree, and I was in the field that my dad chose for me, which was electrical engineering. He decided I was gonna be an engineer, and to be honest, I wanted to be an auto mechanic. So I said, ‘Okay, Dad, where am I going and what am I majoring in?’ And he said, ‘Well, you’re going to the University of Minnesota, where I went to school, my alma mater, and you’re going to major in electrical engineering.’ I said, ‘Okay, that sounds great.’

So, two years in it wasn’t going well. I really disliked electrical engineering and had to find something else. So I tried to join the Navy and go through ROTC. That didn’t work out, but I decided in the end that what really drove me was chemistry. I’ve never been a huge fan of math. I certainly do some, but I really like chemistry, and I like physics as a backup to chemistry, I like doing physics as well. So I was smart enough to realize that chemistry and physics are certainly great fields, but if I really wanted to do something applied and help solve problems, I really thought engineering was the way to go.

Materials science and engineering was a new program growing out of the chemical engineering department at the University of Minnesota at the time. And I had another friend that I was in the dorms with that just switched over to materials science and engineering, and he talked me into going over and visiting. So I went over and visited. In the end, fell in love with it. It looked like what I was looking for, you know, chemistry engineering, if you will, even more so than chemical engineering, and physics engineering, kind of combined. And that’s still the way I kind of sell it today as a department chair.

I only had one ceramic engineering class. There was only one ceramic engineering instructor there, Martha McCartney, and I think we all in The American Ceramic Society know Martha well. And, there was a lot of metallurgical engineering, there was a lot of polymer engineering. Well, polymers have always come pretty easy to me, and I enjoy it, I still use it in my research. But the ceramic engineering was intriguing. You know, that inorganic chemistry that I just wasn’t quite as good at it, it didn’t come as easy to me as organic chemistry, I thought was challenging. And I decided that’s what I liked, even though I just had that one course, that I wanted to go into ceramic engineering.

So after finishing at Minnesota, I decided I was gonna go get an advanced degree. I applied to the University of Illinois, I applied to Ohio State University, and they both accepted me. My parents had recently moved to Columbus because my dad retired from the Army and was working for Battelle, and I decided that being closer to home where I could raid the refrigerator was a good thing. So, I decided moving to Columbus and going to Ohio State University to get my ceramic engineering degree and being a little closer to family sounded great.

And so I went to Ohio State and worked for Bill Lee. I think we all know Bill Lee, former president of The American Ceramic Society. And Bill was a young assistant professor, and he had a lot of passion for transmission electron microscopy of materials, which is what I largely focused on, on a silicon nitride-based material. So that was really my first foray into structural ceramics and from there I just decided that I loved research. And so I originally thought I was just going to get a master's degree and then go out and work in the field, but after that I decided no, I'm gonna go get my Ph.D. And I applied to a number of universities and got accepted into those, but ultimately settled on the University of Michigan for my Ph.D. and worked with a gentleman named Tseng-Ying Tien, who was there at the time. And then later did a couple of postdocs, including with John Halloran, somebody else that I'm sure The American Ceramic Society knows quite well. So, that's it in a nutshell."

De Guire: "That's quite a journey from auto mechanic to Ph.D. professor. But it just goes to show you how having an open mind and exploring the opportunities can lead from a place very different from where you started off as an 18-year-old."

G. Hilmas: "Absolutely."

De Guire: "So, Ashley. Your story's probably a little bit different in terms of how you found your way into materials science, certainly about what it was than your dad did. Can you tell us a little bit about why you embraced it?"

A. Hilmas: "Yeah, sure. So, I didn't embrace it at first, I'll start there. I think like a lot of people in engineering, in general my age, how they found it, especially women, I think it starts with 'Oh, we're good at science and math.' And so people are like, 'You should be an engineer.' I had heard of engineering by the time I was in high school, trying to figure out what I wanted to do, and I tried to avoid it at first. I decided to really look into pharmacy schools. My dad even took me up to University of Missouri, Kansas City, and we like went through their pharmacy school program, and I was like, 'Okay, I don't like this.'

And my dad on the way back was like, 'Hear me out. Let's go to Rolla, let's talk to a couple different departments, and let's see if maybe you like engineering more than what you think you do.' So I went, I looked at the materials science department, I looked at engineering management, I looked at nuclear engineering, and maybe one more I'm forgetting. But honestly, I walked into the materials science departments and saw some demos, and I was pretty sold. It wasn't much of a difficult decision for me from there on out.

And, went to Rolla once I decided I wanted to do engineering. But I made sure, the very first thing I did when I decided to go to Rolla was made it very clear that I was not living at home, want viewers or listeners to know that. So I moved into the dorms and the sorority house pretty much right away. But ceramic engineering, yeah, was once I saw the demos, it was kind of over from there."

De Guire: “Very good. Did you know at the start that you were gonna get a Ph.D., or did that evolve for you similar to how it evolved for your dad?”

A. Hilmas: “It’s interesting. Yes and no. So, when I was thinking about it in high school, I was that type of high schooler that wanted like a 20-year plan or a 10-year plan, and I wanted everything like mapped out. And so at that time, I was like, ‘Yep, I’m gonna go get my Ph.D.’ And part of it too was like growing up in my household. I thought that that was just like normal. And then once I got to Rolla and I started doing ceramic engineering, I was like, ‘You know what? Maybe I’m not going to get a Ph.D. Like there’s plenty of jobs out there. I’m not sure I want to do another four to five years of school.’

But in the end, what really pushed me was I did four different internships throughout undergrad. Two of them were in industry and then two of them were more fundamental research. So one in the lab at Rolla and then I also did an internship at Idaho National Lab. And so when I was in my fourth year of undergrad at Missouri S&T, I was starting to think about what I really wanted and what I enjoyed and what made me happy. I definitely was happier doing more of the fundamental research versus working in industry. And so I decided to go ahead and get a Ph.D. because I think it was where, it would help me get to where I wanted to be career-wise. And it did, and getting a Ph.D. was great and I had a lot of great experiences from the University of Michigan. I was a little unique in that I graduated in December. But I looked at University of Illinois, University of Michigan, and a couple other places and ultimately chose Michigan. And, yeah, I guess the rest is history now.”

De Guire: “So that’s very interesting that you both went to the same school for your Ph.D., and also had an overlap in terms of advisors, because I think your advisor, Ashley, was John Halloran, who was Greg’s postdoc advisor. So one generation, you know, across one generation.

So, Greg, a question for you is, was there any early evidence as you raised Ashley and, you know, watched her grow up? Was there any early evidence that you could cite that pointed to her following this career path?”

G. Hilmas: “Yeah, there’s a great story there. I’m not sure how much true evidence there is, but so, Ashley was born while I was working on my Ph.D. at the University of Michigan, right at the end of my Ph.D. studies. And my wife, who was working at the University of Michigan Medical Center as a nurse, was certainly given some time off, but then after Ashley was born, she had to go back to work. And of course, when you’ve got a newborn, it’s challenging to find a place to get them in daycare and the like.

And so, told my wife, I said, ‘Well, I’ve got to start writing this dissertation.’ So I talked to my advisor and said, ‘Look, I’m gonna spend some time at home with my daughter and I’m gonna write my dissertation.’ So for basically about a month, I spent time writing my dissertation every day while taking care of a newborn child while my wife went back to work. So she was working 12-hour shifts, and so typically in the evenings is when I would spend time writing and then being with Ashley.

So I've got a great picture, and this happened pretty much every day, where I would set Ashley, I would prop Ashley up on the couch or on our bed, and I would have papers all around me. I was reading journal papers and working on my literature review, and so it wasn't unusual for Ashley to be surrounded by 20 or 30 or even 50 or 100 journal papers that I was sorting through. Because that's how we did things back then, right? It wasn't all PDF files, you know, we had printed papers. And I was writing my dissertation in longhand and then I would type it into the computer at night when she went to bed. So I've got a great picture, pictures of Ashley holding pencils to try and keep her preoccupied, and of course I was talking to myself and talking about silicon carbide. I find it kind of interesting that I did my Ph.D. on silicon carbide-based ceramics, and certainly she was surrounded by silicon carbide papers, and then she went and did her Ph.D. on silicon carbide/silicon carbide ceramics. So, is there a connection there? Perhaps."

De Guire: "Yeah, that's a great story. That's a great story."

(music)

## SECTION 2

De Guire: "Though Greg and Ashley share similar educational backgrounds, their career paths diverged after earning their Ph.D.'s."

G. Hilmas: "After my second postdoc in Michigan, I went to work for a small company called Advanced Ceramics Research in Tucson, Arizona. And I was following up a patent that John Halloran and I and some other colleagues had received. It was going well, I was really enjoying it, but at the same time things were changing at the company, and not necessarily changing the way that I wanted to see them change. And I was starting to think about going elsewhere and doing something else.

I got a call from my first postdoc advisor at the University of Michigan, John Holmes, and said, 'Hey, do you know this university in Rolla, Missouri?' Which was called the University of Missouri Rolla at the time. And I said, 'Yeah, I know them. I've never been there.' But he said, 'Well, I just interviewed there, and they're looking for somebody with expertise in mechanical properties of ceramics. And I interviewed there, but they can't afford me. They need a junior faculty member, and I gave them your name and contact information.' And so I said, 'Well, just so happens I'm starting to think about making a change.'

You know, and when I started thinking about it, I realized that when I was an undergrad, I was that undergrad going through that first cadre of students in materials science at Minnesota that was the one that everybody turned to to explain what the professor was saying in class. So again, I look back on it and I think, 'Okay, you know, maybe I am, maybe I can do this.' But frankly, I didn't know. I didn't know if I'd enjoy teaching. I didn't know if I'd really be good at it or not. And, you know, 22 years later, I love teaching."

A. Hilmas: "It's a running joke in our house that he didn't like the real world, and so he went back to college for life."

(laughter)

De Guire: "Greg, can you tell us a little bit about your research focus and a little bit about the topic in general?"

G. Hilmas: "Yeah. So, my research over my career, I think has largely been in the area of processing microstructure and property relations in structural ceramics and ceramic matrix composites. I think over the last probably 17, 18 years or so, I've in particular had a majority focus in the area of ultrahigh-temperature ceramics and their composites.

Now, ultrahigh-temperature ceramics are largely defined in two different ways. Some folks would probably define them as materials that have a potential use at over 2,000 degrees Celsius, and some would argue that maybe they're just materials that in general have a melting temperature over 3,000 degrees Celsius. Either of these definitions is fine with me. I think that works just fine. Ultrahigh-temperature ceramics would largely be defined as materials that consist of the early transition metals, combined with a carbon, nitrogen, or boron atoms, and again these materials have very high melting temperatures, typically in excess of 3,000°C. As an example, zirconium diboride has a melting temperature of about 3,250°C.

When you're working in high-temperature materials, the goal is ultimately to replace other materials that we've really reached their maximum use temperature. That's kind of what got me excited about ceramics in the first place, was seeing that. I mean, I saw what folks were doing in metals, and don't get me wrong, there's a lot of great work going on in the metals field. But I was really driven by the fact that we'd kind of peaked out with certain superalloys. We've gotten to the max temperature, where we're at the point where even a couple of degree improvement in temperature was going to mean a lot to making the next nickel-based superalloy for a jet aircraft engine, say for example. Folks were looking at coating them with ceramics as a way to basically ameliorate that temperature standoff, some of that temperature for the metal. And so, if we could develop these materials, these were gonna be things that could replace metals in really, really high-temperature applications. You know, leading and trailing edges for hypersonic vehicles, rocket nozzles, and again like engine components, I mean even turbine engine components. There's a lot of other extreme environment applications that we don't talk about very often but we're starting to make some inroads there as well. So things like the nuclear field. So, it's exciting."

De Guire: "Great. So, Ashley, since you're just now entering the professional workforce, can you tell us a little bit more detail the research that you're doing and why it excites you?"

A. Hilmas: "Yeah, sure. So like I said, I am still fairly new at AFRL [Air Force Research Laboratory], so I don't have any of my own programs just yet, so stay tuned, I guess. But I

am working on some SiC/SiC CMCs, so pretty similar to what I studied in grad school. But for that work, for now I'm doing a lot of, AFRL has done a lot of gigatron X-ray CT studies. And so I'm working with an undergrad and another group of collaborators to kind of be able to sift through big data sets and be able to quantify the microstructure of composites and then eventually have that lead to different mechanics as well. So we're doing a lot with, I guess, big data. And then I'm also doing some experimental in situ like mechanical work as well, in collaboration with some discrete damage modeling that's being done at AFRL. So that's been fun because I don't have a lot of modeling in my background, so it's been great to kind of start seeing what is being done at not only the Air Force, but in general and start getting acquainted with that type of work. And then I'm also doing some stuff on ultrahigh-temperature CMCs. I can't talk too much about it, but we're doing some stuff with panels and some companies because ultrahigh-temperature ceramics and ultrahigh-temperature CMCs are a big push for the Air Force right now. So, that's a little bit of what I do, I guess."

De Guire: "As you think about your career, what kind of ambitions do you have, or where do you kind of see yourself going?"

A. Hilmas: "What a great question. I think there's a couple different paths my career could take. I do really like the research right now, and I think that that's what I'll focus on for at least the next five to six years, probably. Now that I'm like on not only a national lab but a DoD national lab, I'm starting to see kind of what other options there are. There's always like a management route. I think I'd be really interested in doing something like program management too, I think that that is something I could enjoy and be able to see a little bit more of like what all's out there as well.

I also got really into policy when I was at the University of Michigan. I know when I was defending even, or getting close to thinking about what I wanted to do after grad school, I even looked at a couple of policy fellowships because I thought the information I have and the understanding I have of engineering and then my ability to communicate could really offer some great assistance in some of the policy work that's being done in D.C. So I looked into that, and there's a couple of avenues even through the Air Force and through the Air Force Research Lab where I could go do kind of a type of fellowship thing in D.C. for a year or two. So that's always something that's interesting to me.

One of the nice things about being at a place like AFRL is it really does offer a lot of options if you want to kind of switch things up or try something new. So there's a lot of people on like exchange programs who'll go and, it's almost like an internship or a co-op, and you go work for a company for maybe six or seven months that you're doing collaboration with. We have someone who was recently on my team who is now working in France at their like DoD Air Force Lab. So that type of stuff. So I'm not quite sure what I wanted to do yet. I do think about it often. For now, though, I really am excited to dive into the research and kind of get going on some projects of my own."

(music)

### SECTION 3

De Guire: “So as we start to wind up here, I’d like to ask you both how has The American Ceramic Society helped each of your careers? Greg, why don’t you start. You got there first.”

G. Hilmas: “Yeah, the Society has played a very important role in everything that I’ve done. I mean, I remember back to, go back to when I was at Ohio State. And again, I was in the ceramic engineering program at the time, and Dennis Reedy was department chair, and every graduate student went to The American Society meeting. I mean, that was a big focus, it was back when it was the spring meeting. And the graduate students would all give practice presentations in front of all the faculty, and so my first American Ceramic Society meeting was in 1987. And that’s the year that I joined, I’ve been a member ever since. And that continued through my Ph.D. career, making sure that I always went to The American Ceramic Society meeting. I don’t think I’ve missed one. And then even after we joined up with Materials Science and Technology Conference, I always go and I always bring our students from here. In fact, I bring a very large cadre of our students.

In addition to that, as a professor, as an academic, the service role that we play, we really have to have a professional organization that we’re part of, that we help serve. And so, particularly when I came to Rolla as a faculty member, I certainly made a focused effort to get involved more with The American Ceramic Society and go through various committees and help out where I could. And that’s meant a lot to me. It’s what I do. I’m teaching the students to play a very strong role in their Society. And so, yeah.”

De Guire: “And how about for you, Ashley?”

A. Hilmas: “Yeah, I agree with everything my dad said. ACerS has been instrumental in both my career in grad school and now. So I’ll start kind of off what he said, how Rolla brings a large cohort of students every year to the MS&T conference. So my first MS&T conference was in 2012. I was an undergrad, and I went as a Material Advantage student. And I can say that in undergrad I didn’t quite grasp the whole understanding of like what the Society is, how they work, that type of thing. But from an undergrad student perspective, it was great to be able to go to different types of talks. They often did go over my head, but at least I could kind of see like what type of research was out there, especially when I was at that point in undergrad where I was trying to figure out what exactly I wanted to do next.

I got an internship one year out of meeting someone at MS&T, sitting down and talking with them about kind of what I wanted to do. And I was really big in Material Advantage at Rolla as well. And so being able to go to the Material Advantage meetings and meet other undergrad students from other universities I thought was really great because it’s always good I feel like to bounce ideas off of people who are going through the same thing that you are. So from my undergrad perspective, it was great in that way.



So in grad school I got involved in the President's Council of Student Advisors. So PCSA, under ACerS. And I was in that pretty much all through grad school. So I was a committee chair, and then I was chair of the PCSA, and honestly that really created the trajectory for my career. I was able to, through being a committee chair and especially the chair of PCSA, not only meet other students, I was able to create a budget, make sure everyone was able to travel, like do all of the logistics and kind of grow as a leader that way. And then I was also able to network with the ACerS Board, and so build my networking skills, not only with people my own age but with people who are well known, both within the Society and within my engineering field. And so that was so helpful to me.

And I don't think I would have the job I have today without PCSA. So I was able to meet Dr. Lisa Rueschhoff, who is also AFRL, through PCSA. We became pretty close. She invited me out to do a seminar at AFRL about my work when I was in grad school. And it was while I was there giving the seminar that someone from the team I'm on now was like 'Hey, we have a position open. You should apply. Like, I think you could be a decent candidate.' And so if I didn't go give that seminar, would I have known about the job? Like who really knows, I guess. But ACerS definitely played an instrumental role. I'm still really involved, and I'm excited to stay involved and see where the Society goes for the next couple years."

De Guire: "Great. Thank you. Ashley, do you have siblings?"

A. Hilmas: "Yes, I am the oldest of three. So I have two younger sisters. And one is an English teacher. She kind of swore off science and engineering. But she's a great middle school English teacher, a lot of fun, she's two years younger than me. And then my youngest sister is actually in ceramic engineering at Rolla right now. She's a junior. So, we've got another one coming."

De Guire: "That's really interesting."

A. Hilmas: "I do think she wants to do more of the biomedical side. So she's kind of creating her own path. But I was actually just home a couple weeks ago. And she's a junior, so she's starting to think about like what she wants to do afterwards. And she's pretty sure she wants to go to grad school, and I was like, 'Okay, well Michigan has like a great biomedical program.' She's like, 'I'm not going to Ohio State, and I'm not going to Michigan because I want to go to my own school where no one in my family has ever been.' Like, okay, okay, Krista."

De Guire: "Well, okay. Alright, so here's the last question. What does Dr. Ashley Hilmas call Dr. Greg Hilmas when you're in a professional environment?"

A. Hilmas: "I still call him dad. Sometimes I'll call him Greg, depending on the group. But most times I call him dad. Dad's the number one go to."

De Guire: "Alright."

G. Hilmas: "I just want to add that I like to call her 'A' Dr. Hilmas and I'm 'The' Dr. Hilmas."

A. Hilmas: "No, no, no, no. I will add, because this is kind of a funny story, I mentioned earlier that going to conferences and having the last name Hilmas, there have been so many people that are like, 'Oh, are you related to Greg? Oh, are you Greg's daughter?' And at the last MS&T, we went out to dinner one night and he was like, 'I'll just have you know, someone came up to me today and was like, Oh, are you Ashley's dad?' and I was like, it's all I wanted in life. So it is coming full circle."

De Guire: "Well that's great."

(music)

## CONCLUSION

De Guire: "It is not unusual for children to enter job fields similar to their parents. But as Greg and Ashley showed, the same degree in university can lead to different career paths afterwards.

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

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"Visit our website at [ceramics.org](http://ceramics.org) for this episode's show notes and to learn more about Greg and Ashley Hilmas and their work at Missouri S&T and the Air Force Research Lab, respectively. Ceramic Tech Chat is produced by Lisa McDonald and copyrighted by The American Ceramic Society.

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