CERAMIC TECH CHAT

Episode 40

Title – "Pathways to excellence through research and writing: John Mauro (E40)"

INTRO

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

Finding your passion in life can sometimes be a life-long process. For some people, however, their interests reveal themselves from the very start."

Mauro: "I've been captivated by glass ever since I was a young child. I just love all the different shapes that it can take on, all the different colors, the beauty, the way it interacts with light. It's a material that has literally infinite possibilities because you can continuously vary all of these features. The chemistry of the glass, the colors of the glass, the geometrical dimensions, the properties. The possibilities are really limitless."

De Guire: "That's John Mauro, Dorothy Pate Enright Professor of Materials Science and Engineering at The Pennsylvania State University. John spent the first 18 years of his career as a glass scientist at Corning before transitioning to Penn State six years ago. In addition to teaching and conducting research with students, John serves as editor-in-chief of the *Journal of the American Ceramic Society*.

While glass is John's passion, he has been able to pursue that passion along several pathways. Today he'll share with us his experiences working with glass in the worlds of industry, academia, and scholarly publishing—and we'll talk about his interest in fantasy fiction writing, a genre for which he frequently writes reviews during his spare time."

(music)

SECTION 1

De Guire: "You've been a member of The American Ceramic Society really since the beginning of your professional career, maybe even back into your student days, and you've been a Fellow since 2015 and held a number of leadership positions over the years. So how has being a member of ACerS been a benefit to you?"

Mauro: "So I became an ACerS member when I was a freshman at Alfred University because that's what all the cool kids were doing. They were like, 'Hey, do you want to come to an American Ceramic Society meeting?' I didn't know what it was, but I said, 'Yeah, sure, let's do it.' So, yeah, I've been a member ever since 1997, and the ACerS community has been there for me every single step of my career. When I was an undergraduate student, a graduate student, an early career researcher, mid-career researcher, all these different roles

that I've had from organizing conferences to serving in leadership roles for the Society to editor, now editor-in-chief of *JACerS*.

The Society has always been there to help its members. I've been a member of several professional societies, and none of them does it quite as well as ACerS in terms of creating that supportive community where people generally want to help each other out. To be a part of that throughout my entire career and even before my career started has impacted me in ways that are too numerous to be able to describe. So, yeah, it's been a vital part of my education, and frankly, I don't know where I would be in my career without ACerS."

De Guire: "Wonderful. Isn't it interesting to have the perspective of a couple decades later and look back and see how there are these forks in the road, and when you go down one, you don't know it at the time, but it really is a much more critical decision than you realized."

Mauro: "Absolutely, yes."

De Guire: "So, the first 20 or so years of your career, you conducted R&D at Corning Glass in Corning, New York. How is leading research at a university different from leading research in a corporate environment?"

Mauro: "Oh, great question. And I get this question a lot, too, because, you know, oftentimes people will go into careers in industry alone or careers in academia alone, so there aren't too many of us who have crossed over.

I worked at Corning Incorporated for 18 years, and I absolutely loved it there. Some of the things that I loved about working there were, of course, all the facilities that they have, the wonderful people, bringing together the world's greatest experts in these areas. And the ability to take something from, everything that was like a formula on my screen to an actual product out the door. It's just a really cool experience.

You know, at the same time, with a career in industry, there may be difficulties depending upon what company you're at in terms of doing some more of the basic science. Corning fortunately is a company that understands how important science is for enabling engineering and enabling the design of new products. Many companies may not necessarily have that ability to invest in science the way that Corning does. Ultimately, though, the decisions that are made by corporations are driven by the business needs, whereas the goal of a university is education.

So now at Penn State, I've been here now for a little over six years, and it's a different mission. The mission here is to educate the next generation of students both, specifically in my case, in materials science and engineering and glass science, but more importantly, we're developing them into hopefully trying to become better humans all around. And that's the role that universities play, and I think Penn State is a great place to go about doing that.

So, in the university environment, I'm still able to do a lot of the research that I love. I actually have even more freedom here compared to working in industry because nobody says no. And this is one of the things that I discovered in my first couple of years here, is that I was pursuing like every possible avenue of research I could think of, and I talked to one of my colleagues here, Venkatraman Gopalan, who gave me some really good advice. He said, 'You know, you're the one with your foot on the accelerator, John,' and I realized that, you know, that's true.

But what I love most is, of course, the ability to work with young people. They're coming here with so much passion and interest and creativity. They're just thirsty for knowledge, thirsty for learning more, both technically as well as what it's like to work in industry, what it's like to work in academia. So, I feel very fortunate that I've been able to take both paths in my career.

You know, it's unfortunate we only have one life to live, right? And there's so many things that I want to do and I want to experience, and I feel very fortunate that I have been able to pursue both of these paths."

De Guire: "Well, that's great. They say it takes about five years for a Ph.D. to start their program and work their way through all the way to defense. So if you've been there six years, that means your first handful of students, Ph.D. students, are probably graduated and out. Is that about right?"

Mauro: "Yes. In fact, I've had eight Ph.D. graduates already in these six years. I've been blessed with wonderful students. They're approaching glass research from so many different angles. Some of them are more into synthesis, others characterization, others basic theory or modeling and simulation. Even one student, actually a couple of students, who are on the artistic side as well.

So, my first Ph.D. graduate from Penn State was Collin Wilkinson, and he is Alfred University's newest assistant professor of glass science, which is so satisfying for me at multiple levels. Obviously, I'm very proud of Collin and everything that he's accomplished. And I, of course, am a graduate of Alfred University. I grew up in that area. I've got deep roots in that area. And to have my own student, my first graduate, go back there to become a professor where I grew up and where I went to school is just wonderfully satisfying for me.

And he's doing an amazing job. I've been up there to visit a couple of times, and everyone that I hear from just says that he's having a big impact, not only on glass and materials science but on the university as a whole. He's the type of person who has so many great ideas, creative ideas, and he converts them into practice. He's got seemingly boundless energy to take these ideas and pull them into practice. And I think the students feed off of that energy, too."

De Guire: "I've met Collin a number of times, and I think that the description 'boundless energy' is really apt.

So, your research group recently announced the development of a new glass composition called LionGlass. I suppose the Nittany Lion."

Mauro: "That's correct."

De Guire: "So, can you tell us what LionGlass is? And more importantly, what is the impact of this discovery?

Mauro: "Sure. So, one of the problems that's been in the back of my mind for a long time is, 'How can we move the needle with respect to the carbon footprint of the glass industry?' So, I've spent many years at Corning working on developing new glass products there. And those have been very successful, they've had a big impact. But the fact remains that even something like Gorilla Glass, the volume of Gorilla Glass is tiny compared to the volume of sodium lime silicate glass. So if we want to do something about the carbon footprint of the glass industry, we need to do something about soda lime silicate.

This is the glass that is used in every single architectural window, every glass that you drink out of, every jar and bottle of foods and beverages. It's ubiquitous, and it hasn't changed in a very, very long time.

And the soda lime glass industry is very much a commodity industry, and they really haven't worked with other compositions. They don't have the R&D budgets to invest in that type of research, either. If we want to move the needle with respect to carbon footprint, we need to have a step change with soda lime, and the goal with LionGlass was to do that. It would be to have an alternative to soda lime silicate that can still achieve all the things that soda lime is good at. So, optical transparency, good strength, good chemical corrosion resistance, and low enough cost but dramatically cut the carbon footprint.

So, what LionGlass is is a new family of glasses. We filed the patent application for that back in March [2023]. It reduces the melting and forming temperatures by on the order of 400°C. So it reduces the energy consumption by about 30% in the process. So that, you know, dramatically reduces the carbon footprint of the energy process. At the same time, it also eliminates the use of carbonates. So, soda lime is called that because two of the main ingredients are soda ash and lime. Those are both carbonates. And as the carbonates are put in the glass melter, they decompose into oxides, they release carbon dioxide in the process. And that part is completely eliminated by LionGlass. So overall, it's a net reduction of about 50% of the carbon dioxide emissions using LionGlass. So we're really excited about this.

There's been a number of news stories about this, so I've been getting tons of interest from glass companies from around the world as well as from customers of glass companies wanting to learn more and hopefully partner on this. And so right now, we are in the stage of having these discussions, getting proposals on the table from these various companies, and then figuring out how Penn State wants to go forward with this.

One of the nice things with respect to the intellectual property is that we performed this research without any external funding. So it was all using internal funds. Which means that we don't have any obligations to any external sponsors for LionGlass. So the IP [intellectual property] is completely owned by Penn State."

De Guire: "Really interesting approach there. So besides its applications, are there other considerations that would have to be worked out ahead of commercialization? So, for example, the glass industry does a lot of recycling already. So, would the recycling of LionGlass and how that would fit into the existing stream have to be worked out? What kind of challenges are you facing there?"

Mauro: "Yes, that would definitely be one of the challenges because the cullets from LionGlass and soda lime silicate are not compatible with each other. So we need to have separate recycling streams for those two glasses. So this could be similar to what the plastics industry does, and sorting out different types of plastics during the recycling process. One of the things that we'll need to address is the best way to screen like what is LionGlass versus soda lime silicate. They do have differences in their UV [ultraviolet] cut off. So LionGlass actually absorbs quite a bit more in the ultraviolet compared to soda lime silicate. So that could be a way to optically screen between the two to help with sorting of the two glasses."

De Guire: "Sounds like there's a fair amount of work yet to do."

Mauro: "Absolutely."

De Guire: "But the initial idea has proven out as doable."

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SECTION 2

De Guire: "Would you mind commenting for our general audience on what is the role of scholarly publishing in the research and innovation ecosystem?"

Mauro: "It is absolutely essential for both research and innovation because this is ultimately what we're leaving behind as researchers, right? We do this research, we discover new things, we learn new things. And if you keep it to yourself, then it's as if you've never done it. I mean, you have to publish this somehow to get this out there to the community.

In industry, of course, there's a lot of emphasis on patents. That also constitutes a public disclosure of what you've done. But for journal publications, the focus is on rigorous science and putting what you're done out there for the community so that they can build upon what you've done. And this is how we collectively move forward.

We are all standing on the shoulders of these giants that have come before us. I routinely refer back to, say, articles published in *Journal of the American Ceramic Society* that go back to 1920s, and these are still relevant today. And, you know, every decade you can think of major papers that shaped the way that we think about glass and ceramics or major advances in their science. If we didn't have them published, then all of that would be lost. So, it's absolutely essential to have that.

It's also essential for individual researchers to publish their work to build their track record. That can be difficult when you're working in industry, to get approval to do those publications. But for a career in academia, it's essential to establish that track record. And for new Ph.D. students looking for a career in industry, it's also important to have your track record of publications there so that potential employers can review what you've done and see if it would be a good fit for their company.

There are other ways to distribute your information. Going to conferences is a great way to meet people, have discussions. But that information is not retained in the same way that papers are published in journals.

Another alternative nowadays is the preprint servers, like arXiv, for example. And the problem there is that it's not peer reviewed. So there's no quality control. And we just saw that recently with this supposed high-temperature superconductor that had been getting all kinds of hype and news and, more recently, was found to be bad science. And if it had gone through the peer review process, I'm sure that would have been flagged. So that whole peer review process provides quality control that is so important to ensure the integrity of the scientific process."

De Guire: "You touched a little bit on young Ph.Ds. And, of course, master's and bachelors can do scholarly publishing, too. But why is it especially important for young researchers? Can you expand on that just a little bit more beyond just the employers discovering them?"

Mauro: "Sure. So, this is an important part of getting mastery of your subject area. So, first of all, reviewing the literature to understand what is currently known about their topic area, what is the status quo, and then what is the next step that needs to be taken kind of into the unknown. So, research necessarily involves doing something that nobody has ever done before, and you can't do that unless you know what has already been done. And then when you take that next step forward, then that needs to become a part of the overall literature so the next students who come, or whoever picks up on this research later, can learn from those students and take it forward.

The act of writing the paper forces you to be rigorous, too, to make sure that you're making arguments that make sense, they're scientifically sound, that you don't have any gaps in what it is that you're trying to convey. And nothing really beats the process of writing a paper to ensure that level of rigor, especially when it goes through the peer review process."

De Guire: “What are some of the more common mistakes that young researchers make when writing their manuscripts?”

Mauro: “So, precision of language I would say is the most important thing. The biggest mistake that I see among young researchers is being a little bit careless with the words that they choose to describe whatever scientific or technical process that it is that they’re describing.

So, for example, if you just say the word energy. What does that mean? It could mean potential energy, kinetic energy, vibrational energy, free energy. There are so many different things that it could mean, and you want to convey to the reader exactly what it is that you mean so that there’s no way that it can be misinterpreted.

Another thing is like using words in kind of a colloquial sense or kind of a general English sense that have technical meaning. Like the word potential, for example. If your paper is talking about thermodynamics, and you say that there is great potential for something, that means something from an English point of view, but it means something from a technical point of view, too. And one needs to be really careful with the words that they choose to make sure that the information is conveyed clearly and that nobody can misinterpret it.”

De Guire: “That’s good advice. We hear a lot about open access in publishing. And one goal of open access is global equity.”

Mauro: “I think oftentimes open access is kind of oversold as a solution to this problem of global equity. Because there are pros and cons to the subscription model, just as there are pros and cons to open access.

So, the main problem with open access is that we still have to pay for everything that goes into these articles. The typesetting process, the publication process. And it’s just shifting the burden away from the institutions to the individual authors.

And this, it actually terrified me at first with all these movements toward open access as somebody who publishes about 25 papers per year. Depending upon the journal, open-access charges are $2,000 or $3,000. We’re talking like $50,000 to $75,000 a year just to publish my papers that I’d been publishing for free. And that’s how much money it takes to hire two Ph.D. students. And I’m not willing to let people go or deny people that education because I have to pay article processing charges.

So, a major disadvantage of open access is that, and you’re putting that burden on the authors. And if the authors are coming from less wealthy countries, that’s an even bigger burden than it is for me, coming from the United States. So, the key thing is really going to be getting agreements in place that allow people to publish without having to pay those article processing charges out of their budgets.

My saving grace came in the form of Wiley’s agreement with the Big 10 Academic Alliance. So Penn State, as you know, is a Big 10 university. And there’s an agreement in

place between Wiley and the Big 10 where anyone who has a Big 10 email address gets to publish open access in any of the Wiley journals for free. And that has been transformative for me because I can publish, you know, I publish most of my papers in ACerS journals, and now I can do them all open access, and it's all covered, which I would not be able to do otherwise.

So, we're doing that as the Big 10. But the Big 10, that's a group of some of the largest, most prestigious universities across the country, right? What about the smaller institutions that may not have that bargaining power? What about the institutions coming from countries that may not have the government support like they do in Germany, for example? I'm worried about how we're going to get those agreements in place.

So, I think that's where the greatest attention needs to be paid. Because ultimately, it costs money to run a publishing house, and somebody has to pay for it. Regardless of whether it's the subscription model or the open-access model, there's still going to be challenges for people coming from either smaller, less wealthy institutions or countries."

De Guire: "Interesting. So, we also hear a lot about impact factor as it relates to a metric for trying to understand the quality of a journal. And it's a highly imperfect factor, but it's an easy factor. You've given some thought to the impact factor, as well as some other metrics that are measures of journal quality. So, how do you personally think about measuring journal quality?"

Mauro: "So, impact factor I would say is one number that really doesn't mean very much. And so when we consider, say, a journal like *JACerS* that has over 100 years of history with how many thousands and thousands of articles that have been published in so many different topic areas and have influenced so many other articles and scientists and just, the impact is absolutely enormous and impossible to quantify. And then to assign like one number to all of this? It makes no sense. It makes no sense for *JACerS*, it makes no sense for any journal. And with something like an impact factor that only considers two years of data, it makes less sense because it's completely ignoring the entire history of impact that the journal has.

Moreover, the emphasis that has been put on impact factor has led some journals to make decisions that kind of artificially inflate their impact factor at the expense of true quality. And so it's, I would say it's quite unhealthy, actually. And I'm hoping that we can move past this as a community.

There are other metrics as well. There's this MZE metric, which was proposed by Maziar Montazerian and Edgar Zanotto and Hellmut Eckert. That's definitely a major step forward compared to impact factor because they have normalized out factors such as the number of articles published. They have normalized out field-to-field variations that you get by citations. Because, you know, the glass community, for example, is a very small community. Even the ceramics community as a whole is small compared to, say, the polymers community or the medicine community. And those factors, they have a big impact on the impact factor of journals. And so what the MZE index does is to normalize

out some of those issues so one can compare within a given field. Even then, it's giving you a single number for something that is so complex.

So, in an ideal world, I wish that those quantitative metrics would just sort of go away and we could evaluate impact based on actual impact that papers have had on scientific thought, on further advances on educating people. You can't quantify that with just a single number."

(music)

BREAK

De Guire: "From groundbreaking fundamental research to novel applications of ceramic and glass materials, articles published in ACerS journals have a lasting impact on materials science and on our society. Explore the scope and aims of each of ACerS four journals to determine which publication is the best one for your research at www.ceramics.org/journals."

SECTION 3

De Guire: "Besides your scientific publishing activities, you are a voracious reader and a frequent review contributor to the fantasy fiction genre. So can you tell us a little bit about that world?"

Mauro: "Sure. So, this sort of gets back to one of the things I mentioned earlier about, you know, just having multiple interests but only one life to live. So I want to pursue all the different passions that I have, and I've always loved to read and loved to write as well. I fell in love with fantasy literature at a young age. Obviously, I've written lots of journal articles, I've written two textbooks as well. And I felt after my second textbook really drained, like I couldn't write another sentence. I felt like, 'Okay, I need something to kind of hit the reset button on this,' and there were other reasons, too.

But I love writing for the beauty of the writing and for the ideas being presented. And likewise with writing, I try to incorporate at least some little bit of artistry into my own writing wherever possible. It's not always the easiest thing in technical writing. And the way I learned from that is by reading as much as possible from authors who write beautifully, and a lot of that is happening on the fiction side of things.

So, I love to both read and to share my love of reading with others. And reviewing is a way to do that because you're getting the word out about great new books, you're getting other people interested in them. And if you can convince at least one other person to pick up a book, read it, and get something worthwhile out of it, then that's a win."

De Guire: "Absolutely. So do you see any similarities between scientific writing and fantasy fiction storytelling?"

Mauro: “Yes, I do. And that what we’re trying to do with technical writing is also to tell a story. We need to motivate the story, we need to tell it in a way that flows, and we want to grab the reader from early in the process. We want to make them understand what’s going on in a way that’s coherent, that’s interesting. We want to emphasize the key points, and we want to do it in a way that people actually like reading it.

And like I said, that’s usually not the case in technical writing where it’s like, ‘Okay, just the facts, please.’ But if you write something in a way that is enjoyable to read and provides a good reading experience, then more people will read it, and it will ultimately have a bigger impact.

I’ve gotten that feedback from a number of people, which actually is one of the most meaningful things that I get when somebody compliments not just what it is I’m saying technically in the paper but just how it was written and making it accessible so young students can read it and understand it. That really opens up the door for the papers to be not just a way of conveying information but a way of promoting education of the students, a way of piquing their interest so that they will want to learn more. So yeah, I think there are some overlaps in that respect.

Also, the process of doing research is inherently a creative process because you’re coming up with something that nobody has ever done before. And that’s the same thing with fantasy fiction, right? People are inventing things, dreaming of things that nobody has ever done before, and then putting that to the paper.”

De Guire: “Sort of asking the question like, ‘What if we could do this?’”

Mauro: “Exactly.”

De Guire: “‘What if we could make a glass with 30% less CO_2 emissions?’”

(music)

CONCLUSION

De Guire: “Pursuing your passion or passions in life may seem like a daunting prospect at times. But as John says,”

Mauro: “Focus on the quality of the work that you’re doing, and everything else should follow.”

De Guire: “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 John Mauro, LionGlass, and the ACerS journals. 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.”