

## CERAMIC TECH CHAT

Episode 56

Title – “Joining materials and people together: Monica Ferraris”

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### INTRO

McDonald: “I’m Lisa McDonald, and this is Ceramic Tech Chat.

Technology has advanced rapidly over the past century, and sometimes it can be a struggle to keep up with all the changes. But these new systems and devices also give us the unprecedented ability to collaborate across vast distances, and so becoming proficient with this technology is well worth the effort.”

Ferraris: “I’m more than 60, but I have children and also my young colleagues and students. So, I know the importance of being online, of social [media]. And then we have to do our best to adapt with this new way of being social.”

McDonald: “That’s Monica Ferraris, full professor at Politecnico di Torino in Italy and cofounder of the university’s interdepartmental, multidisciplinary research center on advanced joining technologies. She is also this year’s president of The American Ceramic Society.

In today’s episode, Monica will share details about her work on the joining and coating of materials as well as discuss her plans and goals for the Society this year.”

(music)

### SECTION 1

Ferraris: “I’ve been always interested in doing something scientific. When I was very young, I decided to study what at my age was called solid-state chemistry. Now they call it materials science. So, that’s what I did, mainly working on spectroscopy and the interaction between light and matter. Actually, I worked during my master’s thesis on a particular kind of spectroscopy, which was called electron paramagnetic spectroscopy, and I was hired immediately after by the Italian Telecommunication Research Center to work on this spectroscopy on optical fibers. So, that’s when I started working on glasses, absolutely by chance in 1985; it’s almost 40 years! And well, I never stopped because I worked on these glasses for fiber optics five years. Then I moved during these five years on another glass composition but always glasses, so fluoride glasses. That changed my life. I spent some time in France in a university in Brittany, University of Rennes. And I worked on this new composition of glasses. Then I moved to a completely different subject because I left the Italian Telecommunication Research Center, and I moved to Fiat Research Center. You may know the name Fiat, car manufacturer in Italy.”

McDonald: "Oh yes, of course."

Ferraris: "So, during these years at Fiat, I actually worked in collaboration with the university where I am right now. So, Politecnico di Torino, which is a technical university. And [during] these years, well, I shifted a little bit from glasses to metals and composites. And then finally I joined Politecnico with a position in the early '90s. And I'm still there. Now I'm a full professor there. And I started working on glasses and ceramics again because my former boss told me, 'Well, you know something about glasses. We don't know glasses here. You have expertise on glasses. Bring this expertise here.' So that's why we started. And now we work in our group on several kinds of glasses, ceramics, composites. And we use glass to join ceramics and composites. So, this is my story."

McDonald: "And you know, that is like such a wonderful transition to our next topic about kind of the research that you're doing now with joining."

Ferraris: "Yes, exactly. This is I would say the main area of my research right now. I use glass to join materials like an adhesive for high-temperature applications. So, for composites, since you used composite for energy, aerospace, nuclear, you need to join different parts for high temperatures. You cannot use a traditional polymer adhesive, so you need a glass. In our group, for the past 30 years, we have developed many, many glass compositions able to join and also to do some mechanical tests. And we have now a recent research center just on joining. It is called J-Tech, 'J' is for joining. And I'm very happy to be cofounder of this research center inside Politecnico, which is on joining activities."

McDonald: "So, what type of materials do you typically join together with glass? Like glass to a different glass? Glass to metal? Like what usually is it used for?"

Ferraris: "We join everything. Actually, we work pretty much with companies or with European projects, and so when they ask us to join something, is because the traditional way of joining somehow failed or they are not feasible. Just to give you an example, we work pretty much on ceramic matrix composites, like silicon carbide fibers with silicon carbide matrix, and silicon carbide doesn't melt, so you cannot weld it. So, we had to find a glue, sort of a glue, which is actually a glass, able to join it to avoid failure at high temperature, for instance. So, we join ceramics and composites and metals together, or what we call dissimilar joints. So, metal to a ceramic, composite to a metal, which is quite tricky because of their different coefficient of thermal expansion. So, you believe you did a good job, and then it breaks. But anyway, it's fun."

McDonald: "So I think that is a really important point that you mentioned, is there is a lot of similar material welding together, but dissimilar material can be difficult because of that different thermal expansion. So, what are some of the techniques that you use to overcome the differences in how they expand with heat treatment?"

Ferraris: "Well, we may want to do different layers to have a gradual change of the coefficient of thermal expansion. We can also work the surface in order to increase the mechanical

interlocking and increase the adhesion and the mechanical strength of these two materials joined, and this is fun.”

McDonald: “Yes, definitely. And I know you mentioned that one reason the glass is so nice is it can be used to join materials at much higher temperatures than a traditional polymer adhesive. But we also know that people hear ‘glass,’ they think brittle. So, how is it that to use like this brittle material as a glue? Are there challenges to that? Are there special compositions of glass that make it, I guess, less brittle?”

Ferraris: “Well, the first thing you can do is to introduce a second step, which is a crystallization one. So you don’t have a glass only, you have a glass-ceramic. In this case, you somehow improve the mechanical strength, but, well, glass-ceramic is intrinsically brittle. However, don’t forget that very often we use these joining materials to join ceramics, which are brittle, too. So, it’s a matter of we don’t have many other options. If this is the last option, you have to deal with it.”

McDonald: “And I’m assuming we’re using these joining things not at like joints, right? Like, these adhesives aren’t being expected to like bend at a joint or whatever.”

Ferraris: “No, absolutely not, they cannot bend. If you wanted something able to bend, you have to use a polymer adhesive or a braze alloy or a pure metal. There are different options. That’s why I told you we join everything, not necessarily with glasses. That’s dependent on what we have to do, which are the final applications and thermomechanical requirements of the joint. So, in our group, we design the correct joint, hopefully the correct joint material for the application the companies ask us. So, it’s a process.”

McDonald: “And what type of companies do you work with? Like, are they in the automotive field, space field, what kind of companies?”

Ferraris: “Well, mainly in the field of energy.”

McDonald: “Energy, okay.”

Ferraris: “Yeah, energy. But also automotive, aerospace, biomedical. We are a polytechnic university, so we work pretty much with companies within European projects because the European Union funds several cutting-edge research projects. And it is very, very competitive, but when you get one of these projects, you are very well-funded. You work in collaboration with many other European and non-European countries. We are in a couple of projects with the U.S. and also Japan.”

McDonald: “You know, I believe the best way we can put it is you’ve joined together with a ton of different people.”

Ferraris: “Exactly, exactly. Joining not just materials but also people. Then when I got the [ACerS Engineering Ceramics Division] Bridge Building Award, I was so excited because

it is actually a way to, well, to celebrate bridges between countries. Joining is ‘making bridges.’”

McDonald: “Yes, joining is making bridges. So, I know in addition to your joining research, you’ve also done quite a bit with coatings, which in some ways are kind of similar to joining materials because coatings have to stick to the substrate that they’re on. So, I guess what would you say are some similarities? How did you get from joining research to coating research?”

Ferraris: “It’s a nice question because what I tell my students very often is that there is a lot in common between joining and coating technologies. Why? Because if you break one joint, you have two coatings! So, apart from that, they have very much in common: adhesion, wettability, reactions between one surface and the other one.

So, how we started, as always, by chance. About 20 years ago, I was still involved in activities on glasses for photonics. There was a European-funded project where we were asked to put metal nanoclusters inside silica, which is difficult because they are not compatible in terms of temperature and so on. So, we started working on sputtering. In order to sputter silica and silver nanoclusters, gold nanoclusters, copper nanoclusters. But the aim was for photonics. Never worked, never. It happens in research. But since in our group we worked on glasses for biomedical applications, we have these coatings prepared by sputtering, few nanometers of silica containing silver nanoclusters. And the idea was ‘Let’s try, maybe they are antibacterial.’ They were! So, we patented this coating.

But this is not the end of the story. [The coating] was very effective against bacteria. So, in 2018 [or] 2019, we tested against viruses, and it worked. So it was also antiviral, and we patented also the antiviral activity. And when unfortunately the [COVID-19] pandemic started, the first thought was ‘Maybe it’s able to kill this awful virus.’ It was! When we got this news from the hospital, it was May 2020. So, I will never ever forget about that because we were so excited.

Now we have a huge European Union-funded project to upscale this sputtering deposition of our coating, which is antibacterial, antiviral, and antifungal. So, one of my—well, I would say not ‘my’ because we work as a team—so together with my colleagues, it is one of our best and greatest achievements, I think.”

McDonald: “That’s just so beautiful. And, you know, if we all think back to what it was like in the early 2020s, so many of us felt so powerless; there really wasn’t anything we could do.”

Ferraris: “Exactly.”

McDonald: “And so for you find that this research you had started before then was effective in this situation that just felt like so out of control, so that must have felt like such a huge relief, so empowering.”

Ferraris: “It was incredible. We cried when we got the results. I said, ‘No, can’t believe it.’ And now at the University of Torino, they tested with many other viruses—not this one [only]—the results are confirmed. They can kill also other viruses. And there is a big company, they succeeded these days to upscale this coating. So, in principle, we can sputter this coating on virtually every surface and also [air] filters and, well, I’m happy with this.”

(music)

## SECTION 2

McDonald: “For most of this research as you’ve talked about, you’re based in Italy, which also, you know, considering everything that happened with COVID-19, you’re kind of like right there in like the thick of it when it first started for doing this research.

But, you know, also being based in Italy is really special for us because we are The American Ceramic Society, but about 35% of our members come from other countries. And so the ability to have someone from another country coming in as our incoming president this year, and in Italy, it has one of our ACerS International Chapters, which allow our members in different countries to connect together.

You were instrumental in helping to found that Chapter. So, can you tell us a little bit about how the Italy Chapter came to be?”

Ferraris: “This is another wonderful story. That’s why I love The American Ceramic Society, because this was a big opportunity for us. I was asked, ‘Would you like to have a Chapter in Italy?’ and together with my friend and colleague Paolo Colombo, we said, ‘Yes.’ So, I’m co-chairing this Chapter together with Paolo, and we organize things, which is the main aim to keep this community together—”

McDonald: “To join them together.”

Ferraris: “Yeah, to join them together. Well, we organize quite a lot of interesting events. So, our events are open, free of charge. And we keep this community together also online. This is something that I am really fond of, and I really take this opportunity to thank The American Ceramic Society because, well, it was a brilliant idea, brilliant. We organized recently in May this year [2024] an event in Venice, which is a super location, unique.”

McDonald: “I don’t think you could pick a better one.”

Ferraris: “I agree with you. It’s one of my favorite cities in Italy and around. And so this event was on glasses. So, we put together people working on glasses for nonconventional applications, like bioglasses, glasses as joining materials, but also glasses as coatings for antiviral, antibacterial applications, or recycling materials through vitrification. And we are going to organize another one next year [2025], end of March, on ceramic matrix composites. We are going to do this in the collaboration with the Spain Chapter, the

Germany Chapter, and the U.K. Chapter. And then we also invite people from France because the community working on composites is very strong in in France, too. So, even if they don't have a Chapter, we invite them."

McDonald: "That is so great that you're being able to use your Chapter as an ability to network with other Chapters, but then also just other members who might not be part of a Chapter yet. But hey, we can just increase those bases overtime so they can start forming their own Chapters."

Ferraris: "Hopefully so. And then the event I like most is the Happy Hour that we organize in Daytona Beach every year. Now is the third edition. We have the Chapters Happy Hour, and you'll be invited to join us."

McDonald: "I need to make it to ICACC at some point. Maybe in 2025."

Ferraris: "You should. It's fun. It's on Monday evening. So, we put together all the Chapters. It is an interesting evening, believe me."

McDonald: "It is exciting at this point that there is enough Chapters that you can have this whole event with Chapters from all over coming together to network, talk with each other, exchange tips about how to cohost events like you're going to be doing next year."

Ferraris: "The end aim of everything is to put people together, to give them networking opportunities. Because when you are in a relaxed environment like we are right now, you chat and there are new ideas popping up. I cannot tell you how many ideas, how many projects, how many activities were born in Daytona Beach or at other conferences of The American Ceramic Society during networking activity, which was during coffee break or evening together. Because, I don't know, there must be something in our brain, when we are relaxed, the brain works better."

McDonald: "I think that is such an important point, is you can't be 24/7 on the go, to the grind. Sometimes just stepping back, having that relaxed conversation is when the best ideas start to flow."

Ferraris: "And also by chance because you at the coffee break or at the poster session, which I love, you talk with people without choosing. You just walk around and if you find something interesting to see, you stop and you talk. And this is fantastic because there are a lot of wonderful ideas that come up by chance, and I have many, many examples for that, and that's why I love our conferences. And I do hope to be able to bring more and more people to our conferences because content is excellent and people are amazing, too. And then we are able to offer many opportunities to work together in a very relaxed environment, like here, in Pittsburgh, it is wonderful place, too."

McDonald: "And I know that your comment about hopefully getting more people to meetings kind of hints at what we're going to talk about later: some of your priorities as you come in as president to this year. But before we get into all of those details, it sounds like you've

gone to tons of meetings, you've networked with tons of people. How did your journey of joining ACerS begin in the first place that you are at this point where you're so integrated within the Society?"

Ferraris: "Again, it was by chance and because of meetings. When I started working at Politecnico di Torino, I started working on glasses, but immediately after, I was asked to join ceramic matrix composites together from nuclear applications, and one option was to use glasses as joining material. So, since I didn't know anything about CMCs, ceramic matrix composites, there was a conference of The American Ceramic Society on high-temperature ceramic matrix composites [HT-CMC] 1995, Santa Barbara, California. So I say, 'Okay, that's a good occasion and a nice place, very focused conference.' And I went to this conference, I started knowing the community, and it was great and the location was also great one.

So, I joined the Society because when you register, you have one year of membership. And I never left because at this conference I met with many, well, I can say with many friends because now after 30 something years of working together, we are more friends than colleagues. So, those friends in the U.S. and in Japan but also in Italy. I met many, many, I would say most of my Italian colleagues or German or French colleagues working in this community, [I met them] in the U.S. That's amazing."

McDonald: "You had to go all the way across the ocean and meet the people right next door."

Ferraris: "There are plenty of occasions in Europe, too, right now. But in the past, we had this meeting in the end of January or the High-Temperature Ceramic Matrix Composites [HT-CMC meeting] is now in several countries, but the very first one for me was in the U.S."

McDonald: "That's just lovely."

(music)

BREAK

McDonald: "ACerS International Chapters offer a way for our international members to connect with each other through regular technical, educational, and professional events and networking opportunities. Learn more about ACerS International Chapters at [www.ceramics.org/internationalchapters](http://www.ceramics.org/internationalchapters)."

SECTION 3

McDonald: "So now, as we've mentioned several times through this podcast, you're coming in, you're sworn in at MS&T24 as the new president for 2024–2025 of The American Ceramic Society. What are some of the goals that you're most excited to try to accomplish during your term?"

Ferraris: “Well, I talked to many people about these three M’s, which are members, meetings, and marketing. Members because our members are fantastic, global people, and I really would like to help make them even prouder to be members of the Society and making their membership more and more valuable. So, I really would like to increase the number of our members, but not just the number, I would like to increase the satisfaction to make them [think], ‘Okay, I have to stay with the Society because of that, that, that.’”

In particular for young people, at the beginning of their career, like it was for me, the advantage of my career was really enormous, and I would like to help make young people feel, ‘Okay, I have to stay there because it is great for my career.’ So, mentoring young people, and also mentoring them when they attend a meeting for the first time is very important because otherwise maybe you’re alone sometimes during the coffee break, you don’t know anybody. So, having sort of a mentor helping you get connected with people, I think it is important.

And then meetings. Ah, meetings. It is everything for us because as we talked about before, it is the exchange of ideas that make progress run, new ideas. And then we would like to show our results, but not necessary to [only] show [but] to discuss our results. So, making our meetings even more, I would say, a combination of excellent technical content with new networking opportunities and also in a nice environment, nice location, it’s a good merge of different requirements that now we have.

After the pandemic, we know very well that there are things that we would like to do by ourselves, but there are a lot of other things we would like, we want to do together in person, and these are meetings. So, we’d like to make clear to many people that attending our meetings is something more than what you expect from a meeting.

So, I’m excited to work with you, with all the staff of The American Ceramic Society, which is incredible. There is nothing that can be done without your help, I want to be very clear. And so, in collaboration with all of you and with our members, I do hope to be able to do that.

And then marketing because it is important. We are living in the time of our lives where we have to post stuff on Instagram even before the event is finished; we want to see it posted. And since we are doing great things here at The American Ceramic Society, we should be able to, in my opinion, to market it in a more effective way. Because we can attract more people, have more people at our meetings, and have more fun.”

McDonald: “And it also works out very well for us because this past fall, we launched a brand-new website for ceramics.org. And so having that new platform should really help us with this marketing initiative as we’re going into 2025. So, during all of your time being part of ACerS, what do you think is the most professionally or personally fulfilling for you?”

Ferraris: “Well, together with being able to connect with people all over the world, it’s friendship. You know, it’s different when you receive an email from, well, you know this name, but you never interacted. Well, you answer, of course, but it is a different feeling.



So, it's a pleasure when I need help—I don't know, can be advice because of my career or a paper—I send an email to wherever they are, my friends and colleagues from ACerS, and I receive the answer in no time. So, this is fantastic. And, of course, I do the same when I receive an email from one of my friends and colleagues. This network of people created during the past 30 years of membership, well, we are sort of family. So, we answer immediately; we help each other. It is wonderful.

Another project I'm really fond of is trying to help less developed countries to grow. For instance, we have several very motivated volunteers in France, and they share this nationality with some African countries. So, we are trying to help."

McDonald: "And I know one of the initiatives that was announced not too long ago is the fact that people from these developing or emerging economies are able to submit papers to the ACerS journals at discounted or no-cost rates. So, that is like one way we can help support and network with these people."

Ferraris: "Absolutely."

McDonald: "We've touched on so much today. Do you have any final thoughts you'd like to share with our listeners?"

Ferraris: "I just want to finish by thanking all my colleagues because this is an achievement that you cannot receive by yourself. It's also because of collaboration and the activities we've done together on glasses, on ceramics. They are with me at most of the conferences. And so, I'm not alone; I prefer not to be alone. So, thank you so much for that."

(music)

## CONCLUSION

McDonald: "Thanks to professional societies such as ACerS, people can more easily join with others in their research community and together support the search for the next big discovery in materials science.

I'm Lisa McDonald, 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 Monica Ferraris and the Society's plans for 2025. Ceramic Tech Chat is produced by Lisa McDonald and copyrighted by The American Ceramic Society.

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