

CERAMIC TECH CHAT

Episode 36

Title – “Manufacturing innovation at US national labs: Chris Heckle (E36)”

INTRO

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

In the United States, the national laboratories serve a unique role in the R&D [research and development] landscape by conducting basic and applied research, and also by making sophisticated laboratory resources available to researchers. For example, the Department of Energy’s Argonne National Lab in the Chicago area offers a 35-beam line X-ray synchrotron at its Advanced Photon Source, and many other similar resources.

The connection between that type of fundamental research and manufacturing is not very obvious, but Argonne National Lab is working to change that.”

Heckle: “Argonne created this role, Materials Manufacturing Innovation Center, to link to industry and work with them on what needs that they have, what technologies or analysis could be useful as manufacturing and industry embark on their own decarbonization or sustainability approach and work.”

De Guire: “That’s Chris Heckle, director of the new Materials Manufacturing Innovation Center at Argonne National Lab. In today’s episode, Chris will talk about the current state of the DOE national laboratory system and how the new Materials Manufacturing Innovation Center aims to improve and expand the labs’ support for industry.”

(music)

SECTION 1

De Guire: “DOE operates 17 national labs, and I know there’s some others, mostly connected with the Department of Defense. But in the role of the DOE labs, what is their role in the innovation ecosystem for the United States?”

Heckle: “The Department of the Energy is looking for clean energy that’s safe and affordable for everyone and moving toward energy independence in this country. The Department of Energy also has the responsibility to monitor the nuclear weapons, stockpile and supports advancing nuclear energy generation. So anything that touches on improved energy efficiency, decarbonization, foundational materials, work that supports those carbon capture, utilization, and sequestration, like anything that you could imagine that has some kind of touch to improving energy efficiency. It could be the hydrogen economy that’s coming. It could be long-duration energy storage. It could be grid reliability. It could be

grid resiliency. All of these topics fit within the Department of Energy purview and probably more since I've only been there for about four months. So, I don't know quite everything yet."

De Guire: "You mentioned decarbonization in the hydrogen economy, which really speaks to manufacturing. What are some ways that a national lab can advance innovation that are difficult for industry to do?"

Heckle: "I think there's probably a couple of ways the labs can take a longer-term view and make investments in partnership with DOE, that maybe the industry might not be able to do on their own. I mean, I think that we agree, or maybe everybody knows that numbers of large industrial labs are dwindling in this country. And perhaps the national labs can play a bit more of an industrial R&D for some companies that used to do it on their own, and maybe now that they miss it. That's one in terms of long-term investments.

The labs can bring together partners and funding from the DOE that collectively we could get something done together that maybe independently, we couldn't get done individually. And we invest in capabilities that companies need only occasionally, and therefore they can't afford to maintain. And so Argonne as well as a couple of other labs have user facilities where a company can apply to do work essentially for free as long as they're willing to have the work published at a national lab."

De Guire: "Can you tell us a little bit about Argonne National Lab, its history, where it is in the Chicago area, and, most importantly, what's its mission?"

Heckle: "Sure. The lab is about 25 miles southwest of Chicago, and it's one of the original Manhattan Project sites. So, started at the University of Chicago metallurgical laboratory and built a self-sustaining nuclear chain reaction. It's moved a couple of times from that location to its current location in Lemont, Illinois. The mission of the lab, as well as all of the 17 Department of Energy national labs, is to accelerate science and technology that can drive security and prosperity for the for the country. And energy independence is a key focus area of Secretary Granholm that you'll hear her speak about anytime you hear her talk."

De Guire: "Great. So you mentioned the connection already to metallurgy going back to its very earliest days. So can you talk a little bit more about the materials science that's done at Argonne, and are there any examples of ceramic or glass materials science projects that you can talk to us about?"

Heckle: "Sure, there's a few. The American Ceramic Society may be familiar with Dr. Dileep Singh who's at Argonne National Lab. He held a key leadership position in the Engineering Division for a few years. Singh's conducting really great research in his department. In fact, he and his team invented Ceramicrete, which is a new cement formulation, as well as what they're calling TESS, thermal energy storage system, which is based on a molten salt idea, so they can store the energy and then release it later. There's a fair amount of nanopowder synthesis capability at the lab, flame spray,

paralysis, some precipitation reactions, continuous flow processes. There's actually a lot of coatings. There's atomic layer deposition coatings, a lot of membrane work. There's tribology, which is, you know, really important for ceramics. A little bit of 3D printing, not as much as what Oakridge National Lab has, but some. Yeah. So, actually, a fair amount of work that's relevant to ceramics. Not too much in the amorphous materials. And I was speaking to the division director of one of the materials organizations, and she was saying, 'But amorphous materials have such interesting problems. I would really like to work in that space.'"

De Guire: "We would encourage that, of course. Great, well, that's quite a catalog of research activity. And actually it spans a huge range of applications, too. It's very interesting that way."

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SECTION 2

De Guire: "So, Argonne recently launched a new center, the Materials Manufacturing Innovation Center. So, what was the reason behind establishing the Center, and what gap was the lab seeking to fill?"

Heckle: "The American Ceramic Society certainly knows that materials manufacturing is very energy intensive. And industry in general is an important area of the economy for energy efficiency and decarbonization for the Department of Energy to focus on. And so the lab created this position to work specifically with industry on the energy efficiency and decarbonization targets that the Biden administration has set forth."

De Guire: "Okay. Sounds like a really critical role and maybe long overdue in some respects. So, the name of the Center is intriguing. The words materials, manufacturing, and innovation conjure up ideas such as the Internet of Things, advanced sensors, and real-time feedback loops, the Materials Genome Initiative. So how, quote unquote, 'innovation ready' do you think industry really is, and are there sectors of industry that are more ready than others?"

Heckle: "I think those are good questions. And so, I don't know how many people are going to enjoy this, but like that movie Ratatouille, you know, where good cooks can come from anywhere. It's not necessarily that anyone can be innovative, but innovations can come from anywhere. And so, I don't believe that only large companies have the resources to be innovative, and conversely, I don't believe that only small companies are nimble enough to be innovative. So, I mean, I think that there's work happening everywhere, and I don't know that it's industry dependent. I'm not sure that there are certain industries that are more innovative. It's probably individual driven and people driven and leadership driven.

I do think that this administration is working hard to inspire innovation and also to fund innovation. There is a lot of money coming from the Department of Energy right now designed to spur innovation, and especially investments in new technology to achieve energy independence. And so, the DOE really wants to see technology demonstrated. Not

in the lab environment, but there are tens of millions to hundreds of millions of dollars available for companies to take some risk, put some technology in place that they don't have to self-fund. The Department of Energy will fund them to try to get that work across the goal line."

De Guire: "And that goes right back to one of your first comments about how national labs can really help absorb some of the risk and take some chances that are really difficult for companies to really take on themselves."

Heckle: "Yes, that's right, working in partnership. I think one of the surprising things about the national labs is that they are good at maintaining company confidentiality. There are rigorous processes in place for firewalls if that's required. Different labs would have badge access to keep research groups separate. Nondisclosure agreements are taken very seriously. Data plans are required on how data is going to be sequestered and not be made available to anybody in the national lab infrastructure. So, there's really good policies and procedures in place to hopefully assure companies that their confidential information will be maintained."

De Guire: "Great."

Heckle: "So, Argonne actually already has a healthy Rolodex of industrial partners across many sectors. Lots of small companies. So, the lab has, even from entrepreneurs. The lab has the Chain Reactions Institute, which supports entrepreneurs with two years of on-site residency. And then we also do work with large multinationals. Kind of research at request or development at request, process scale up work, that kind of a thing.

One of the things that attracted me to the lab was excellent materials synthesis and processing. There's been a very large investment by the Argonne leadership into the Materials Engineering Research Facility. It has a surprising, to me, anyway, when I interviewed, capability and scale. So, there's even a large high bay that for, a few years ago, was used to deliver tanker trucks worth of material to a company as we were transferring the process that we had developed to them. We were making tanker trucks of material for them that they were taking away and selling.

So, the labs have perhaps larger capability to balance out the basic fundamental side. There's a fair amount of applied side, even up to kind of early pilot, I would say."

De Guire: "I had not realized that the national labs, or at least Argonne, since that's the one you're most familiar with, had that ability to scale up to prototype industrial scale. That's fascinating, actually."

Heckle: "Yes. Coming from industry, you hear mostly that the labs are quote 'academic.' But in fact, that's not really universally true. Labs are 5S'd [workplace organizing system: Sort, Set, Shine, Standardize, and Sustain], for example. And they have these really great processes, like I mentioned, to manage information. And there's a fair number of ex-

industry people that work at the labs that can help translate between how companies talk and how scientists and technical people talk.”

De Guire: “True, yeah. And if a company wants to work with a national lab, how would they go about doing that?”

Heckle: “If you go to any lab’s website, there will be a link that says ‘Work with us,’ or something analogous. And then it will connect you to the right people, [and] we can walk through several different kinds of arrangements or several different ways that we might work together.”

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BREAK

De Guire: “The American Ceramic Society’s Manufacturing Division addresses the needs of manufacturers and the full value chain involved in the production of ceramic and glass components and products. This Division holds its annual business meeting during the yearly industry trade show, Ceramics Expo. Learn more about this Division at www.ceramics.org/manufacturingdivision.”

SECTION 3

De Guire: “You’re the first director [of] the Materials Manufacturing Innovation Center. So, what attracted you to the role, and what is your own personal vision for the Center?”

Heckle: “I’m attracted to the role because it has, I think, the opportunity for impact. It’s good to work to support manufacturing from one industry or one company’s perspective. But this role, because it’s so broad to materials and chemical processing companies and technologies, has the opportunity to impact multiple companies, impact multiple industries in the U.S. So, I find it patriotic in many ways to support manufacturing in this country.

And so, the vision would be to deliver technology to companies that can bring it to market and create a more sustainable world for all of us. I mean, the scope is materials and chemical processing, which is already pretty broad. But it’s also broad in terms of area of opportunity. So, in my imagination or experience, what manufacturing companies need goes from personnel and workforce development through raw materials and supply chain, process, whether it be OEE [overall equipment effectiveness] or yield, or straight line manufacturing or efficiency, circularity, use of materials, certainly cullet, in some of our industries smart manufacturing, IoT [Internet of Things] manufacturing for all these things through new products. So, the lab can invent new products that companies can use to expand their market and quality architecture, packaging shipping, like all of these things, are really important to manufacturing companies. And the lab has work in nearly all of those categories to deploy into the marketplace.”

De Guire: “Interesting. And how are you working to create an environment where ideas and collaboration can flourish?”

Heckle: “I have found in my career that openness and transparency are kind of the key things to collaborations. And I really enjoy this argue/discuss, argue/discuss model of engagement. It’s based off of improv, which takes this ‘yes...and’ kind of an approach. You know, in improv, if somebody says something kind of outrageous, the other person will build on it. They’ll never say no because that shuts it down. And the argue/discuss model encourages disagreement as a way to get to understanding.

Disagreement is healthy and important, especially in science and technology. But it’s got to be framed as a ‘no...because.’ Anytime that I might say, ‘Here’s what I think that we ought to do,’ and somebody says, ‘I don’t think that’s a good idea,’ that shuts the conversation down. But if they say, “I don’t think that’s a good idea because,’ and then they have a reason, then we can continue the conversation and get to a place of common understanding.

So, openness, transparency, ‘no...because,’ open dialogue, it’s okay to disagree. In fact, as technical people, we need to disagree in order to get to that common place. These are the methods that I try to employ for good ideas and collaboration.”

De Guire: “Do you have some programs you’re running to help make that happen? Do you run workshops or things like that, where you actually bring people together to have those conversations?”

Heckle: “So, I don’t have any active programs right now, but the lab did have a couple of things last year. One was The Better Plants Day, from the Industrial Efficiency and Decarbonization Office. We brought in some companies and talked about what we need to do in order to decarbonize industry and help focus on plants. The lab also held a cable workshop, which is to address the thermal conductivity materials for industrial efficiency. And there will be a lot of opportunity in the future to host workshops around the hydrogen economy, around industrial electrification or different process gases. So, there will be opportunities to hold workshops. And if anyone would like to participate in a workshop, they’re certainly welcome to contact me, and we would plan around that.”

De Guire: “Excellent. That’s wonderful. So, of course, I work for The American Ceramic Society, and you’re a member of The American Ceramic Society, too, for many, many years. How can the Society work with Argonne National Lab to help move along some of the ideas that we’ve talked about today?”

Heckle: “You know, I think that’s a great question. It’s something that I’ve been thinking about since before I took this role, is that I don’t think that the lab infrastructure leverages trade organizations as much as they can. I’m starting to, a little bit, engage with the different trade organizations. So, one thing I’ve developed is a little bit of content that I can share with trade organizations on how to work with the Department of Energy.

So, there's all this money available, but if you've never taken government funding before, it can seem daunting. And so, we have a little bit of, 'Here's the four different websites you have to register at, and here's some tips and tricks on how to read funding opportunity announcements, and here's some lessons learned about writing concept papers and full proposals,' that we can share with trade associations and their membership. We could have webinars for their members, for example. So, that would be one thing that I think that we could probably do a little bit more of.

And then also leveraging trade groups as listening sessions. So, the DOE and we think we know what's important to industry, but wouldn't it be great to hear from industry directly: "This is what's really important." So, we have our connections, and we can put pieces together, but to get a more direct interaction, a cohesive interaction, I think would be really great.

It does come with a little bit of a risk because often companies that belong to the same trade organization are competitors, and sometimes they don't want to ask questions or make comments in front of their competitors. So it can be a little bit tricky. But if we can talk more in generalities that might lead to more specific conversations on that private basis, then that would be really helpful."

De Guire: "That's a good point. Because there are ways that a professional society like us and others have the ability to structure conversations among people who have a hard time talking to each other otherwise. Through conferences, or you mentioned webinars, even publishing, is a way to help people talk to each other.

Is there anything else that you'd like to emphasize to our listeners?"

Heckle: "That we're here for you. We have a website. It's www.anl.gov/manufacturing. Or I'm on LinkedIn, and people can pretty readily find me. And so, I really appreciate any opportunity to help somebody that is looking for an expertise, a skillset, a technology, joint funding. Any way that we could work together, you have an idea that you want somebody to work on for you. Contact me, reach out to me, and we'll find a way to work together."

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CONCLUSION

De Guire: "It can be challenging for companies to secure outside support in today's competitive manufacturing landscape. Fortunately, the Department of Energy's national laboratories are here to provide expertise and funding to help advance the technological innovations at small and big companies alike.

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 Materials Manufacturing Innovation Center at Argonne National Lab. 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.”