EP.152 Mike Tarlov

Narrator: You're listening to *BioTalk* with Rich Bendis, the only podcast focused on the BioHealth Capital Region. Each episode, we'll talk to leaders in the industry to break down the biggest topics happening today in BioHealth.

Rich Bendis: Hi, this is Rich Bendis, your host for *BioTalk*. And for the listeners, you've noticed, we've been off for, oh, probably three weeks or so, trying to find the best guest that you would be interested in listening to. And so we have a first-time organization we've never had on *BioTalk* in the last seven years, and I can't believe it, since it's one of the mainstays in the Montgomery County in the BioHealth Capital Region, and has been around for a long time. But we have Michael Tarlov, who is the Chief, Biomolecular Measurement Division, Material Measurement Laboratory for the National Institute of Standards and Technology, which is better known as NIST by everybody, located in Gaithersburg, Maryland.

0:01:03 So, Mike, welcome to *BioTalk*.

Mike Tarlov: Hey, Rich, thank you for inviting me here, and it's great to be here. And I'm looking forward to telling you more about NIST, and what we do, and how it relates to the local biotech community.

Rich Bendis: And I'm sure a lot of the people that live in this region and drive by all the time say, "What is this NIST thing, and how come there's so many deer running around the campus?" And it almost looks like a deer farm sometimes, because it's really beautiful grounds that you have over there, Mike.

Mike Tarlov: Yeah, we do have a beautiful campus. It's just under 600 acres. It's a pretty large facility, and it was one of the reasons why we moved out here. So it was originally the National Bureau of Standards located down on Connecticut Avenue where University of District Columbia is.

0:01:59 And they needed a site that was big enough that would help environmentally isolate a lot of the work that was done that was sensitive to environmental perturbations like vibration, external radio frequencies, things like that. And so that's why we are where we are. [laugh]

Rich Bendis: Well, I think it was a good decision, and we're going to learn a lot more about it today, as you give a little background information to everybody about NIST. But, before we do that, I think they'd be very interested in learning about you, and a little bit about your background, how you entered into NIST, how you evolved through NIST, and where you are today. And then we'll talk big picture about the NIST organization. But we want to learn about Mike Tarlov first.

Mike Tarlov: OK. I got a PhD in analytical chemistry from the University of Minnesota. I certainly didn't get to where I am today in a very sort of linear way.

0:02:56 So I like to tell people the first sentence of my PhD thesis is, "Tin oxide is a wide bandgap metal oxide semiconductor," and now I'm the head of the biochemistry division at NIST. So how in the heck [laugh] did I get there? Well, I came to NIST. I joined a division, it was called process measurements division, and half of it was really sort of traditional NIST metrology. Metrology is a word for measurement science. And what they did was establish like the US standards for temperature, pressure, and flow. And then the other half of the division was more research-oriented. They did a lot of work with fancy laser spectroscopy methods for probing combustion, even semiconductor manufacturing.

0:03:57 And I did research actually in chemical sensing and biosensing, so the relationship to my thesis was electrochemistry. Electrochemical methods are used a lot in biosensing. My career took a pretty big turn around 2000. My division chief came to me, and he said, "Tarlov, you're the only one in this division that does anything in bio." And our laboratory director, Dr. Willie May, who went on to become the director of NIST—

Rich Bendis: Sure, I remember Willie.

Mike Tarlov: —he was really pushing people to get into bio because he thought that there was a lot to do. And so my division chief James Whetstone said, "Tarlov, why don't you find out what biotechnology is, and maybe there's something related to process measurements that we could do."

0:04:57 I didn't know what biotechnology was, so I started looking into that, and I started going to industry conferences, reading trade magazines, things like that. And what I found out was, wow [laugh], a lot of this is about drugs, I mean, developing, discovering, developing [laugh], manufacturing drugs. And then the thing I found out was one of the

overarching issues that they have is that they can't define, or it's difficult to define by measurement, the products that they make because they're so complex and heterogeneous. So back in 2000, they were manufacturing primarily therapeutic proteins. Monoclonal antibodies were just beginning to really start kicking in, in terms of being commercial successes.

0:05:59 The other thing [laugh] I found out was, wow, we have a major biopharmaceutical company that is our next-door neighbor.

Rich Bendis: [laugh]

Mike Tarlov: I didn't know what they did, and I found out like, wow, this area is filled with a lot of companies.

Rich Bendis: I think you're referring to MedImmune, right?

Mike Tarlov: Yes, MedImmune, which was acquired by AstraZeneca. And we ended up establishing a very close relationship with MedImmune, AstraZeneca. But this all sort of leads in to the NIST mission. But, anyway, so that led to me putting together a program at NIST. It was called biomanufacturing, which proposed to tackle some of the major measurement science and standards needs for the biopharmaceutical industry. And that got internal traction at NIST.

0:06:57 And eventually Willie May sold the program [laugh] downtown, and it got funding. And actually that funding was related, linked to the Affordable Care Act. And the reason why was because there was one part of the Affordable Care Act called the Biologics Price Competition Innovation Act, which introduced a regulatory pathway for biosimilars for the FDA. And somebody downtown realized that [laugh] making a biosimilar, a lot of that is about measurement science, because if you can't define the originator product by measurements, then you're not going to be able to make a copycat version of that. And so they saw that NIST had a potential role in proving those kinds of measurements in the development of biosimilars.

0:07:58 And I like to think that we have had an impact in that space in helping the development of biosimilars, and improving access to those really important medicines to the US public.

Rich Bendis: And so what you've done is build upon what started almost 24 years ago in that bio space to where it's now the biomolecular measurement division and also material measurement laboratory. And so I guess you've sort of stayed fairly close to the bio and the pharmaceutical industry over the last 24 years?

Mike Tarlov: Yeah. And this sort of goes to the NIST mission, and certainly how I interpret that, to a certain extent. But the NIST mission is to advance measurement science and innovation to promote industrial innovation and competitiveness. So the important thing there is industry.

0:08:59 So our mission is really to work with US industry. And we do that very well. One thing, we have very deep scientific and technical roots that I think are admired throughout the scientific and technical world. But the other thing that helps us in working with industry is that we are a non-regulatory agency within the Department of Commerce. Because of that, we are a trusted third party that is impartial that can work with industry, and we can also work with federal partners like the FDA. And I think that we have served at times as a bridge between the regulated industry and the FDA. So when we started off with this program, we really didn't have a track record of working with industry.

0:09:58 But the important thing is for us to go out and to find out what are the most important measurement science problems for us to work on that we think we have expertise and resources to solve. And then also, the kinds of problems that we want to work on are what we call infrastructural measurement problems. And so these are problems that exist across an entire industry, the problems that every company would have. We don't want to work on company-specific problems. We want to solve problems that's going to lift everybody's vote. And from that perspective, the FDA has been an important partner for us because they have that view. They know what those problems are across the biopharmaceutical industry because of their regulatory role.

0:11:03

Rich Bendis: I think what you're mentioning there is very important because you're looking for industry-wide problems. And generally what you try to do is to put together a collection of industry experts or partners to come together and work on these collectively. And if there are solutions, they

become made available to everyone, rather than for an individual company. Is that true, Mike?

Mike Tarlov: That's definitely true. And what we work on, 99% of the time it's going to be made publicly available for all of industry to benefit from.

Rich Bendis: And then who determines what the priorities are that you work on?

Mike Tarlov: That's a good question. Some of the things I already mentioned, you know, one is an infrastructural measurement problem. Is it potentially an impactful problem to solve?

0:11:58 Do we have the expertise and resources to bring to bear on that problem? And so in determining some of those, we need to work closely with members of industry to try to find out what those problems are. And so that's another thing that NIST is very good at, is convening stakeholders to try to tease out what the priority areas are that we should work on, the measurement problems to solve, or potential standards that we need to develop. And we can do that. We do it through a number of ways. Like, initially, we used to hold a sidebar meeting off of—I don't know if you're familiar with the organization CASSS. But CASSS is an organization that holds meetings, usually a meeting in Washington, D.C. in January, and we used to convene a meeting off of that, assembling about a dozen experts from industry in the CMC areas which most relate to our program.

0:13:09 So CMC is chemistry, manufacturing, and controls, or sometimes referred to as quality. And that's where really a lot of the measurement issues are encountered in development and manufacturing of biopharmaceuticals.

Rich Bendis: I think another thing is basically innovation's happening so quickly. How do you try to stay up with innovation as it's occurring within industry when you're trying to solve problems that you've already identified in something that's existed for a long time? And then, all of a sudden, everybody's innovating about with gene therapy, gene editing, synthetic biology, regenerative medicine, CAR T-cell therapy, and all of these things that are constantly evolving within the bio and the pharma space right now.

0:14:00 So how does NIST keep up with all of these emerging technologies and trends that are occurring?

Mike Tarlov: Good question. We try. [laugh]

Rich Bendis: [laugh]

Mike Tarlov: I've thought about this a lot. And if you remember, I mentioned like I was in this division that did a lot of work actually related to semiconductor manufacturing. And we have our programs reviewed by external panels. And every time they would come in and say, "The semiconductor industry moves so fast, how do you guys keep up with it?" And that was always a criticism of some of our programs. So now working with the biopharmaceutical industry, and I've got to say, by and large, I think the biopharmaceutical industry moves more slowly, and that's because I think it is more highly regulated, and it's not as difficult for us to keep up.

0:14:57 Now, I think we certainly all saw how fast the industry moved during the pandemic, and that's certainly a tribute to the biopharmaceutical community. But it's funny, you know, a lot of the problems that we became aware of even 10–15 years ago, many of them still exist today. And part of the reason why is, well, one, they're hard problems. But I think a lot of the problems could be solved by better collaboration across the biopharmaceutical community. And that's something that we try to do. But there are problems. I mean, there are common problems involved in development of manufacturing of biopharmaceuticals certainly that still exist.

0:15:57 One of the early ones that we became aware of was the measurement of what they call subvisible and visible particles in biopharmaceuticals. And so this is a classic infrastructural measurement problem because every vial of a biotherapeutic must be visibly inspected for particles, an actual person looking at them. And that's still a big issue today because the people that do that are very good at it, and they can see things that aren't necessarily supposed to be there. And that could trigger an investigation, possibly discarding millions and millions of dollars of products. But it was one of the first areas we learned about. In tackling a lot of the problems, the experience I've had is you really need to understand, have a deep understanding of what the problem is.

0:17:02 And initially you might think that's simple and it's already been solved, but maybe you don't really understand everything about the problem and the constraints that a company might be operating under in terms of

the methods they need to use to do measurements like that or the regulatory implications of how they do it.

Rich Bendis: So let's talk a little bit then, Michael, about biotechnology in general, and some of the outcomes that have evolved from the work NIST has done. And I have some notes on a few things here, and maybe you can elaborate on them. Maybe the standards such as gene delivery systems that you've been involved with? Another one is really the monoclonal antibody reference material that probably came underneath your division, I would imagine.

0:17:56 And then the newest one is really NIIMBL, the National Institute for Innovation and Manufacturing Biopharmaceuticals, which is really a national program to bring people together from a collaborative basis. But, if you don't mind, talk a little bit about some of these wins that NIST has been involved in that you've personally been involved in in your division.

Mike Tarlov: Yeah, certainly probably the biggest win I've been involved in, and certainly a very satisfying experience, has been the NIST monoclonal antibody reference material, known as NISTmAb. And that was initially proposed in that sidebar meeting that I mentioned, where we had about a dozen people from industry in a room. And at the time, one of our junior scientists—his name is John Schiel—made a presentation to them. So in these meetings, we would basically try to find out what the measurement problems were, and then we would tell them about the work that we were doing, and we would get feedback from them on it.

0:19:00 But we had an idea about, how about if we developed a monoclonal antibody reference material? I mean, monoclonal antibodies have emerged to be, well, first of all, just incredibly important from a public health perspective and certainly an economic perspective for the biopharmaceutical industry, and it's emerged as a platform. We thought, well, if there was a reference material, maybe that could help with the development of the analytical methods that are used to characterize and quality control those products. And they have to be developed when you are developing a monoclonal antibody. And they're very important for ensuring the quality and the consistent manufacturing of that product.

0:19:58 So John Schiel made a presentation about a monoclonal antibody reference material [laugh]. And I'll never forget, the feedback we got was about half the people said, "Yeah, I think we'd use that," and then the other half said, "Ah, we'd never use it." The other thing John laid out [laugh] in his presentation was, "We don't have the capabilities to make a material. We would need one of you to give us this material [laugh], and allow us to develop it as a reference material, and then make it publicly available, and distribute." So we left the meeting, and about a month later, I got an email from Mark Schenerman, who was at MedImmune at the time. He's now the director of the UMBC biotechnology program. And Mark said, "I think I might have a material for you." [laugh] "Whoa, really?"

0:20:57 It turns out he did, and it was a considerable amount of material, which it's not uncommon when a company [laugh] is developing a monoclonal antibody, and they're going into a phase III clinical trial, they're manufacturing a significant amount of material. And so we very quickly did a material transfer agreement, received that material. And then about the same time, John Schiel was contacted by two people in industry—Oleg Borisov, who was at Amgen; Darryl Davis, who was then at Janssen—who were writing an ACS book on analytical characterization of monoclonal antibodies. And they asked, "Would you like to be involved in this book?" And John said, "Yes, and not only that but we have this monoclonal antibody material. How about we share it with all the potential authors, and they can do their own particular analytical methods that they are experts at and would like to write a chapter on."

0:22:07 And so from that, there were about 100 people from industry, academia, and the FDA that were involved in developing this book. It turned out to be a three-volume book series on characterization of our antibody. And it was sort of a unique thing for NIST because, typically, the way we develop a reference material is we get a material, and then we go behind closed doors for several years, and then open the doors after extensive characterization and value assigning or certification, and say, "Here it is." But this was different. It was really sort of a, like, we call it a crowdsourcing characterization of the material, which turned out to be a great way to leverage the capabilities, resources, and expertise of industry and others in characterization of the material.

0:23:03 And then it also made people aware of the material. We got it in 2014, then issued it as a reference material in 2016. Since then, it has become NIST's best-selling reference material. It's been used or has been used by nearly every major biopharmaceutical company. That always makes me think back to that meeting where half the people said, "We'd never use it." It's used extensively by analytical instrument vendors. So there's the major players in there, like, people like Thermo Fisher, Waters Corporation, Agilent, SCIEX, and then all smaller vendors. But they use it to demonstrate the capabilities of new analytical technologies, methods, and workflows.

0:24:02 And we see that they produce these—they're called application notes. It's like sort of company publications on what their analytical technologies can do for characterizing monoclonal antibodies. So that's very satisfying because we are firm believers that advances in measurement science and analytical technologies drive progress in manufacturing of biopharmaceutical products. So with better analytical technologies, they provide more fundamental knowledge about those products. They can tell you what the consequences are of manufacturing changes if you're making manufacturing changes. They can help you evaluate the impact of new manufacturing technologies.

0:24:59 So we really think that, at the end of the day, the NISTmAb has really helped to accelerate development and manufacturing of monoclonal antibody therapeutics in general.

Rich Bendis: Which is so important to the industry. I guess one other question, just on that before we go to another topic, would be, how often is that updated?

Mike Tarlov: Well, like I said, we have a significant amount of material, and so what we do is we go through what's called a re-certification process. And there are certain analytical methods that we use in characterizing the material, and we determine that, basically, it hasn't changed. It's stored at minus 80 degrees C. We don't expect there to be a change, and we haven't seen a significant change in almost 10 years.

0:25:59 But data is constantly being [laugh] generated from that material, not just by us but by people outside of NIST. And there's over several hundred peer-reviewed publications where the NISTmAb has been used in some way, and data is generated. And then we've used it a lot for what

we call interlaboratory studies, to examine a particular analytical method such as nuclear magnetic resonance, NMR, or mass spectrometry techniques. And, again, those are community efforts where we'll enlist industry and academic participants in helping us to basically assess the current state of a particular analytical method, whether the results can be comparable between labs.

0:26:59 What are gaps of methods? How could the method be improved? What are maybe best practices to be shared? Is this just another example of how the materials impacted the community?

Rich Bendis: Well, congratulations. We know what your legacy is now; it's NISTmAb, right?

Mike Tarlov: [Laugh]

Rich Bendis: But you're not done yet? You have much more to give, I'm sure, Mike.

Mike Tarlov: Yeah. Well, I mean, the NISTmAb has sort of opened our eyes about potential other materials. And we'd like to take a page out of the NISTmAb playbook for other materials, like viral vectors or lipid nanoparticle mRNA vaccines. So, I mean, that would be great. But, again, it's a matter of we can't make those materials. We would need somebody who saw the potential of the greater good for the community. And that's the thing I've learned, that you need a champion on each side of the equation.

0:28:03 On our side, we've got to believe in something. This could be impactful. Yes, we do have the resources to bring to bear on this. But then we would need that champion, say, on the industry side that could drive through the donation of a material.

Rich Bendis: Well, hopefully, that champion's going to listen to this podcast, and you might get somebody reach out to you and say, "Hey, we've got some material in viral vectors we'd like to work with you on."

Mike Tarlov: Yeah, that'd be fantastic. [laugh]

Rich Bendis: Well, we'll put a call out to all of the listeners in industry.

Mike Tarlov: You'll tell them where I am, right? [laugh]

Rich Bendis: [laugh] We'll let everybody know we're talking to Michael Tarlov, who's the Chief, Biomolecular Measurement Division with NIST, and talking about some of the significant programs that they've been involved in.

0:28:50 And one of the things that is, I think, very beneficial for our region—which we call the BioHealth Capital Region, Maryland, D.C., and Virginia, which is now ranked as the third-leading biopharma region in the United States, just behind Boston and San Francisco—but it's nice to have this collection of companies and assets in your backyard. And you mentioned MedImmune and AstraZeneca. But we've got Emergent and GSK and United Therapeutics and a whole bunch of smaller companies that are located here in our backyard. But, more importantly, you've got NIH with 6,000 scientists in 27 different institutes. And you have the FDA. You've got some of the leading research academic universities in your backyard too. And I think the new director of NIST has come from the University of Maryland system. That's correct, right?

Mike Tarlov: Yeah, that's right. So the current NIST director is Dr. Laurie Locascio. And she was my boss for a number of years at NIST. And then she, at one point, left NIST, and became vice president of research at University of Maryland, College Park.

0:30:00 And NIST actually has a close relationship with University of Maryland in a number of ways. Close to my heart, we have a joint institute with University of Maryland, College Park and University of Maryland, Baltimore, that is the Institute for Bioscience and Biotechnology Research, which is in Rockville, Maryland, located really in the heart of the biotech ecosystem. And then we have other joint institutes in the area of quantum physics with University of Maryland, College Park.

Rich Bendis: And basically University of Maryland is starting a new biocomputing center in Rockville. I'm not sure if you're aware.

Mike Tarlov: Yeah, the Health Computing Institute.

Rich Bendis: The Health Computing Institute, and basically going to focus on AI, machine learning, quantum, and what the impact is sort of in the healthcare industry.

0:30:55 And I think they really have, with the strength of computer science in the University of Maryland, in that area, they have a chance to become a

national leader in this healthcare computing space. And I would imagine you would be a critical partner to them in that.

Mike Tarlov: Yeah. I mean, we have already started exploring ways in that we might be able to interact with the Health Computing Institute. We've had a number of meetings. We are very connected with the parts certainly of [0:31:28] and they're involved in that institute. It's going to be close by. It's just going to add to the biotech community around here, and I'm sure it'll be another asset that will help not only draw but help retain [laugh] biotech in the area.

Rich Bendis: So you're even talking like an economic development professional now, with the traction and retention now, Michael? [laugh]

Mike Tarlov: [laugh] Well, yeah. So I've been at NIST for, like I said, 37 years. We're very stable.

0:32:00 And I'll say that's one of the challenges in working with the biopharmaceutical industry. You can make a contact in a company, but there's a lot more turnover in that industry [laugh] than there is at a place like NIST. And so you really sort of have to constantly work at it in maintaining your contacts, and know where they are.

Rich Bendis: Yeah, that's true. I mean, one of the best examples is MedImmune, which were acquired by AstraZeneca. But they spun out a company called Viela Bio. I don't know if you mentioned Viela Bio. But then they were acquired by Horizon out of Ireland, and then Horizon was just acquired by Amgen. So now we have Amgen in our region, which is great, and some of those people that started all the way back in the MedImmune days are still associated with Amgen now, which sort of helps build that continuity, which you need within a region. But it's also nice to know that Amgen thought enough about this region not to move Horizon and Viela out of the region, and keep it here because of all the connectivity and the assets we have in this region for them to collaborate with.

0:33:06

Mike Tarlov: Yeah, I was aware of that. So actually right now, I'm sitting in the Institute for Bioscience and Biotechnology Research, IBBR. And that's literally a stone's throw away from two big new buildings that are going up. And I know, well, Horizon was originally slated to go in there. And I would look

forward to Amgen hanging their shingle outside that building, because it would be great to have a local partner like that. I mean, we've actually interacted a lot with Amgen in a number of areas. But certainly that would be a real feather in our cap to have an Amgen in this area.

Rich Bendis: You know what's funny is that Ike Leggett, who is the county executive, help create BioHealth Innovation.

0:33:58 His daughter Yaminah Leggett-Wells, was at MedImmune, and she survived through AstraZeneca, Viela, Horizon, and now she's at Amgen, and involved in doing partnerships. So you might end up doing some partnerships with Yaminah Leggett-Wells, whose father was very instrumental in really helping shape the Montgomery County area as one of the leading biopharma regions in the United States. And I think through the Health Computing Institute, we're talking about a partnership there around commercialization of health computing, things that might spin out of the university, as well as some of the innovation that's going on there. And that might enable BHI and the Institute and NIST to actually be working together someday, which I would hope.

Mike Tarlov: I think that that's all something that we're considering, and I think would be of benefit to NIST, this region, and the rest of the country.

Rich Bendis: I would agree. So let's talk about the future.

0:35:00 We've talked about the past, some of the good work that's going on. Tell me about what you see as some of the future for your division, for NIST, and things that you would like to see NIST get involved in in the future.

Mike Tarlov: Certainly, I think we will continue to work in the biopharmaceutical space. When you look at biotech, biopharma is the biggest part of biotech, and a lot of it is still evolving. But biopharma is a very important stakeholder and customer, so we will continue in that area. And certainly, you mentioned it earlier, there's really a lot of exciting work involving emerging modalities, like viral vectors for gene therapy, cell therapies that have shown the ability to do things like actually cure cancer, lipid nanoparticles, mRNA.

0:36:00 Going back to the original thing that we saw in this space was it's hard to define by measurement these products, and the products are only getting more complex. A viral vector is 500 times bigger than a

monoclonal antibody and a living cell as a therapeutic. And so certainly we've only begun to really scratch the surface, I think, in understanding the complexity of those products, and being able to accurately, reproducibly characterize and measure them. So there's going to be a lot of future work. And certainly this area is a hotbed for cell and gene therapies. You mentioned there's a lot of start-ups in that area, and that makes us pretty excited to be able to potentially work with them. With that said, we are keeping our eye out on—I call it the other biotechnology. You know, this is biotechnology that might be used for chemical production, agriculture, climate science, food.

0:37:02 There's certainly a lot of interest in that area, it's nascent, but we're keeping our eye on that. That's been identified as an important part of the administration's recent bioeconomy executive order, and calling for greater federal private-academic partnerships in that area to advance those emerging technologies.

Rich Bendis: I think NIST has been a role model for private-public partnerships with a number of their initiatives. And I mentioned the Manufacturing Extension Partnership. There's like 67 different extension centers around the United States that are all private-public partnerships. And you have the NIIMBL program now, which involves some private-public partnerships with the Institute Manufacturing Biopharmaceuticals. So I think that NIST gets it, how important it is to reach out and have industry as a partner.

0:37:59 But, for the listeners, as we come close to closing this edition of *BioTalk*, Mike, is there anything that you want the listeners to know about NIST or your program that we haven't talked about yet, or is there any call to action you'd like to challenge them with?

Mike Tarlov: I hope I got across the point that I think NIST is a real asset, not only to the local community here but the national biotech community. We have a history of working closely with industry partners to solve their problems, not necessarily our problems, and we just look forward to working with the community more to advance all the things that are happening in the biotechnology space.

Rich Bendis: So I think the key would be is that it's taken me seven years to interview somebody from NIST, but we shouldn't wait another seven years because of the important work you're doing, Mike.

0:39:00 So I think as we identify some of these new private-public partnerships that are emerging, I'd like to bring a lot more information related to those to the listeners, and also engage them to get involved with you.

Mike Tarlov: I've been in this for 37 years, and a big reason why I've stayed is certainly the people. I love working with the people. And the expertise that the people have, it's so diverse and interdisciplinary. We have expertise in biochemistry, biology, physics, materials science, and things that you may not necessarily think would be applicable to biopharmaceuticals. But, like, we have a neutron scattering center, which is an example of one of the unique resources that NIST has.

0:39:53 And it turns out that a lot of very important fundamental and applied research has been done with that facility for biopharmaceutical products, ranging from looking at monoclonal antibody formulations to the lipid nanoparticle mRNA vaccines. So a lot of exciting things happening at NIST that are applicable to the biotech space.

Rich Bendis: Well, we want to thank you for your 37 years of service to NIST, Mike, and hopefully there's another 37 there. But you need to take a break sometime. But we've had Michael Tarlov, the Chief, Biomolecular Measurement Division, Material Measurement Laboratory with NIST, as our guest today. I've learned a lot through this discussion. I hope the listeners have as well. And I think it's just the beginning of us continuing to educate the people within this community and nationally about how important the role is that NIST plays within the biopharmaceutical industry, and many industries that you participate in. So thank you for being on *BioTalk* today, Michael.

0:40:59

Mike Tarlov: OK, Rich, it was great talking with you today. Thanks for having me on. I really appreciate it.

Narrator: Thanks for listening to *BioTalk* with Rich Bendis.

End of recording