Tanya Domi:

Hi, this is Tanya Domi. Welcome to The Thought Project recorded at the Graduate Center of the City University of New York, fostering groundbreaking research and scholarship in the arts, social sciences, and sciences. In this space, we talk with faculty and doctoral students about the big thinking and big ideas generating cutting edge research, informing New Yorkers and the world.

Tanya Domi:

Rein Ulijn joined the CUNY family in 2014 as director of the Advanced Science Research Center's nanoscience initiative, and as Einstein Professor of Chemistry at Hunter college. In 2019, he added another title director of the ASRC Sensor, Center for Advanced Technology. When he won a highly competitive bid for the ASRC to become one of 15 centers for advanced technology, designated and funded by New York State, his multiple hats mean on any given day Ulijn might be found overseeing research in his own lab, the Ulijn Group and consulting with ASRC Nanoscience Initiative faculty teaching an undergraduate course at Hunter or working to advance the ASRC Sensor CAT's goal of growing the sensor technology industry and workforce in New York State. While his work spans a wide range of activities, Ulijn believes they are all integral to his career as a scientist and commitment to growing the graduate center's goal of driving science for the public good.

Tanya Domi:

Prior to joining the graduate center, Ulijn was professor of nanochemistry at University of Strathclyde in Glasgow, UK, where he also received his PhD in chemistry. Rein Ulijn is here today with us to talk about some fascinating work that is taking place at the Advanced Science Research Center nanoscience labs and how the Sensor CAT is working to create jobs in New York State and bring cutting edge technologies to market. Also joining us today is my colleague, Shawn Rhea, who leads the graduate center's science media work and engagement. Welcome to The Thought Project, Rein Ulijn.

Rein Ulijn:

Thank you very much. It's a pleasure to be here.

Shawn Rhea:

So Rein, maybe a good place for us to start would be giving our listeners an understanding of your field of science. What I understand is that nanoscience is really cutting edge in terms of manipulating on a very small scale, the chemical elements of materials found in nature. And by doing that, you all are able to create totally new ones that can be used in everything from medicine to industry or even for environmental purposes. Can you give us a quick layman's primer on what exactly is meant when we talk about materials and the scale at which you work?

Rein Ulijn:

Yes, absolutely. Thank you for that question. Nanoscience is actually everywhere right now. It's touching upon our everyday lives, let's give you two quick examples, the iPhone 12 has nanoscale transistors. So these are tiny transistors that enabled these phones to work incredibly fast, to be incredibly powerful and perhaps more topical. The coronavirus vaccines are actually nanoscale particles, thus contain a biological code, the functional piece, but then they're embedded within a lipid particle that enables that biological code would be delivered where it's needed in the body to allow the body to become immune.

Rein Ulijn:

So the point here is that nanoscience is very diverse. It ranges from iPhone components to coronavirus vaccines. What it has in common is actually a size range. So where this field of science is very different from something like chemistry or biology or physics, is that the connecting aspect is a size range, a size range where interesting physics happens, the size range for biology becomes functional and a size range that's hard to engineer, but where you can get really interesting new properties out of materials.

Shawn Rhea:

So that's really interesting and I think for many of us lay people, it totally redefines how we think of materials, right? We typically tend to think of it as very tactile things, but you're working at a much smaller scale and the materials could literally be a particle that we typically think of coming in liquid form or particle that we typically think of coming in on a hard form.

Rein Ulijn:

So you have basically the entire range of those properties available. Of course you can't see these things with the naked eye, but another feature of this is that it translates across lens scales. So events that happen at the nanoscale where you can't see them ultimately translate into events that happen at the microscopic scale. So it's very much about not just engineering on the nanoscale, but also understanding how it impacts on things that happen in our everyday lives around us.

Tanya Domi:

So I know that your lab has been working for the past couple of years to create synthetic melanin. And in fact was featured on NPR's Science Friday program when you had your initial big breakthrough a few years ago, does the term synthetic melanin refer to the range of human skin pigments that we typically think about when we hear that word? Or is it something slightly different?

Rein Ulijn:

Yeah, that's a great question. Thank you. So the melanin example illustrates really well, a common way of working in nanotechnology. You look at biology, identify a material or function of interest, figure out it how it's works and then basically tame it essentially and make it your own so it can become engineerable. And the melanin example is exactly that. So this started off by us being intrigued by this material which provides us with protection. So melanin is to protect a function and living systems. It protects against UV radiation, against [crosstalk 00:06:31]

Tanya Domi:

Like sunscreens.

Rein Ulijn:

Things like that. Yes. And so can you make a biological version of that? So that was that first big breakthrough that you refer to, and that was at the time we be patented this, and this is now being considered as an additive to certain cosmetics to provide it with a UV radiation protection. You look at biology, you copy an idea and then apply it in a way that's similar to what it was intended for, but what you can also do once you figure out how these things work, you can also take it further and take it outside what biology does. So I'll give you a couple of-

Tanya Domi:

For other applications, right?

Rein Ulijn:

Yes, exactly. So for example, we learned that melanins can be conducting so they can be electronically conducting wires, for example, biodegradable electronics that you may want to consider for use in contact with the body or inside the body, even. So devices that report on the events that happen in the body, diagnostic devices, if there could be biodegradable, that would be very helpful.

Tanya Domi:

Pacemaker, possibly?

Rein Ulijn:

For example, components of things like that. So that is something that engineering is only possible by understanding in a lot of detail how these materials work and another example, I mean, melanins are of course known as pigments. So there's an aesthetic function as well as a protective function. And we played around with that idea a little bit as well figuring out it's how you get the pigmentation stuff we were familiar with from biology and then going a step further and actually making new colors. So we recently published on a whole range of colors that could be achieved, that are actually not known in biology. And again, these could be useful in sensing applications in detecting of various metabolites. So yes, that hopefully illustrates how you take an idea from biology, learn how it works and then engineer it further and use it in different contexts.

Shawn Rhea:

Wow, that's really fascinating. It truly, truly is. Particularly when you talk about new colors. Maybe we can shift gears a little bit now and talk about the ASRC Sensor CAT or the Center for Advanced Technology, which we're really excited about here at the graduate center, from what I've learned about the CAT, it's focused on developing sensor technologies that have a broad range of uses things such as monitoring the environment or as components in medical devices, or even as a way of automating some aspects of manufacturing. And this all really sounds like the next level of smart technology. How has the ASRC Sensor CAT enabling this work in New York City and the state?

Rein Ulijn:

Thank you for that. So we're super excited to have the Center for Advanced Technologies at the ASRC as you mentioned, sensor technology touches upon many areas, medical devices, environmental sensing, and it's booming. If you think about like you as a person, you're probably wearing some sensor technology right now. Exactly smartwatches. Yes. And these are becoming smarter and smarter, right? So they can give us more and more information about us and our environments. And it's not just people, we want to know what happens in the city. We want to know how our environments impacts our health as many levels as possible and get sensors also to talk to each other and really give a full picture of what goes on in our environment. So it's booming. It's also getting increasingly complex. I mean, there's all great ideas out there, but if you want to develop a new sensor technology, you need access to high-end facilities.

Rein Ulijn:

You need to have access to very expensive, complicated equipment. And the advanced science research center is exactly a hub for this type of stuff. We have 15 core facilities that are highly specialized and are exactly there to allow for high-end experiments to be performed. So many small companies won't have access to that type of equipment. And that's where the CAT comes in. So the CAs can give these companies grant to come and work in the facilities. And this may sometimes be just access to the facilities. It could also be working with the CUNY professor who happens to be an expert in one of the areas they want to get involved with. So we have a fantastic ecosystem within CUNY, very large number of very smart people who work on technology that is often relevant to sensors. And within the ASRC itself, you have these core facilities, but also experts in biomedicine, experts in environmental science.

Rein Ulijn:

So within one building you can develop and test sensor technology. So it's very well set up for that. We spend a lot of time on workforce development and basically getting our students much more savvy about entrepreneurship, not just being a STEM researcher and inventing something new, but also understanding how this might impact on the city, on society and how it might also provide economic impact. So forming a company, licensing the technology. So all of that, it's becoming a much more seamless system of innovation and application. So we sometimes say the CAT is a catalyst for that type of development. So we hope that it can help to trigger a really a boom in sensor development in New York City.

Shawn Rhea:

Yeah, that's really interesting. And we know that one of the chancellor's main focuses is on workforce development. It sounds like this really kind of fits right in with some of those major priorities.

Rein Ulijn:

I completely agree. I just wanted to add is that especially in STEM, there is a lot of development needed there. So workforce development is big in CUNY already, but in STEM, there are now some really, really exciting opportunities to get our students to think more entrepreneurial to form companies to help with also with the post pandemic recovery.

Shawn Rhea:

Yeah. And on that note, I mean, I think you're kind of leading right in the direction that I was hoping the conversation would go. And I know that CAT was launched just a little less than a year ago on the heels of COVID. And the first request for funding proposals was last April in response to the COVID-19 pandemic. So maybe you can tell us a little bit about the aims of that call and I guess more excitingly about some of the companies that you've been able to work with.

Rein Ulijn:

Yeah. As you said, the CAT indeed started off last year, early 2020. We hired our business development director. Soon after he started, we had to close our doors. So it was a bit like, "Okay, what now?" And it turned out to actually be a good opportunity for us because we were getting to know some companies, we could see that companies were struggling to think about what to do next. And we really felt that the CAT could maybe play a role there. Companies turned out to be very agile in trying to find ways in which they could repurpose their technology to potentially address some aspects of the COVID crisis. And that's exactly what we then turned out doing. So we had this call where we asked small companies to

come up with ways of which they could pivot essentially their technology to help with the COVID pandemic.

Rein Ulijn:

At that time we were thinking a lot about what would New York look like when we come back and what is needed for that safe return to normality. So we had a lot of interest from a number of companies, and it's varied from things like re-purposing a technology that was previously developed for Zika virus detection. Re-purposing that for the coronavirus detection, we had other technologies that focused on self cleaning surfaces. So clearly with a lot of high touch surfaces, for example, in the New York subway, this technology was then something that could potentially be scaled and be applied to high touch surfaces so that they decontaminate themselves.

Rein Ulijn:

We had also a company that's developing spectroscopy to do diagnostics. And again, now pivoting to detect the virus. So I think it's helped in a number of ways because as the city closed down, we could still keep some of our activities open for COVID specific research. It's helped with the recovery, but it's also helped these companies to be able to continue their work. And it told us a lot about how agile these companies can be. And the response was really quite phenomenal at that time. So it was in the end, a very interesting way to get the CAT launched.

Shawn Rhea:

So can you share with us how many companies you've been able to work with through that call? Or is that something that's still [crosstalk 00:16:12]

Rein Ulijn:

At that time we worked with, I think it was six or seven companies who were involved in the call and we've managed to fund four of those. Others we're working with, so it was a good way to kickstart things.

Shawn Rhea:

Yeah, no, that's amazing. Along those lines, I have one other question and why do you think CUNY is such a great fit for a workforce development partnership with the state in the sciences?

Rein Ulijn:

Yeah. CUNY is really New York City's workforce development machine. If you think about it, most good CUNY students are local. Those could be a very large number of them. And my understanding is that about 80% of them actually end up working in the city. So they really are the workforce. And what we are hearing from some larger companies or smaller companies is that the community product is great, but they're not always ready to join the workforce. And that's basically what we're trying to do, try to meet these companies a little bit earlier.

Rein Ulijn:

So that's not just us trying to train our students to become more entrepreneurship savvy or industry aware, but also bring the companies in and bring the companies in to help us to make our students more ready. At the moment, actually, we're developing a new course together with colleagues from

Baruch and the business school within the graduate center to do a joint science and entrepreneurship course, that is actually an extremely good match and dissolve from science and engineering students to learn how this would work, because we're really good at prepping them for careers in academia but the reality is that nine out of 10 don't end up in academia.

Rein Ulijn:

So the CAT can also really help with this. And yeah, and our job is to a large extent to make sure that young people succeed and we propel them up and do great things. And we feel we can help them a little bit and also help New York as a whole to become more STEM savvy, and more connected to technology.

Tanya Domi:

So, I mean, this is such a huge feather in the ASRC's [inaudible 00:18:29], this great grant that you're leading and working in multiple ways across the city within CUNY. I mean, of course with the business school, that's really synergistic how it's operating in. You're creating knowledge and helping young people develop these STEM skills so that they can go out into the world and prove the world. So a big part of this mission is workforce development. And so, you've been able to partner with outreach programs and core laboratories at the ASRC to begin offering career track and skills training opportunities to not only graduate students, but also undergrads and even high school students. Can you tell us about that project and how exciting that is for the city and for CUNY in particular?

Rein Ulijn:

This is all I guess, related to pipeline that if we want-

Tanya Domi:

CUNY Pipeline Program.

Rein Ulijn:

Yeah. Well more in a general sense, not a specific... So the idea that you get students interested interested at an early age. What I've certainly learned is that young people who are good at science often end up thinking about medical school first as a really good application of science and I'm absolutely not saying that that isn't a great trajectory for a young person who likes science, but it's not always understood that being a scientist can be very interesting and important and fulfilling career. And especially if you combine it with entrepreneurship, I mean, there's nothing greater than inventing something and then starting a company and see this whole thing develop. I mean, and I think that awareness is not always there. So that's something that we want to catch students early.

Rein Ulijn:

So that's why we have also a focus on high school. And we often do this in partnership. So we work a lot with the World Science Festival. So I was involved in a project where we worked with students from across the world, high school students who are very good at math and basically share with them some ideas of what can be done outside math, or how math can be applied to different scientific disciplines. We work with Kendra Krueger and Ricardo Toledo-Crow, colleagues in the ASRC to develop, what they call a citizen's science sensor lab. And what that is, is basically you can build quite simple sensors that give you information about your environment. For example, a carbon dioxide sensor that can be built at

home from simple components, and actually allow you to do measurements that will tell you something about your environment.

Rein Ulijn:

This turns out to be very, very powerful, because you can build it and learn about the engineering of that. And then you can also apply and actually get data to tell you something about your environment. You have a whole bunch of these people doing this together, and you can start to map certain parameters like CO2 or anything else in a particular area neighborhood environment. So it's a very interesting way to get people comfortable with science by doing it themselves. So that is a program that we do collaboratively.

Rein Ulijn:

So the CAT is able to co-fund some of this. At other levels we do for undergraduates, we do a lot of matchmaking. So there's a lot of opportunities for placements or secondments to industry. And we play a role there in matchmaking, like finding the right companies, finding the students who can can basically do these projects, have those interests. And then at the graduate level, we do a lot of training. So basically skills training that make the students more attractive to industry. So it's really a whole raft of training opportunities that range all the way from high school to our community colleges, four year colleges and grad school eventually.

Shawn Rhea:

So lots of entry levels, lots of entry point for young people.

Tanya Domi:

Well that's a very good news story. And also how this money can be used to train and energize young people and then create a synergism with the local economy. It's a great project. So we thank you for coming on to the show today, Rein and we will spread the word. And I know the chancellor cares very much about this project. There's a lot of interest in it. And the president, of course, being a scientist, she cares about it. So we help get heavy back on as the CAT grant proceeds and you're able to do more and be able to talk about it to the public.

Rein Ulijn:

Well, thanks very much.

Tanya Domi:

Thanks for tuning into The Thought Project and thanks to our guest, Professor Rein Ulijn, director of the Advanced Science Research Centers, Nanoscience Initiative and the Einstein Professor of Chemistry at Hunter College CUNY, The Thought Project is brought to you with production engineering and technical assistance by Kevin Wolfe of CUNY TV. I'm Tanya Domi. Tune in next week.