
BATTERY & STORAGE: UNLEASHING THE POTENTIAL OF 3D-PRINTED BATTERY TECHNOLOGY WITH ARWED NIESTROJ OF SAKUU
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Bill Derasmo:

Hello, welcome back to the Troutman Pepper Battery + Storage podcast. I'm very pleased today to be spending some time with Arwed Niestroj. Arwed, welcome to the program.

Arwed Niestroj:

Thank you very much, Bill, for having me. It's a pleasure to be here.

Bill Derasmo:

Great. Well, Arwed, you're the senior vice president of E-Mobility and Product at Sakuu Corporation. You've had a very distinguished career, a lot of leadership positions. You were the former CEO of Mercedes-Benz Research and Development North America. You've had a lot of other advisory board and senior executive positions at a number of other companies. Why don't you just tell me a little bit about yourself and our audience about how you came to be at Sakuu?

Arwed Niestroj:

Yes, sure. Thank you. I've always been a technology guy. I studied nuclear physics actually at the beginning and then got into a very interesting program at my employer Mercedes-Benz right after studying. And I always urged towards the technology part of the business, which is research and development and also very much electric vehicles. So after my first year in the company back in 2007, I actually started getting engaged in developing electric powertrains, hybrids and fuel cell powertrains, electric motors and that brought me also to starting to leading companies like a joint venture that I did of Mercedes and Bosch back in Germany. And then the role that you just mentioned in the U.S. overseeing all the R&D activities of Mercedes-Benz in the United States. So always been excited about mobility, about bringing new technology to the market and the more sustainable, the better. So I'm glad that coming from the internal combustion engine path, I have spent my last 15 years in electric vehicles and electric propulsion.

And having be done these entrepreneurial roles in the last two bigger assignments, I turned and follow the call back to Germany that came at some point and say, technology is exciting. And at that time Silicon Valley was at its peak with autonomous driving and electrification and starting artificial intelligence into vehicles. And at that time I thought if I ever want to do something more entrepreneurial and not go back and lead a department at Mercedes, now is the time. So I remained in the United States, did one role at another car company in automotive tier one for a year, and then made the jump into the exciting startup world and joined Sakuu.

Bill Derasmo:

Well, tell me about Sakuu in particular. I mean I know you've got, based on our pre going on the air conversations, but you got a lot of exciting things going on. You talked about lithium metal anode. And why is lithium metal anode so important? Where would you fit in terms of your lithium metal anode, where you would deploy that technology and approach?

Arwed Niestroj:

Yeah, let me first maybe say a few sentences about Sakuu because it is a pretty unique setup. So Sakuu is an additive manufacturing technology and also a battery company. So we have developed an additive manufacturing technology, which you could also call it 3D printing. It's an industrial speed technology, very important that can print batteries at lower cost and lower capital expenditure and also more performant batteries. That is the key because we're convinced we need a leap frog in the manufacturing technology to get to better batteries all over the place. And lithium metal batteries are one of these things. So we also developed a lithium metal anode battery technology because in battery manufacturing, I think most of the audience knows, manufacturing comes very close together with development. You cannot do one without the other because the battery is a very complex device.

So we developed this lithium anode and lithium metal as it is the densest form of lithium and the highest energy serves to make a very energy dense battery. Very energy dense battery means you need less volume, you need less weight to put energy into a certain volume or space. So this really applies to applications where energy density is key, which can be electric mobility vehicles, motorcycles, any applications like those. And on the gravity metrics side, the weight side, any battery that should be very light, which is very important for example in aerospace applications or even very small applications if we look at wearables where the form and shape is also very important. So our 3D printing technology can actually make batteries in any form and shape, not just rectangular or cylindrical.

When you 3D print batteries, you can decide where you deposit material and make a battery that is not rectangular. For example, imagine a battery for a VR headset that you wear on your head the battery, you should rather be formed according to the form of your head so which is a round shape and there's nothing you can really do very efficiently with today's batteries. But you can do it very volume efficiently with printing and you can immediately achieve 30, 40% higher energy density just by providing the form that the product needs.

Bill Derasmo:

Yeah. When you think of high energy density and you think of lighter weight and all that, of course you gravitate towards the e-mobility sector and that's your field. And so it sounds like you guys have a cutting edge product. And you talked about motorcycles that need to rev up very quickly. You talked about other types of e-mobility, aerospace applications. That seems to be where you guys are going to fit. It sounds like you basically have two ways to think about it. One is that you have a manufacturing process, you talked about 3D printing, and then in addition to that you have a proprietary battery chemistry. So you've got two ways to come at it to customers. I don't know if you want to just expand upon that. If somebody was interested in doing business with you, how would you approach that conversation?

Arwed Niestroj:

The bigger and long term activity of us is really enabling our customers to manufacture batteries in a better way with our additive manufacturing technology. That is the key of the company's focus. And that technology allows to make batteries needing less capital expenditure, needing less footprint, having less material waste, needing less energy. All of these advantages you can only generate by changing from today's role to role manufacturing process into an additive manufacturing process. Of course it has to be fast and that's what our process provides, the right speed.

Now since we of course want to prove that this is possible, we have also put some effort into developing a battery chemistry and this is our lithium metal battery, we call it Cypress, the current generation. And this is a battery chemistry we license to anyone who is interested in it. And as we just touched on before, that's a lithium metal anode, which has its strength in low volume and a lot of energy, low weight and good energy. And it's one of the first safe lithium metal batteries that are available at all and this really applies to energy applications. So this is licensable.

What we are focusing though on at Sakuu is to keep bringing our customers ideas what to manufacture onto our manufacturing platform. So the customer comes and says, "I want to print a battery that has graphite anode, silicon graphite anode and a use of the shell cathode or even a solid state battery. Then this is possible to make with our manufacturing technology. We are capable of adapting the material so that it works in our active manufacturing platform. And then we would provide to customers the printers which are very easy to scale. Imagine it's like a server farm where you add servers as you build the production volume. For us it would be adding additive manufacturing platforms as you grow the size and throughput of your factory.

Bill Derasmo:

Well, it's a cliché to say, but you guys really... I've interviewed a lot of new company representatives, entrepreneurs, people who are doing a lot of really interesting things in this emerging battery space. And you guys really do come at this in a different way from people we previously had on the program. And basically what you're saying is forget about where you're going to locate your battery factory or we're going to do this with our battery factory. You're basically saying, "Look, we will help you design your manufacturing process. We will help you to figure out how to manufacture what you want to manufacture." It's basically what you're saying. As you said earlier, 3D printing is another way to put it. And you guys are there to help others produce their proprietary batteries, I suppose.

Arwed Niestroj:

Yes, absolutely. And so we don't consider the existing and upcoming battery companies as real competitors. We can enable them. And let me explain a little bit why this is because, for example, additive manufacturing allows to create thinner layers than you could do in a roll to roll process. It allows to create better interfaces than it is possible in the row to row process. You are certainly aware that today batteries are made from different components and you put them together and then you need liquid electrolyte to make it work. But liquid electrolyte has its flammability challenges. So if you do this in an additive manufacturing process, you can avoid some of these challenges. You can define the interface between the layers, much, much more controlled manner than you can do with row to row. You put material only where you need it so you don't have this cutaway waste that you see today in row to row manufacturing.

So there's many perspectives to look at it and it really brings advantages to the game that apply to batteries, and that's key. The additive manufacturing process is a multi-material and multi-process solution. So we are capable of using the right additive manufacturing process and there's a bunch of them for the right layer, which has maybe different thickness requirements, different speed requirements, the amount of material you want to put down and choosing the right process for the right layer at the right speed at the right composition and the right order for the battery, putting all this together makes it at the end a superior battery and most of our superior process.

Bill Derasmo:

Well, it seems like it has superiority in a couple different ways. One would be efficiency from an economic perspective, but also from an environmental perspective. And another would be flexibility. Because the customer can come to you and say, "I want to do this a certain way." You can work with them to meet whatever customization they're trying to meet. So it seems like there's a lot of advantages to your approach.

Arwed Niestroj:

See, it's actually in the long run, not even us being needed by the customer, but the customer can decide without a tool change, without changing the line, to print a certain set of batteries in the morning and a different set of batteries in the afternoon.

Because everything now in additive manufacturing is digitally controlled. So you have typically your printer bed size, not like in row to row where you have a certain width of the material you code, but now you have a bed size rectangular or square depending on how you want it. And then you decide I put either 10 batteries in the space which are rectangular, or I make 15 in a certain, let's say VR headset say, which is more banana type. And I can do this without tool change. Now I can do this without actually changing my line. And that's a flexibility you don't have today. And we see this ourselves in our pilot line. We have a pilot line for a 3D printing and we have a pilot line for conventional. And conventional just does not have the flexibility. So we enable the customer to be even more flexible down the road by choosing material, choosing chemistry, and choosing the shape and form of the battery every time they decide to print the battery.

Bill Derasmo:

Have you been in conversations with the OEMs, automobile companies?

Arwed Niestroj:

When the automotive world where I come from, everybody talks to everybody anyway all the time.

Bill Derasmo:

Sure.

Arwed Niestroj:

Yes, of course we've been sampling batteries. Of course, not only through my network when most of the team is from the semiconductor space, and I'm really impressed by how the challenges of material science are controlled in a semiconductor driven and created manufacturing approach. It's very different from automotive assembly. So yeah, we are talking to various partners in the consumer industry. We're sampling sales to the automotive industry to electric motorcycle to energy storage partners all across the board.

Bill Derasmo:

That prior question is what we call in the legal profession, a leading question because I kind of just opening the door for you to talk about what I suspected was happening. But because of your target audience naturally I think would include all those companies. Let's switch gears for a second and just

talk about the corporate for a second. In March of 2023, Sakuu announced that it was going to combine with Plum in a SPAC transaction. And understanding that there's some sensitivities around that right now because it's not consummated, maybe you could just tell the audience a little bit about where they might learn about that transaction and what the advantages of it are.

Arwed Niestroj:

So of course, trans scaling our solution and bringing it out to customers and accelerating the remaining development work. We're happy to have found the partner Plum Acquisition Corporation. As you can see from the information that has been shared on our website and the investor section, a great team to work with us. They themselves have big experience in not only building startups but also in the additive manufacturing space. And of course we are now following through the process that is needed for executing on a SPAC and all the details, evaluation, everything can be found in our investor presentation online. For us, it's a great step to be able to accelerate and really scale like we have planned to do. And of course in current investing and economic situation, that's a very good partnership that we were able to build here.

Bill Derasmo:

Good to hear about. I mean, I understand from talking to other people who I've had on the podcast just about how much time they spend trying to essentially fundraise. Trying to go out to the investor community, private equity community. But we've also had some companies that have gone a similar route through a SPAC transaction. So to me it's always interesting and I think to our audience to hear how different companies are approaching that part of the business because a lot of times we'll have someone like yourself who has brilliant technical background, also, obviously, you got a great business background, but I like to get the people who like to build things and make things also talking about the part about the money, where the money comes in. So it's really interesting.

Arwed Niestroj:

Yeah, this is my first startup and I think it's the big one and the most exciting one. I've seen many startups in my CEO, Mercedes CEO role. Looked at certainly at least a hundred of them. And this was the one I said, "This is where I got to be." Because the technology is so disrupting, it's going to change a lot. Of course as a startup, there's all the sources of funding that people are looking for and there's many factors that come into it. Do you choose the SPAC or do you not choose the SPAC or do you just go through your series ABC fundraising? And of course the current economic situation is very important, right? I mean at the moment, of course economic situation is very dire and difficult. So it's even more important to do the right thing in managing your current resources, but also do the right thing in finding the best partners. And there is no easy recipe to this. Definitely SPAC is one of them, but we've also seen SPAC comes with some additional regulation because not every SPAC was meant to be. So at the end it all comes down to how can I make my technology become available and put it into the market and really achieve what we want achieve with the new technology we have created. But there's no easy recipe to this. And I think after fundraising is before fundraising. That's how it is in the startup world.

Bill Derasmo:

And I know you have a role to play within your company and you've got a chief business officer, you've got a chief legal officer. I'm looking at your roster of executives. So I know probably a lot of people were

involved in the discussions that led up to the decision to work with Plum and to go the route that you've gone. But just tell me for a second, because I'm always interested in this, just how different thought processes work. How is your day different when you know have to focus on that side of it, the investor side versus probably the side that I'm guessing is your first love, which is the product development side. How do you kind of switch off your brain and think, "Okay, this is what we're doing today." Or sort of like elevator speech mode versus when you're working on say product development?

Arwed Niestroj:

Setting up the different roles in the organization. Of course you have somebody who's focused on, let's call it marketing, investor relations that is close to marketing towards customer, also very close to marketing towards investors. It's not a big difference because we're talking about the same things. The same goes on the product responsibility side. I've been responsible for most of the products for some time now I'm looking more at battery systems, which is important because customers want battery solutions, not just one cell.

So I'm looking at these solutions, but I'm also taking investors, give them a tour around the lab and show the printing platform because explaining to them what the key differences are, makes more sense on a technical basis than it does on a purely business or marketing base. And obviously many customers and investors arrive bringing their, for example, their battery chemists, the battery expert next to the business people. And then to be convincing and to show what is different, you have to provide technical expertise also to the discussion. And excitingly, this always repeats in our company, people come in with a certain idea and ask the conventional battery questions they would always ask. And then they notice, oh, this is a different approach. The manufacturing is different, the battery technology is a bit different. So it takes time for most visitors to change their questions so that they really would apply.

Bill Derasmo:

And I think if we're being fair, I think that's the process that I just went through today because I came to the thinking a certain way and then it took a conversation to say, okay, now I understand how you guys are very different from the other people that I've interviewed on this program over the last few years. Very interesting story. You guys really do occupy a unique space, certainly within the community that we've been moving.

Arwed Niestroj:

And it is. I also, for myself coming here, I noticed it really is the meeting of material science, of battery know-how, battery electrochemistry and additive manufacturing. Now if you imagine you go out to battery companies, they don't have additive manufacturing groups. You go to additive manufacturing companies, they don't have battery groups. Putting these three things together is really unique and that makes us so different and gives us, of course, a good headway to others because you first have to bring these people together and all be convinced that there is something new to be done. And that's what we have done. It is definitely very, very unique.

Bill Derasmo:

That's sort of the secret soft point, right? And that's the point I think you were saying. When you have investors come in and you have to show them the work that you're doing, and the real nitty gritty of it is because if you're at this stage of development, the investor is looking for, "Okay, what makes these folks

different? Why am I going to put my money with them as opposed to X company, Y company, Z company." You really do have to get into... I understand your answer. In other words, the question I asked about how do you kind of change your mindset? Well, it sounds like what you're saying is you don't really change it. You still have to talk about the same things and explain it.

Arwed Niestroj:

I think every day what you do as a manager, as an executive, right, you have different audiences, different, let's say perspectives, how you package the information you provide. But this is in a professional environment. When you talk to all levels, that's everyday business. You have to talk to the right people with the right message.

And let me give one interesting future outlook. We're talking about battery now and supplying manufacturing technology to print batteries. It does not only apply to batteries, it is a multi-material, multi-process manufacturing technology. And we decided to go for battery first because once we can print battery, all the rest is easy. So imagine printing any device that consists of, let's say for example, ceramic and metals like micro reactors or micro fluidic devices or antennas. All of these devices are further out in our schedule because the manufacturing technology we have also allows to print those.

Imagine so far as the manufacturing prints typically one object out of one material, like a metal object or polymer object and that's it. But we are combining materials. So we are printing ceramic with metal, with polymer in an arbitrary shape and form. And this becomes an active device. So we are saying we are printing active devices rather than just objects. And the battery is certainly the highest discipline in doing this because it has electrochemical and electrical and mechanical components. But looking into the future, we definitely want to also, once battery is running, we want to put a little bit more focus on the other aspects.

Bill Derasmo:

Well, you mentioned ceramics, and I know from my college days I had some friends who were engineers who had gotten very into the ceramic engineering aspects. And I know from those folks, this is a long time ago, I don't want to age myself, but they were involved with aerospace. And so I always find that interesting when I hear ceramics mentioned. I don't know if you could talk about that for a second, just as a pet interest of mine.

Arwed Niestroj:

Yes, of course. And that's actually a very good segue to also talk a little bit about solid state batteries. That's where ceramic mostly comes in when you want to create solid state batteries. Now in general, the applications you are just mentioning, aerospace, ceramic is light and it's very heat resistant, right? That's the two things which make it great for aerospace. Now, at the same time, it is one of the candidate materials to deliver the promises of solid state batteries.

And that's again where our experience tells us, having been 3D printing batteries for many years now, that with such a material like ceramics and the possibility to 3D print, which means add material to such a ceramic, you again have a much better control of how you create interfaces. Because many companies today working on solid state, they struggle with creating a good interface. Firstly, the materials of course challenge how they make it very conductive and very thin, like 10 micron or even thinner, what everybody wants. Because if it's so thin, it's hard to handle. If you use additive manufacturing though, you have different options. You can put it on another layer that's part of the battery, you don't have to

handle it freely and you can define the interface better. So there's many ways where additive manufacturing also with regards to ceramic has its advantages. Of course, one of the paths we are also strongly working on, which is solid state battery, we're not yet announcing anything on this, but this is part of our plan.

Bill Derasmo:

Oh, come on, we've got to break news here. You got to announce the solid state initiative

Arwed Niestroj:

Not during this back process.

Bill Derasmo:

Just kidding. I'd be remiss as an attorney if I didn't ask about your colleague Edward Lopez, who's your chief legal officer, and what keeps him busy these days? I assume a lot of intellectual property, patents, other IP. If you could just talk a little bit what's keeping you guys busy on the legal front, because that's part of our audience too.

Arwed Niestroj:

Well, I never had that question in my career so far. Okay. So definitely I think all the legal aspects of a SPAC and an upcoming SPAC certainly give a good list of tasks and assignments to him. He's doing very well working on those. On the other hand, of course, our IP portfolio is very good. We have, I think now 27 granted patents, but more than 90 are in the process.

Bill Derasmo:

Oh wow.

Arwed Niestroj:

And even more importantly, and interestingly, we have a lot of trade secrets or more than 120. So if you look at what we do, it very much comes down to material science to make the battery material work in the 3D printer. And this know how is not necessarily reversed engineerable from the final product. So you don't want to patent everything just to have a patent if you have a key know how that is unique and that cannot be reverse engineered. You may rather keep it at the trade secret and keep your advantage hidden from competitors, or we have a lot of those accumulated over time, to make sure that we are really at the forefront than we don't see anybody doing something similar. So very, a good IP portfolio, very active on that. Very good team bringing new ideas every other week. And at the same time, our legal officer is busy.

Bill Derasmo:

Yeah, I'm sure he is very busy. And I did not expect to get any information on what's keeping him busy on the SPAC transaction from. But yes, the IP, I would imagine is intense, interesting to hear about. Well, it's been a great conversation and I hope you've enjoyed it. Maybe like to have you back on the program after your posts back closing and we can kind of hear where you guys are and how you're doing. Really

glad to have you on the program. Is there anything else you want to say to the audience before we close up?

Arwed Niestroj:

I want to thank you very much for having me. It's great to be here. It's great to have that podcast. I think it's important that people spend a few minutes to understand who is doing what and the area is very complex. Everybody thinks our batteries have been around forever, but trust me, I've been in this now very deeply for a few years. It is a complex thing, and to get to new solutions takes significant effort. So it's great that your audience is interested, is listening in. And yeah, go to our website, feel free to follow us. We're in all social media and let us know what you're thinking if you read any news about it.

Bill Derasmo:

All right, well we appreciate Arwed and Sakuu Corporation. Go and learn about them. A lot of exciting things going on. And we are out.

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