DOE SBIR-STTR SUCCESS STORY

Nion – Success in Small Things

> *"Success in life is founded upon attention to the small things rather than to the large things."*
>
> - Booker T. Washington

And so it goes for Department of Energy (DOE) SBIR awardee Nion Company (Nion), which was acquired by Bruker Corporation (Bruker) in January 2024. Nion has developed the most advanced scanning transmission electron microscopes (STEM) on the market and is now a wholly owned subsidiary of Bruker, itself a Nasdaq-traded company. Nion's electron microscope products enable resolutions at the atomic level – opening new fields of study using electron microscopes in materials science and biology, including energy conversion and storage devices.

nion	
Founded	1997, Kirkland, WA
Lineage	Startup
Technology	Scanning transmission electron microscopes
DOE SBIR Use Case	Energy conversion and storage devices
DOE SBIR Funding	5 Phase I, 3 Phase II, totaling $3.5 million
Funding Office	Basic Energy Sciences
Success Metrics	Estimated $10 million annual sales; Acquired by Bruker (NAS: BRKR)
Employees	30
Website	https://www.bruker.com/en/products-and-solutions/microscopes/electron-microscopes.html

Nion's story does not begin and end with its acquisition by Bruker in January of 2024. The company traces its origins to the late 1980s, when Ondrej Krivanek, then the director of Gatan R&D in California, interviewed and hired Niklas Dellby to be the company's chief electronics designer. Dellby spent just a year at Gatan before he went to MIT to study theoretical physics, but he continued to work as a consultant designer for Gatan during his studies. When he obtained his Ph.D., Dellby joined an ambitious project Krivanek and Prof. Mick Brown of Cambridge University got funding for in the UK: building a proof-of-principle aberration corrector for a scanning transmission electron microscope (STEM). Krivanek and Dellby built the corrector in under two years and showed a major resolution improvement compared to the uncorrected instrument.

The Cambridge project having come to an end, Krivanek and Dellby returned to the USA, where Krivanek had been hired as a research professor by the University of Washington in Seattle. They also founded Nion Co., in late 1997, to develop and manufacture ground-breaking electron-optical instruments. Krivanek became the company's President, and Dellby the Chief Technical Officer. As per Krivanek: "There were many fundamental problems to address in electron microscopy at that time, such as limited resolution due to lens aberrations, limited stability of the whole microscope, and inadequate vacuum in the microscope column. We thought that by putting on our physicists' hats and asking: 'what are the best ways to solve these problems?', we should be able to come up with fundamentally new solutions

that would dramatically improve the performance. Our hunch proved correct, and its result has been a series of electron microscopy breakthroughs."

Nion's first project was designing and building a second-generation spherical aberration corrector for a Vacuum Generators scanning transmission electron microscope (VG STEM). It was a research project initiated by Dr. P.E. Batson and sponsored by the IBM T.J. Watson Research Center. The project was paid for up-front, which allowed Nion to start with no external funding. The corrector was a new design that improved on the proof-of-principle corrector built in Cambridge. It was the first corrector delivered commercially (in June 2000). It enabled the STEM to attain directly interpretable resolutions smaller than 1 Å for the first time in electron microscopy, with the results reported in Nature in 2002 and Science in 2004.

With these initial results in hand, the company recognized the need in the market for continued development of advanced technical features that would provide scientific benefits as well as commercial success. They decided to pursue the path of launching their own line of electron microscopes, with funding provided by sales of their correctors, and an order for the new microscope from Cornell University.

Despite securing initial funding for the microscope development, Nion faced a conundrum: how to launch several large and risky research and development projects (that would yield technological breakthroughs and marketplace differentiators) on limited funding. Making major investments in technology research and development can be difficult for small companies because of limited cash resources.

Nion was awarded its first SBIR grant in 2002. The project was titled *Development of an Ultra-Bright Electron Source of Scanning Transmission Electron Microscopy*. The electron source is a key element in powerful electron microscopes that characterize matter on the atomic scale – and a critical piece of technology required for Nion's products. Prior to the grant, Nion had been using refurbished components for their electron sources. The Phase I project was bold in its technical claims that, with a more advanced ultra-bright electron source, Nion could improve microscope brightness by a factor of ten, decrease the energy spread by 2-3 times, and substantially improve the overall stability, reliability, and user-friendliness of its devices.

Nion was successful in its Phase I technical proof of concept, demonstrating an advanced electron source. Nion was subsequently awarded a Phase II prototyping grant. In Phase II, relative to market impacts, Nion claimed that the new source could be incorporated in an advanced electron microscope that would provide revolutionary new capabilities for imaging and analyzing matter. Nion suggested that the world-wide market for such instruments was greater than $500 million, and that there was no U.S. manufacturer for such devices. Nion's go-to-market approach was to position itself as the 'Ferrari of electron microscopy' – serving leading-edge customers by delivering high-end performance machines and maintaining high unit margins. The Phase II prototyping grant was also a success for Nion. The technological innovations achieved in these Phase I and Phase II awards directly led to Nion being able to go after their target market.

As the company's ambitions grew, so did the need to bring in key talent. In 2010, Nion brought on Tracy Lovejoy, a fresh Ph.D. from the University of Washington, initially as a staff scientist. The company had funding from selling its products, and it used it to develop new instruments such as its ground-potential monochromator. This was the project Lovejoy worked on after joining the company. At the same time, Nion saw SBIR grants as a great way to fund the development of radically new technical capabilities that

the electron microscopy community asked for in SBIR calls. Lovejoy became the Nion CEO in 2020 (and is now the manager of the electron microscopy division at Bruker), and he saw SBIR as a key to continuing innovation at Nion. As Lovejoy puts it, "you can draw a direct line from the SBIR awards that we received to the features in our products and to the revenues generated from those products."

Nion has gone on to receive Phase I/Phase II awards for three subsequent projects since Lovejoy's arrival at the company. The innovations include work on their product's spectrometer (2012-2013) and fundamentally improved monochromator (2022-2023). Additionally, Nion received a Phase I award to develop open-source software (2021-2022) for recording, analyzing, publishing, and ensuring the reproducibility of the scientific results from the use of their machines. Producing open-source (free) software can be a challenging business model, but Nion has been able to cover the cost of the development by making the software an integral part of the whole microscope system. In total, Nion has received five Phase I awards and three Phase II awards totaling approximately $3.7 million according to SBIR.gov – an online public source of SBIR/STTR award data.

Lovejoy recalls that co-founders Krivanek and Dellby "love the science and are driven by creativity and innovation. Processing payroll? Not so much." Ultimately, the senior executive team never gets completely away from the operational and administrative elements of the company, but for Lovejoy, "I am driven by science too but don't mind the company administration side. That has to happen, and I'd rather have a hand in it than worry about whether or not someone else would do it."

Nion has been able to grow revenues year-over-year for the past decade. As of 2023, some publicly sourced estimates from data providers such as Pitchbook and Yahoo! Finance place the company's annual revenue at approximately $10 million annually. Estimates for future sales range as high as $20-$30 million annually – selling 6-8 instruments per year each with a $3-$4 million price tag in 2023. Success like this gets noticed.

In early 2022, Bruker asked Nion about joint product development or outright acquisition. A key argument in favor of the acquisition was that while the two companies had developed closely related products, their product ranges complemented rather than competed with each other. Another argument was that with Nion's founders approaching retirement ages, a major reorganization was timely. During subsequent acquisition discussions, Nion wanted to make sure that Nion's culture of innovation would be preserved post-merger. In fact, Nion's innovation capabilities were a significant point of value for Bruker and good fit their needs at the time. The acquisition of Nion by Bruker was consummated in January 2024.

An acquisition by a much bigger player does come with some changes. Per Lovejoy, "it's no longer 'Tracy says it's a go, so it's a go'. We need to run things by Finance, the CFO, IT, etc. The finances at the corporate level have to make sense - but our motives still derive from creating interesting innovations to solve important scientific problems." Being acquired by a company with $3 billion in annual revenue and a $10 billion market capitalization (per Yahoo! Finance) has several benefits too. Nion, now a wholly owned subsidiary, has resources available to it that it never had before, such as a large and stable balance sheet and a dedicated recruiter. Nion is now hiring as fast as they can.

Lovejoy has this advice for small companies that want to follow a similar path: "Do something you love and focus on doing it better than anyone else. The financial side always needs to make sense, but don't put that first and only."