

## DOE SBIR-STTR SUCCESS STORY


### Pixelligent’s SBIRs: On to a Brighter Future

**P**ixelligent’s co-founders and earliest employees were PhDs from the University of Maryland, College Park. Although not a university spin-out, the team was looking to develop deep tech solutions in their areas of expertise. With a unique mix of backgrounds in physics, electrical engineering and solid-state chemistry, the team initially set out, in 2000, to develop new materials to upend the semiconductor industry.

Pixelligent received several government grants and early private capital to develop technology for nanoparticle design and manufacturing to support the development of more powerful and energy efficient chips. This funding enabled the team to make nanomaterials very precisely by controlling the particle size and shape. For each wavelength required in chip manufacture, the particles had to be very precise in size and shape, and of high-quality material. The semiconductor industry, however, was moving fast and the capital required to bring Pixelligent’s leading-edge technology to market was substantial; larger and better-capitalized companies had the upper-hand over Pixelligent – the smaller, less-capitalized newcomer. With the aid of additional outside capital, Pixelligent continued to advance its technical capabilities, but if the company were to survive, it would need a pivot.

**B**eginning in 2010, Pixelligent began looking for other applications where its proprietary nanoparticle design and best-in-class dispersion technology capabilities could be applied. In 2012, the company applied for and was awarded their first DOE SBIR award from the Vehicle Technologies Office (VTO) within the Office of Energy Efficiency and Renewable Energy (EERE) entitled “Nanocrystal Additives for Advanced Lubricants”.

Under the Phase I grant, the Pixelligent team, along with partners from the University of Pennsylvania’s School of Engineering and Applied Science and Argonne National Laboratory, were able to advance their technical capabilities; showing that they could design and produce nano-enhanced additives for lubricants that have the potential to significantly impact energy efficiency and reduce the emission levels in a number of industrial sectors, especially, the automotive industry. In 2014, Pixelligent was awarded a Phase II grant to work on the scale up of the technology. Z. Serpil Gonen Williams, PhD (Gonen Williams), Pixelligent’s CTO and one of the company’s founders, reflects on that Phase II work: “anyone can go in the lab and make 5 grams of nanomaterials that are very precise and uniform. But

	
Founded	2000, Virginia
Lineage	Startup
Technology	Nanomaterials design and manufacturing
DOE SBIR Use Case	Lubricants, Light Extraction for OLED
DOE SBIR Funding	4 Phase I, 4 Phase II, totaling \$4 million
Success Metric	\$58 mm VC raise, \$38 mm debt
Employees	43
Website	<a href="https://pixelligent.com/">https://pixelligent.com/</a>

then when you try to scale up to the multi-ton level that we accomplished, the particle size and shape control becomes very, very difficult.” Pixelligent’s breakthrough lubricant additive technology, which creates highly durable coatings on metal surfaces, subsequently was picked up by the Department of Defense and awarded several follow-on contracts. Pixelligent is currently working with large commercial testing partners, including ExxonMobil, Infineum, and Winergy, to test and bring its innovative coating technology product to the automotive and renewable energy markets.

Under the technology leadership of CTO Gonen Williams, the company continued to search for new markets where it could deploy its unique nanomaterials. One of the emerging areas that looked promising was using its technology to increase the refractive index of polymers. There were several mass-market applications emerging that required the combination of high refractive index and highly transparent materials, including OLED lighting.

By attending the PI Meetings associated with prior DOE SBIR grants, Pixelligent was able to meet and form a collaborative working relationship with OLEDWorks – a fellow DOE SBIR awardee and recognized leader in OLED lighting applications. Beginning in 2014, Pixelligent started partnering with OLEDWorks and subsequently was awarded a series of SBIR Phase I, Phase II and Phase IIB grants. The grants, titled “Advanced Light Extraction Material for OLED Lighting”, were used to extend their core nanoparticle design and manufacturing technology to dramatically improve the light output of OLED lighting panels. Under the grants, Pixelligent was able to develop high-index zirconia and titania dispersions and formulations, that when applied to glass substrates, demonstrated the ability to more than double the outcoupling efficiency of an OLED lighting device.

Although technically successful, the OLED lighting market did not materialize in a meaningful enough way at the time to convince the Korean-based market leader (and Pixelligent’s largest customer) to remain in the market. According to Gonen Williams, “in general, OLED lighting has not yet become a big success in the lighting market, however there are positive signs developing. But what we learned was that we were developing formulations that could be used in many different optoelectronic applications, not just OLED lighting.” Pixelligent’s market exploration and IP development was aided by the use of \$50,000 of Technical and Business Assistance (TABAs) funding during their Phase IIB grant. Per Gonen Williams, “the experience and capabilities garnered through these grants has enabled Pixelligent to become a leading high-refractive index formulation company and has paved the way to the success we are seeing now.”

**P**ixelligent is now shining brightly in markets where their precision superior products are delivering never-before seen performance and efficiencies across a broad set of next generation electronics. Their ability to balance power, brightness and clarity in glass applications has found a strong and growing niche for use in headsets in augmented reality (AR) and mixed reality (MR), known collectively as XR. According to Precedence Research, the XR headset market is on track to be a \$140 billion market by 2032<sup>1</sup>. Pixelligent has also made in-roads into OLED display and sensor applications where leading consumer electronics, display, and automotive companies require materials that have a critical combination of robust optical, mechanical, and reliability properties.

With the aid of multiple SBIR grants, Pixelligent was able to grow way past the ‘5 grams in the lab’ model enabling them to learn how to control scaled reactions for precise particle sizes and size distribution.

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<sup>1</sup> <https://www.precedenceresearch.com/ar-and-vr-headsets-market>

Today, the company has the capacity to formulate over 30 tons of each of the zirconia and titania products to meet the projected XR, Display, and sensor demand starting in 2025.

Over the course of the SBIR grants, Pixelligent's business model advanced along with its technical capabilities. When the company first applied for R&D funding, they were designing and manufacturing only nanomaterials and nanocrystals; then selling nanocrystal dispersions to customers who would formulate a solution for the device manufacturers. Pixelligent has expanded its capabilities in the product value chain - becoming its own formulator and selling directly to the device manufacturer in the process. This has enabled Pixelligent to be more responsive to device manufacturers' needs and see firsthand what consumers are demanding. Pixelligent now has the unique ability to make nanomaterials with a specific refractivity quotient, develop specialized compounds, and then quickly scale the production of the formulation.

Private financial markets have also noticed Pixelligent's technological advancement and huge growth potential. Per PitchBook, since a financial re-boot in 2009, when the company went through a reorganization, the company has raised approximately \$58 million in venture capital. The use of funds has been to build an award-winning manufacturing platform, develop market leading formulations and dispersions under its PixNIL<sup>®</sup>, PixJet<sup>®</sup>, and PixClear<sup>®</sup> brands, expand the technical team and continue developing IP while evolving their go to market plan. Under Gonen Williams' direction, the company has grown a portfolio of over 90 patents – many of which stem from work performed on SBIR-funded projects. Additionally, in 2022, the company raised almost \$38 million in a debt facility to expand its product development and manufacturing capabilities in Baltimore, MD. Pixelligent also has a sales presence in Taiwan, Korea and Japan.

“Our success to date would never have happened without the SBIR program”, acknowledges Gonen Williams, “private investors will always say they are interested in what you're doing, but they're usually not willing to inject the high risk capital into unproven technologies at the beginning.” Gonen Williams always advises teams to go after non-dilutive and risk-focused SBIR funding for early-stage R&D.

Strategic partnering has also been crucial at every step of Pixelligent's development and the SBIR programs have played a key role in those as well. Gonen Williams says that “the government grants helped with not only in directly funding technology development, but they also allowed us to attract major corporate and university partners we may not have been able to attract otherwise.

And with respect to team building (Pixelligent is now a team of 43, headquartered in Baltimore, MD), Gonen Williams offers this advice: “You have to be honest with your team. You have to communicate well. Priorities will change and you have to be able to quickly adapt to changes in the market. There will be difficult times, but if you can grow together and rise to the challenges, you will be successful.”