WHITEPAPER

STRATEGIC RISK ASSESSMENT:

HAS THE U.S. LOST CONTROL OF THE DEFENSE OPTICS MARKET?

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STRATEGIC RISK ASSESSMENT

95%

OF OPTICAL

FROM OVERSEAS

THE PRODUCTION CONTROL OF CRITICAL OPTICAL TECHNOLOGIES GIVES CHINA AN ADVANTAGE AND POSES A SIGNIFICANT THREAT

Today, the Department of Defense (DoD) currently sources over 95% of optical elements from overseas, including adversarial supply chains - with up to 80% of systems containing lenses from China. This foreign reliance creates national security risks, leaving the U.S. vulnerable to supply chain disruptions and geopolitical challenges.

The production control of critical optical technologies gives China an advantage and poses a significant threat for Indo-Pacific deterrence, especially in military and intelligence operations that depend on advanced optics for surveillance, targeting, and tactical warfighting. This near-monopoly gives Beijing economic and strategic leverage, allowing it to disrupt supply chains critical to U.S. and allied defense systems in the region during a conflict.

In a conflict scenario, China could weaponize its control over this essential material by restricting exports, degrading quality, and sabotaging lenses destined for defense applications - hindering the readiness and effectiveness of military assets such as night vision devices, satellites, drones, and precision-guided munitions.

Moreover, dependence on a geopolitical competitor for mission-critical components weakens resilience and complicates long-term strategic planning. Without diversification and domestic production capabilities, Indo-PACOM forces face an unacceptable risk in maintaining technological superiority and operational effectiveness in the face of potential adversary actions.

The 2022 National Defense Industrial Strategy focus on economic deterrence and resilient supply chains is directly threatened by reliance on Chinese manufacturing capabilities. Every optical lens purchased outside of the Defense Industrial Base (DIB) weakens the American economy, prevents reshoring critical high-skilled manufacturing, and degrades our technical edge against Chinese industrial espionage. Allowing Chinese dependence also poses a significant risk to the warfighter. There is every reason to believe our adversaries could embed nanotechnologies or deliberate faults into military lenses designed to be triggered by specific wavelengths of light or laser frequencies, allowing Chinese forces to detect and disable U.S. military equipment. These critical risks need to be prevented before they jeopardize the lives of American Soldiers, Sailors, Airmen, Guardians, and Marines.

90%

DEPENDENCE ON CHINESE MANUFACTURING

50%

DECLINE IN OPTICAL MATERIAL

The U.S. military optics infrastructure and supply chain face five key risks:

1. **90% Dependence on Chinese Manufacturing for Optical Glass** – The backbone of our most critical warfighter technologies - night vision, drones, fire control systems, and more - hinges on optical glass, 90% of which is sourced from China. This heavy reliance on a single foreign supplier poses a significant strategic vulnerability, impacting national security, supply chain resilience, and defense readiness.

2. **50% Decline in Optical Material Availability** – Over the past 50 years, the range of materials used in optical systems has decreased by nearly 50%, largely due to global environmental and manufacturing safety regulations. The production of materials like flint glass, beryllium, cadmium, and various rare earth metals is heavily regulated to protect worker safety, leading to increased outsourcing and a more restricted supply chain, further restricting U.S. manufacturing.

3. **Lack of Standardization in Optical Materials** – Leading manufacturers of optical materials have yet to establish universal standards, resulting in increased supply chain costs and a heightened risk of obsolescence. Each manufacturer certifies and labels its own materials independently, creating inconsistencies, compatibility challenges, and inefficiencies that complicate sourcing and long-term system sustainability.

THE BACKBONE OF OUR MOST CRITICAL WARFIGHTER TECHNOLOGIES- NIGHT VISION, DRONES, FIRE CONTROL SYSTEMS, AND MORE - HINGES ON OPTICAL GLASS, 90% OF WHICH IS SOURCED FROM CHINA

LGRIN POLYMER OPTICS REDUCES THE MATERIAL WEIGHT, AND THE WAVE GUIDES UTILIZES PRINCIPLES OF OPTICS TO DIRECT LIGHT EFFECTIVELY, PROVIDING A COMPACT, LIGHTWEIGHT, AND HIGH-RESOLUTION DISPLAY.

4 **Countering the Risk of Embedded Malicious Capabilities** – China has shown a pattern of creating embedded backdoors and installing other control mechanisms in products with intelligence or military applications. Robust countermeasures are essential. This underscores the need for stringent security vetting, trusted domestic manufacturing, and continuous monitoring to prevent unauthorized access, disruption, or control of critical defense technologies.

5 **Strategic Leadership at Risk** – Reliance on China for critical systems threatens the U.S.'s ability to sustain leadership in military and intelligence technologies. Without secure, domestic alternatives, supply chain vulnerabilities could undermine innovation, operational readiness, and long-term strategic dominance.

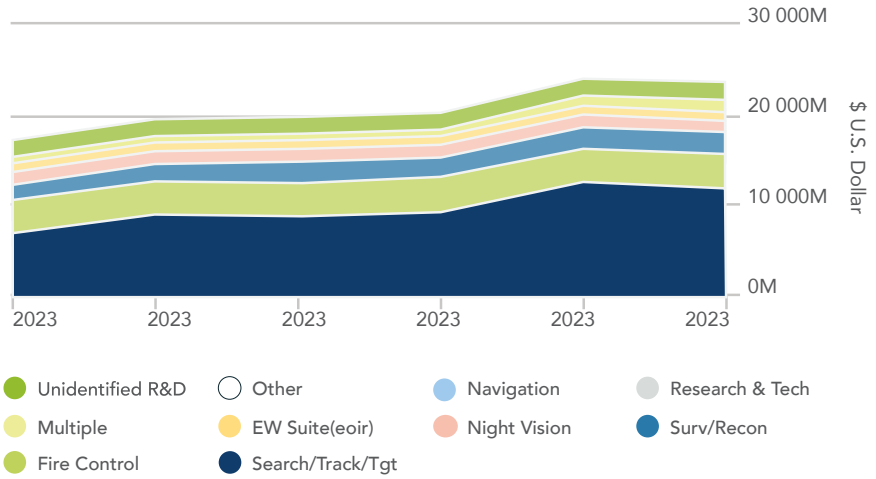
In 2024, the U.S. and other allied nations spent nearly $20 billion on defense optics systems using Chinese optical glass. We need warfighter systems that are designed, developed, built by U.S. citizens in the United States. These efforts are essential to rebuilding the entire supply chain and ensuring American self-sufficiency, free from foreign interference.

Peak Nano's patented Layered Gradient-Index (LGRIN) nanotechnology, marketed as NanoPlex™, represents a critical breakthrough in U.S.-based optical systems, offering a secure and superior alternative to foreign-sourced optics - especially those from China. LGRIN-based optics reduce reliance on adversarial supply chains by replacing traditional glass with hybrid polymer solutions, enabling lighter, more durable, and cost-effective systems. Enhanced by AI and Industry 4.0, LGRIN dramatically shortens development cycles, streamlines manufacturing, and supports passive athermalization, all while maintaining high performance under extreme conditions. This reshoring of military optics manufacturing strengthens national security by eliminating vulnerabilities in the defense supply chain, delivering unmatched technological resilience, and ensuring long-term superiority in modern warfare. Peak Nano positions LGRIN not as a choice, but as a strategic imperative for safeguarding America's defense infrastructure.

This paper provides a risk assessment and mitigation plan to return our most advanced warfighter systems to a U.S.-based development and supply chain that ensures mission readiness and protects our military personnel. The core of this risk lies in the need for advanced optics systems that do not rely on Chinese-based lenses. Many military systems are assembled in the United States but still source critical components from China, creating supply chain and operational risks that should be eliminated. It is essential to consider not just where the final product is assembled but also where each component is manufactured to ensure a resilient and self-sufficient defense industrial base.

The United States leads the world in advanced lens technologies, with Layered Gradient Refractive Index (LGRIN)-based nanotechnology at the forefront of both military and civilian applications. To maintain our strategic edge, we must modernize existing optical systems, counter malicious design threats, and eliminate reliance on China within our national optics supply chain. A crucial step toward this goal is migrating military optics to proven U.S.-based LGRIN solutions. Advancing this transition is not just an opportunity, it is a strategic necessity for our national security.

Worldwide Night Vision Market Forecast



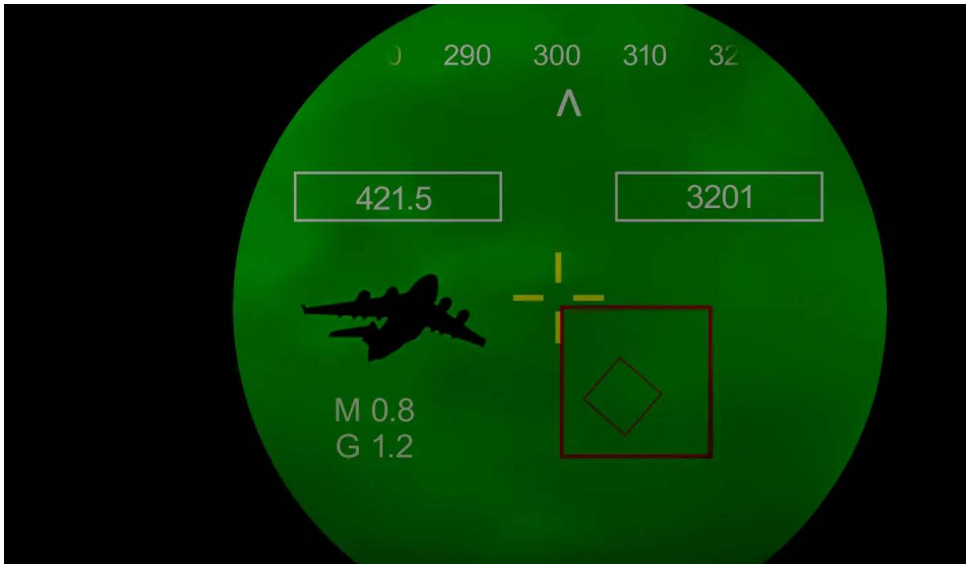
STRATEGIC RISK OVERVIEW

THE CHINESE NEAR-MONOPOLY OF OPTICAL GLASS USED IN DEFENSE SYSTEMS GIVES BEIJING SIGNIFICANT ECONOMIC LEVERAGE BUT ALSO INTRODUCES SERIOUS GEOPOLITICAL AND TECHNICAL SECURITY RISKS.

In the high-stakes arena of modern warfare, technological dominance is not just an advantage, it is a necessity. Advanced optics are the eyes of the U.S. military, empowering warfighters to see first, act first, and win. From high-resolution surveillance systems to precision targeting solutions, these instruments are the foundation of America's battlefield superiority. Yet, a grave and growing threat looms over our defense readiness: the U.S. military is dangerously reliant on foreign sources - especially China - for these mission-critical optical components.

In terms of strategic risk, the Chinese near-monopoly of optical glass used in defense systems gives Beijing significant economic leverage but also introduces serious geopolitical and technical security risks. Before a conflict even begins, China could weaponize its dominance by restricting exports, degrading quality, or even sabotaging lenses intended for defense applications. There is little reason to believe adversaries could not, or would not, embed nanotechnologies into military lenses, designed to be triggered by specific wavelengths of light or laser frequencies and allowing Chinese forces to detect, track, or disable U.S. military equipment. Military assets such as night vision devices, drones, satellites, and precision-guided munitions could be compromised, weakening Indo-Pacific deterrence and degrading operational effectiveness.

Foreign-controlled optical components expose U.S. defense systems to embedded hardware and software vulnerabilities. Adversaries could introduce malware, hardware backdoors, or compromised firmware, allowing unauthorized access to sensitive data or even remotely disabling systems during critical missions. A recent example, reported by the New York Times on July 29, 2023, highlighted malware discovered by Microsoft that could allow China to disrupt power, water, and communications at military bases worldwide. The possibility that optical components could be embedded with similar hidden threats is a **direct risk to national security.**



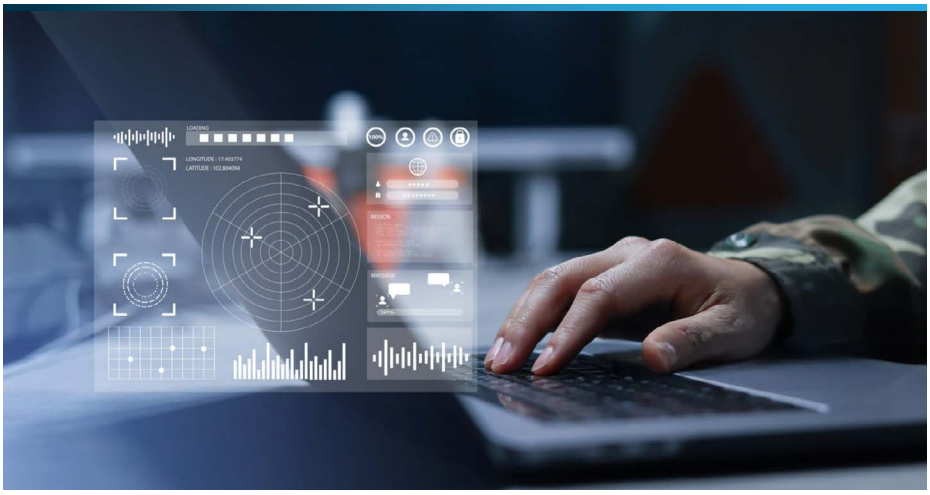
This dependence also undermines long-term strategic leadership. The 2022 National Defense Industrial Strategy emphasizes economic deterrence and resilient supply chains, yet reliance on Chinese manufacturing weakens the American defense industrial base. Every optical lens purchased outside the Defense Industrial Base (DIB) slows the reshoring of critical high-skilled manufacturing, erodes technological superiority, and leaves the U.S. vulnerable to Chinese industrial espionage.

To mitigate these threats, the U.S. must act decisively to **diversify its supply chain, increase domestic production of optical materials, and implement rigorous security vetting and quality standardization.** The time for action is now - before this unchecked dependency compromises the technological edge and operational readiness of U.S. military forces. Given the increasing complexity and interconnectivity of modern military technologies, these risks pose a significant challenge that necessitates reevaluating and fortifying procurement strategies.

U.S. MUST ACT DECISIVELY TO DIVERSIFY ITS SUPPLY CHAIN, INCREASE DOMESTIC PRODUCTION OF OPTICAL MATERIALS, AND IMPLEMENT RIGOROUS SECURITY VETTING AND QUALITY STANDARDIZATION.

CRITICAL INFRASTRUCTURE AND APPLICATIONS RELIANT ON OPTICAL SYSTEMS

PRECISION OPTICS ARE ESSENTIAL IN TARGETING SYSTEMS, SURVEILLANCE, AND NAVIGATION FOR VEHICLES SUCH AS TANKS, AIRCRAFT, AND NAVAL VESSELS.



The military's dependence on optical instruments extends across diverse applications, integrating seamlessly into multiple platforms and operational environments to enhance situational awareness, targeting precision, and mission effectiveness. In both combat and peacetime operations, soldiers operate as an extension of advanced technology, merging man and machine through cutting-edge optics integrated into their rifles and helmets. Holographic sights, night-vision goggles, and augmented reality displays enhance situational awareness and precision, allowing warfighters to seamlessly adapt to dynamic environments, whether in daylight or total darkness. Precision optics are essential in targeting systems, surveillance, and navigation for vehicles such as tanks, aircraft, and naval vessels. These platforms often use sophisticated electro-optical and infrared sensors, including thermal imaging and laser rangefinders, to ensure accurate engagement and mission success.

Optical instruments are equally vital in unmanned systems, serving as the eyes of modern warfare across air, land, and sea. Unmanned Aerial Vehicles (UAVs) leverage high-resolution cameras, LiDAR, and multispectral imaging to conduct intelligence gathering, surveillance, and precision strikes with unmatched efficiency. Meanwhile, ground-based unmanned systems, such as Remotely Operated Vehicles (ROVs) and Autonomous Ground Vehicles (AGVs), depend on advanced optical sensors for obstacle detection, target identification, and navigation in complex and often hostile environments. These platforms extend the reach of military forces, enhancing lethality, survivability, and decision-making speed in both urban arenas and contested battlefields.

GPS HAS BECOME A CORNERSTONE OF MODERN MILITARY OPERATIONS, ENABLING PRECISE NAVIGATION, TARGETING, AND COORDINATION ACROSS EVERY COMBAT DOMAIN.

GPS has become a cornerstone of modern military operations, enabling precise navigation, targeting, and coordination across every combat domain. From guiding missiles with pinpoint accuracy to synchronizing battlefield movements, this reliance on GPS is essential to maintaining operational superiority and mission success. However, in a conflict with a peer or near-peer adversaries, the certainty of GPS reliability becomes highly precarious. Potential actions range from deliberate jamming and signal interference to destroying satellite constellations, jeopardizing GPS-dependent systems. This threat has forced military strategists to reevaluate their dependence on GPS and develop alternative methods of navigation and communication, including resilient, non-GPS-based technologies. One example is the recent patent of the "Skymark" method by Draper Labs, which uses an upward-viewing optical system to record star and satellite positions day and night. The information offers positioning updates equal to the accuracy of GPS.

The role of optical applications in modern defense systems is unmistakably evident and increasingly decisive in contemporary warfare. These technologies, defined by their precision, clarity, and reliability, form the backbone of numerous defense strategies and operations. Their significance extends far beyond observation, directly impacting decision-making, tactical planning, and operational effectiveness.

The war in Ukraine has underscored the critical importance of advanced optical systems in modern conflicts. Ukrainian forces have effectively leveraged drones, night-vision optics, and precision-guided munitions to counter a numerically superior adversary, demonstrating how battlefield awareness and targeting precision can shift the balance of power. Meanwhile, Russia's struggles with inferior optical capabilities and compromised supply chains have highlighted the vulnerabilities of relying on outdated or foreign-controlled technology.

These lessons make one thing clear: securing and advancing optical technologies is not just an advantage - it is an absolute necessity. As warfare evolves, ensuring uninterrupted access to high-quality, domestically produced optical components will be essential for maintaining U.S. military superiority, resilience, and strategic dominance.

REDUCING RISK IN THE NATIONAL OPTICAL SUPPLY CHAIN

90%

DEPENDENCE

ON CHINESE

MANUFACTURING

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5. **Strategic Leadership at Risk** – Reliance on China for critical systems threatens the U.S.'s ability to sustain leadership in military and intelligence technologies. Without secure, domestic alternatives, supply chain vulnerabilities could undermine innovation, operational readiness, and long-term strategic dominance.

DEPENDENCE ON CHINA-BASED SUPPLY CHAIN

90%

DEPENDENCE

ON CHINESE

MANUFACTURING

While most optics-based warfighting systems undergo final assembly in the United States, they remain 90% dependent on China for the lenses that power these critical systems. Given current geopolitical tensions and the global supply chain vulnerabilities exposed during COVID, this reliance represents an unacceptable strategic risk to U.S. national security.

For decades, the U.S. defense sector has relied heavily on Chinese optical glass suppliers, creating deeply entrenched supply chains that are difficult to unwind. Many defense contractors and manufacturers have established long-term contracts with Chinese suppliers, making an immediate transition to domestic alternatives challenging. Additionally, China has developed advanced and cost-effective processing capabilities that the U.S. currently lacks at scale, further reinforcing this dependency. Replacing these foreign suppliers would require not only the identification and development of new domestic vendors capable of meeting stringent military-grade optical specifications, but also extensive requalification and testing of materials for aerospace and defense applications. Without dedicated efforts to build supply chain redundancy and encourage domestic production, the U.S. remains vulnerable to supply disruptions, price manipulation, and potential security risks associated with foreign-controlled manufacturing.

Beyond supply chain vulnerabilities, the continued reliance on Chinese optics raises serious intellectual property (IP) concerns. Over the years, U.S. optical technologies - many originally developed for defense applications - have been co-opted, reverse-engineered, and integrated into China's own military-industrial complex. The transfer of knowledge through manufacturing partnerships has allowed China to leverage U.S. innovations while simultaneously restricting access to its own advancements. This imbalance weakens U.S. technological superiority and allows adversaries to exploit American-developed optics for their own military and intelligence purposes.

50% OF OPTICS MATERIALS ARE AT RISK

50%
DECLINE IN
OPTICAL
MATERIAL

Reshoring optical glass production in the U.S. is not simply a matter of rebuilding factories - it is fundamentally constrained by material availability and regulatory challenges. The optics industry has long struggled to maintain a vast library of specialized optical materials, as doing so is both resource-intensive and increasingly expensive. Over the past few decades, the number of available glass varieties has plummeted - with Schott, a world leader in optical glass manufacturing, reducing its offerings from more than 270 varieties in the 1970s to just 130 today. As materials fall out of mainstream use, production costs skyrocket, making it even more difficult to source small quantities for specialized defense applications.

Compounding this issue is the complexity and hazardous nature of optical glass manufacturing. High-performance optical glass requires precise chemical compositions and processing techniques involving materials such as lead, beryllium, cadmium, and rare earth metals - all of which are heavily regulated due to their toxicity, environmental impact, and worker safety risks. U.S. manufacturers face strict OSHA and EPA regulations that limit domestic production capacity, increase costs, and deter investment. In contrast, China has capitalized on its lax environmental and labor laws to dominate global optical glass production, offering lower-cost alternatives while avoiding the stringent regulations that drive up U.S. manufacturing costs.

As a result, most optical glass manufacturing has been outsourced, further deepening U.S. dependence on foreign suppliers for mission-critical materials. This reliance presents a major national security risk - particularly as geopolitical tensions escalate and supply chain disruptions become more frequent. Manufacturers and defense agencies now face a dual challenge: sourcing scarce or discontinued optical materials while ensuring compliance with ever-evolving environmental standards.

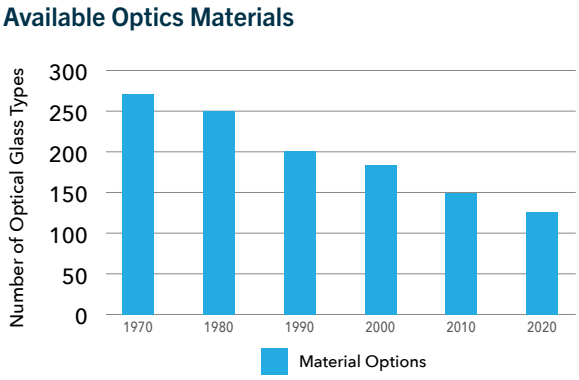


Figure 2: Decline of Schott optical class catalog from Ref. *[6]*

OBSOLESCENCE

SERVICE LIFETIME RISK

Unlike commercial technology, which is designed for rapid innovation and regular updates, military systems are built to last for decades - not because technology stagnates, but because of the slow, bureaucratic, and costly process required to develop, test, and field defense platforms. These systems remain in service for extended periods due to enormous financial investments, rigid procurement cycles, and outdated acquisition policies that fail to keep pace with technological change. However, this longevity introduces a critical challenge: parts obsolescence.

As technology evolves, components that were once cutting-edge become outdated, discontinued, or impossible to source. While commercial industries adapt quickly to market demands, upgrading products frequently, military procurement is plagued by red tape, slow-moving approval processes, and rigid contract structures that make modernization efforts cumbersome. The U.S. military often finds itself scrambling to integrate newer technologies into legacy systems or relying on costly and inefficient workarounds to replace obsolete components - all while navigating excessive oversight, lengthy approval timelines, and outdated procurement policies that further delay solutions.

The consequences of this inefficiency extend far beyond procurement headaches. Operational readiness, reliability, and even security are compromised when military platforms depend on aging, unsupported technologies. A lack of proactive planning and flexible system designs forces defense agencies into reactive, crisis-driven decision-making, leading to increased costs, supply chain disruptions, and vulnerabilities that adversaries can exploit.

OPERATIONAL READINESS, RELIABILITY, AND EVEN SECURITY ARE COMPROMISED WHEN MILITARY PLATFORMS DEPEND ON AGING, UNSUPPORTED TECHNOLOGIES.

NO STANDARDS FOR OPTICAL MATERIALS

THE ENTIRE OPTICAL SUPPLY CHAIN FOR DEFENSE APPLICATIONS MUST BE U.S.-BASED OR SOURCED FROM TRUSTED ALLIES TO ENSURE LONG-TERM SECURITY AND STABILITY.

Each optical manufacturer - including China DC, Schott, Ohara, Hoya, and others - produces materials that, while similar, are not fully interchangeable. Slight variations create single-source dependencies, introducing operational and performance risks that drive up costs and complicate supply chain management. Without universal optical standards, manufacturers must redesign or extensively test components when switching suppliers, leading to inefficiencies and supply vulnerabilities.

For example, the semiconductor industry follows JEDEC standards, which ensure that memory and microelectronics from different manufacturers remain compatible across multiple platforms. A similar approach in the optical industry, where manufacturers align on standardized optical glass formulations and specifications, would increase interchangeability, reduce single-source risk, and enhance supply chain resilience.

However, standardization alone is not enough. The entire optical supply chain for defense applications must be U.S.-based or sourced from trusted allies to ensure long-term security and stability. Any universal standard for optical materials must include a requirement that components are sourced from domestic or allied manufacturers to eliminate dependence on adversarial nations like China.

RISK OF MALICIOUS CAPABILITIES

As noted in the introduction, concerns over Chinese malware infiltrating military hardware and software have drawn significant attention within the U.S. defense establishment. However, a critical blind spot remains: the optics industry. While discussions have primarily centered around glass obsolescence and its impact on maintaining and refreshing military systems without costly, extended downtimes, little attention has been given to the potential for adversaries to embed hidden threats within optical components themselves.

The following sections explore both the ongoing glass obsolescence crisis and the emerging risk of adversary-manipulated optics, where seemingly benign components could be engineered to degrade performance, introduce vulnerabilities, or actively compromise U.S. forces in the field. Optical elements, such as lenses and coatings, could be subtly altered to affect clarity, targeting precision, or durability under battlefield conditions. More concerningly, nanotechnology and photonic manipulation could allow adversaries to embed covert tracking mechanisms or “kill switches” activated by specific wavelengths of light, potentially exposing U.S. operations to detection, disruption, or failure at critical moments.

As reliance on foreign optical suppliers - particularly China - remains dangerously high, securing a domestic and allied-controlled supply chain for these critical components is no longer just a matter of supply stability; it is a matter of national security and operational survivability.

THE HIDDEN THREAT OF SPECTRAL CODING

THIS WOULD ALLOW ADVERSARIES TO IDENTIFY, TRACK, AND COUNTER U.S. OPTICAL SYSTEMS IN REAL TIME, COMPROMISING MISSION EFFECTIVENESS WITHOUT DETECTION.

The widespread use of optical systems in modern combat has driven the development of advanced detection devices capable of rapidly and autonomously identifying optical equipment on the battlefield. These systems operate by transmitting a light pulse (typically a laser or a light-emitting diode) and analyzing the reflections or 'glints' from optical surfaces to locate potential optics-based equipment. A commercially available handheld detection system, along with imagery from the device, is shown in Fig. 3. Beyond handheld devices, large-scale autonomous systems now incorporate built-in geolocation capabilities, short-wave infrared (SWIR), and thermal imaging sensors to enhance battlefield awareness.

These identification systems are inherently "dumb" - while they excel at detecting the presence of optical devices, they lack the intelligence to distinguish between different types of optics. For example, they cannot naturally differentiate between a riflescope, a camera, or a pair of binoculars. More critically, they are incapable of identifying whether a detected optical system belongs to a friendly force or an adversary.

A far more concerning risk emerges when adversaries gain access to the U.S. optical supply chain. Through spectral coding, they could embed hidden optical signatures into military optics, creating an invisible tracking system undetectable under normal inspection. Similar to marked playing cards used in cheating, subtle alterations in optical coatings could be revealed under specific laser wavelengths. This would allow adversaries to identify, track, and counter U.S. optical systems in real time, compromising mission effectiveness without detection.

Figure 3: The Sentinel S45 handheld optical detection system *[7]*

Spectral coding is a technique used to embed unique optical "fingerprints" into optical coatings or materials. Just as human fingerprints can uniquely identify an individual, spectral coding can be used to identify a specific optical system, its type, model, or even its exact function. This can be achieved by embedding a series of narrowband reflectance peaks - small optical markers - within the broadband anti-reflection coatings applied to nearly all military optics.

An example is shown in Fig. 4, where an optical coating contains subtle, engineered spectral markers that are virtually undetectable without specialized equipment. If an adversary knows where and how to look, they could use a tunable narrowband laser to illuminate the optics and instantly decode the spectral signature - revealing the exact identity, origin, and function of the optical system.

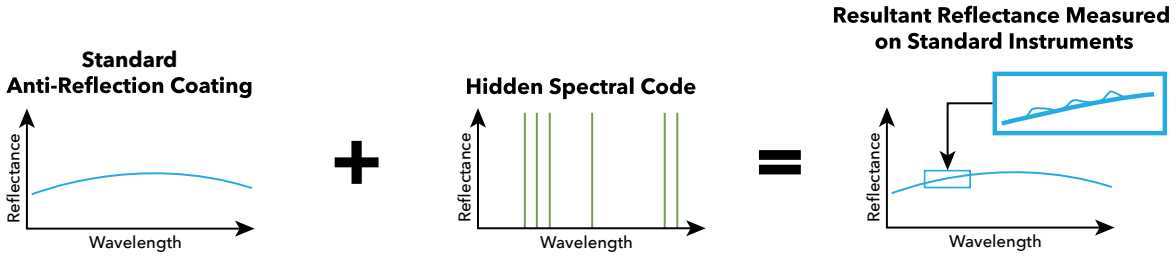


Figure 4: Example of a method to embed hidden spectral coding.

OPTICAL DAMAGE AND DARKENING

WITH INTERNAL ACCESS TO THE SUPPLY CHAIN, ADVERSARIES COULD COVERTLY SABOTAGE U.S. OPTICAL SYSTEMS BY INTRODUCING FOREIGN MATTER OR SPECIALIZED DOPANTS DESIGNED TO LOWER THE LASER DAMAGE THRESHOLD.

Recent news articles have exposed a rising trend of directed laser attacks on pilots, causing temporary blindness and disorientation - an issue that has captured public attention. However, this fleeting interference is only the tip of the iceberg. The real danger lies in the deliberate, permanent damage that lasers can inflict on military optical systems, a threat the defense community has warned about for years.

High-energy laser strikes pose a permanent threat to critical optical sensors used in surveillance, targeting, and missile guidance. A single, well-placed burst can blind drones, disable fighter jet optics, or burn out satellite sensors, crippling combat effectiveness instantly. This isn't hypothetical; adversaries are actively developing laser-based countermeasures to neutralize U.S. optical superiority. As warfare grows increasingly reliant on precision optics, the risk of preemptive sensor attacks is no longer distant - it's an urgent and escalating reality.

While the aforementioned risks illustrate the threats we face when adversaries operate from an external standpoint, the dangers intensify exponentially when these adversaries gain access to our supply chain. Covert optical sabotage actively works to cripple U.S. systems from within instead of just marking U.S. optics for tracking. This method exploits ultra-narrowband absorption to silently degrade optical performance when it matters most.

With internal access to the supply chain, adversaries could covertly sabotage U.S. optical systems by introducing foreign matter or specialized dopants designed to lower the laser damage threshold. These hidden alterations would make the optics exceptionally vulnerable, allowing even low-intensity laser exposure to cause irreversible degradation.

An adversary could also embed engineered nanoparticles during manufacturing, to pre-program failure into U.S. warfighting systems. These particles would remain dormant and undetectable until exposed to a specific wavelength of light, at which point they would trigger photodarkening, selectively absorbing light, scattering energy, and permanently degrading optical clarity. The effect would be catastrophic: a pilot unable to see a target, a drone suddenly blind mid-mission, a missile guidance system thrown fatally off course.

This is not just a theoretical risk - it is a silent, asymmetric attack vector that exploits America's dependence on foreign-controlled optical supply chains. Without strict material sourcing controls and advanced forensic testing, we risk handing our adversaries the ability to cripple our forces before the first shot is even fired. The battlefield of the future is already being shaped - not by bullets and bombs, but by the invisible sabotage embedded in the very tools we rely on to see, track, and strike.

THIS IS NOT JUST A THEORETICAL RISK - IT IS A SILENT, ASYMMETRIC ATTACK VECTOR THAT EXPLOITS AMERICA'S DEPENDENCE ON FOREIGN-CONTROLLED OPTICAL SUPPLY CHAINS.

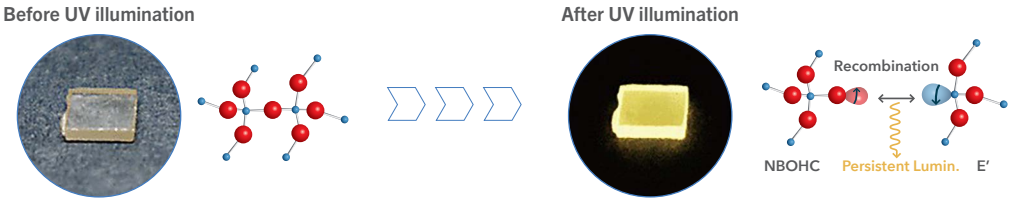


Figure 5 An example of photodarkening from Ref. *[13]*

STRATEGIC LEADERSHIP RISK

U.S. dependence on Chinese optics jeopardizes both current tactical superiority and future strategic advancements. China's well-documented disregard for intellectual property rights poses a direct threat to U.S. defense technologies, increasing the risk of theft, replication, and exploitation. To protect national security and maintain a competitive edge, the U.S. must establish an entirely domestic optics industry - from research and design to manufacturing. Securing a U.S.-based supply chain is not just an economic necessity; it is a critical defense imperative to prevent adversarial exploitation and ensure long-term military superiority.

NANOPLEX™

SECURING THE NATIONAL OPTICAL SUPPLY CHAIN WITH LGRIN TECHNOLOGY

Peak Nano is a U.S.-based company leading the world in advanced lens technology – Layered Gradient-Index (LGRIN) Nanotechnology. It is sold under the market name of NanoPlex™. Peak is positioned to help safeguard America's military superiority by leading the charge in eliminating dependence on China, upgrading existing optical systems, and mitigating embedded security threats. By migrating military optics to U.S.-based LGRIN solutions, we can regain control of our national supply chain and ensure uncompromised defense capabilities.

This transition is not optional - it is a strategic imperative. To secure our nation's optical supply chain, four critical requirements must be met:

1 **Migrating to LGRIN Polymer-based Nanotechnology** – Migrating from predominantly foreign-sourced glass to hybrid LGRIN optics (a combination of glass and polymer) offers a stable U.S.-based supply chain, reduced weight, and improved optical performance. This transition ensures greater reliability for military applications while reducing dependence on foreign suppliers. This shift not only eliminates reliance on adversarial sources but also delivers lighter, higher-performance optics with superior durability and cost-effective scalability for military applications.

2 **Accelerate Strategic Optics Development with AI and Industry 4.0** – Integrating Artificial Intelligence (AI) and Industry 4.0 advancements into LGRIN-based optics development significantly reduces design cycles, cutting development time from years to weeks. AI-driven optimization and advanced manufacturing techniques enable rapid prototyping and continuous innovation, ensuring the U.S. maintains a technological edge over adversaries while streamlining production for enhanced scalability and adaptability.

3 **U.S.-based Design and Manufacturing** – LGRIN-based optics will reshore this critical industry, eliminating reliance on foreign suppliers and preventing adversarial nations like China from embedding malicious technology into military optics. This transition will fortify the Defense Industrial Base, ensuring secure, high-performance optical systems that support long-term national security and technological leadership.

4 **Advancing Our Optics Systems Capabilities** – LGRIN-based optics will ensure we can innovate faster and with more significant results than our adversaries. NanoPlex, polymer technology, the advanced mathematics required for the AI-based design tools, and the chip-like manufacturing process developed in the United States will ensure our leadership critical to national security.

The virtues of LGRIN-based optical design have been well-documented in numerous studies and articles. As a cornerstone of modern optical advancements, LGRIN's multifaceted impact resonates across critical qualities such as size, weight, performance, and cost (SWaP-C). This innovative approach not only miniaturizes components, but also ensures size and weight reductions do not compromise performance. In terms of improvements, LGRIN-based optical design has demonstrated a significant reduction in overall system costs, making it a practical and cost-effective solution for modern optical systems. The appendix provides a detailed overview of LGRIN's attributes and advantages for those seeking a deeper technical understanding.

Beyond the immediate benefits in size, weight, performance, and cost, LGRIN-based technology is paramount in fortifying our optical supply chain. A singular LGRIN-based solution can dramatically streamline the design process, which addresses performance requirements and logistical challenges. Specific enhancements include:

LGRIN OPTICS FORTIFY THE FUTURE OF DEFENSE TECHNOLOGY - DELIVERING A SECURE, SUPERIOR, AND SUSTAINABLE SOLUTION FOR MILITARY AND NATIONAL SECURITY APPLICATIONS.

- **Drastic Reduction in Dependence on China-based Glass Lenses:** LGRIN-based optical designs reduce the dependency on a wide range of catalog glasses. LGRIN significantly reduces the number of glass lenses and dramatically reduces supply chain risk. Further ensuring supply chain security, LGRIN polymers are sourced domestically or from European ally nations – not China. By simply reducing the number of glasses and creating optical standards, we can focus on the most common and frequently produced glass types.
- **Conversion of Aspheres to Spherical Surfaces:** This transition streamlines design and improves efficiency in manufacturing and testing. Spherical elements are easier to produce and validate than complex aspheric lenses, leading to lower production costs and shorter lead times. Additionally, spherical optics allow for more flexible optomechanical tolerances, reducing assembly complexity, cost, and time.
- **Passive Athermalization:** Passive athermalization is the ability of an optical system to maintain consistent performance across temperature variations without requiring active thermal compensation. LGRIN-based optical designs can be engineered to passively athermalize systems beyond military specifications, minimizing the effects of thermal expansion or contraction on optical alignment.

  This capability reduces the need for complex optomechanical adjustments, simplifies overall system design, and ensures reliable performance in diverse and extreme environmental conditions.

The breakthrough capabilities of LGRIN-based optics eliminate critical vulnerabilities while driving next-generation innovation. Traditional optics rely on foreign-sourced materials, complex manufacturing processes, and supply chains susceptible to adversarial manipulation. LGRIN technology removes these risks, offering a secure, U.S.-based alternative that enhances national security and technological resilience.

LGRIN OPTICAL TECHNOLOGY IS MORE THAN AN ADVANCED INNOVATION; IT IS A STRATEGIC NECESSITY WITHIN OUR NATIONAL SUPPLY CHAIN.

LGRIN-based designs simplify optical systems, reduce manufacturing complexities, and ensure high-performance functionality across all operational conditions. By eliminating foreign dependencies and supply chain weaknesses, LGRIN optics fortify the future of defense technology - delivering a secure, superior, and sustainable solution for military and national security applications.

PEAK LEADERSHIP IN OPTICS

	Traditional Glass Lenses	Peak LGRIN Lenses
Field of View	Limited	**Up to 50% improved**
Resolution	Standard	**Up to 75% improved**
Weight	Heavy	**4X Lighter**
Thickness	Full	**2X Thinner**
Color Correction	Standard	**Enhanced**
Cost	Expensive	**Net Savings**
Design Process	Complex	**Simple**
AI Optimized	No	**Yes**
U.S.-based Supply Chain	No	**Yes**

Peak NanoPlex-based LGRIN Lenses are Protected by 19 Patents

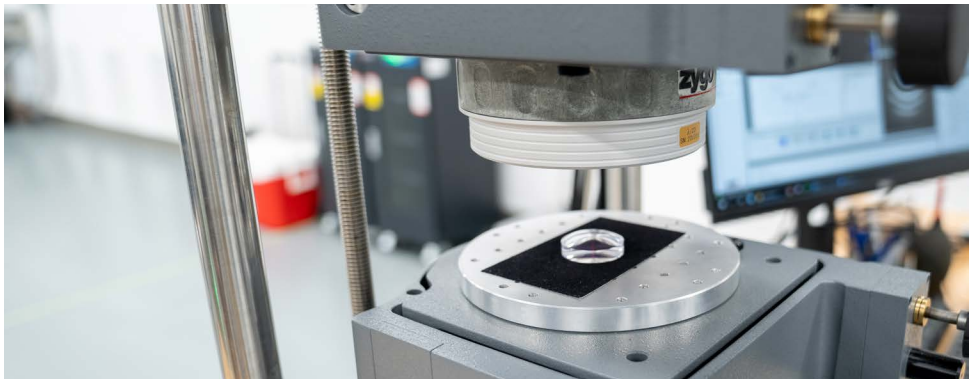
CONCLUSION

In modern military operations, optical instruments are not just essential, they are the foundation of operational dominance. Every phase of military action depends on them, from targeting systems and reconnaissance to missile guidance and satellite surveillance. Yet, the widespread reliance on fragile, foreign-dominated supply chains exposes an alarming vulnerability: if compromised, these systems could cripple U.S. military readiness.

Our research has revealed a stark reality - a moderately sophisticated adversary with access to our supply chain could inflict catastrophic disruption on U.S. forces. The supply chain's exposure is extensive, with some critical optical materials facing supply guarantees as short as three years. Even more concerning, a significant portion of the glass used in Department of Defense optics is sourced directly from China, a geopolitical competitor with both the means and motivation to exploit this dependence.

LGRIN optical technology is more than an advanced innovation; it is a strategic necessity within our national supply chain. By eliminating excess glass elements produced in China, LGRIN simplifies fabrication, reduces reliance on vulnerable materials, and enhances performance. This breakthrough not only levels the playing field, it shifts the advantage decisively in our favor. Unlike conventional optics, LGRIN technology has no foreign equivalent, making it an indispensable national security asset.

Peak Nano is confident that its patented LGRIN technology, AI-driven design tools, and advanced manufacturing represent a cornerstone of securing America's military infrastructure. As we confront the harsh realities of modern warfare and global supply chain threats, securing our optical supply chains is not just a priority - it is a national security imperative. LGRIN is not merely an option; it is the only viable path forward.



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