



Leveraging Novel Materials in Infrared Glass

February 1, 2022



GLOBAL LEADER
OPTICS & INFRARED SOLUTIONS

Introduction to LightPath

LightPath Portfolio of Solutions

Precision Molding Capabilities

Novel Infrared Solutions



35+ years of diversified market experience in supplying **millions** of precision visible and infrared optics annually, serving the defense, industrial, commercial, medical and telecom industries



Global Provider of OEM optical components, differentiated by proprietary manufacturing techniques and vertically integrated low cost / high volume manufacturing capabilities



Deep expertise in cost-efficient fabrication of lenses using high-volume molding techniques



World-class optical design and engineering solutions from prototype to production



Large and growing portfolio of superior quality precision molded VIS & IR optics

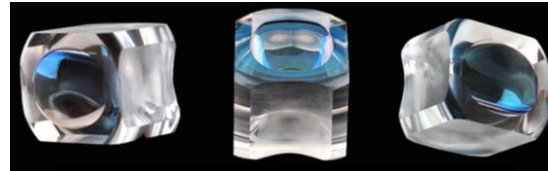
Molded Aspheric Lenses

Visible/NIR

Short-Long Wave



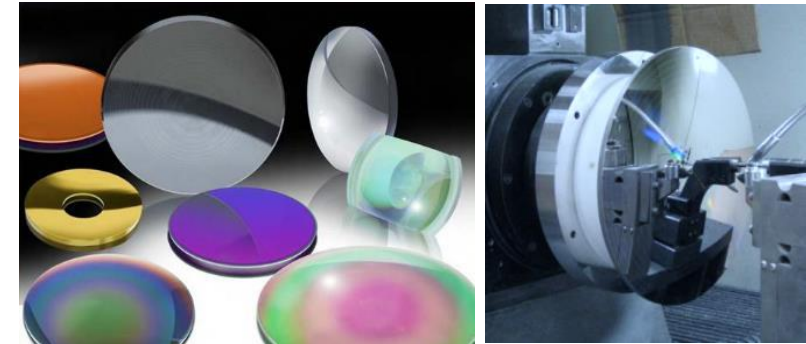
Molded Freeform Optics



NEW Technology!

Diamond Turning, CNC

Crystalline Materials and Coatings

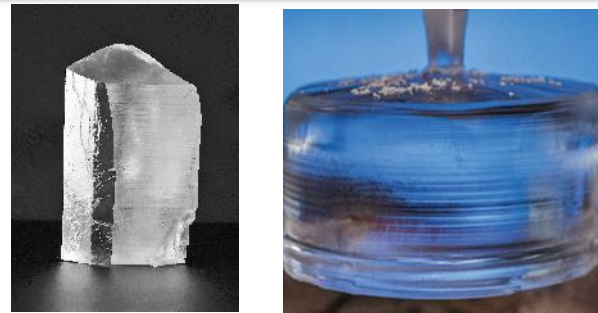


Assemblies

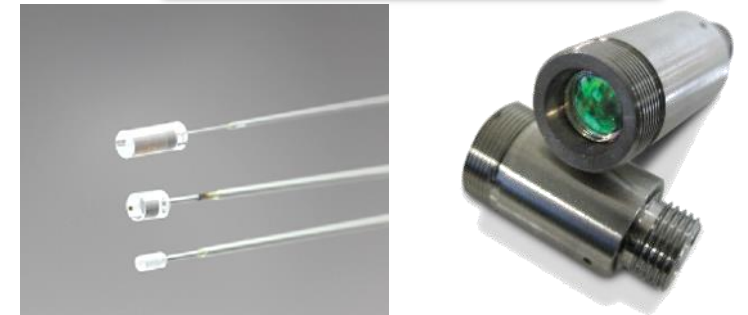


Specialty Products

KBr & NaCl Crystal Growth

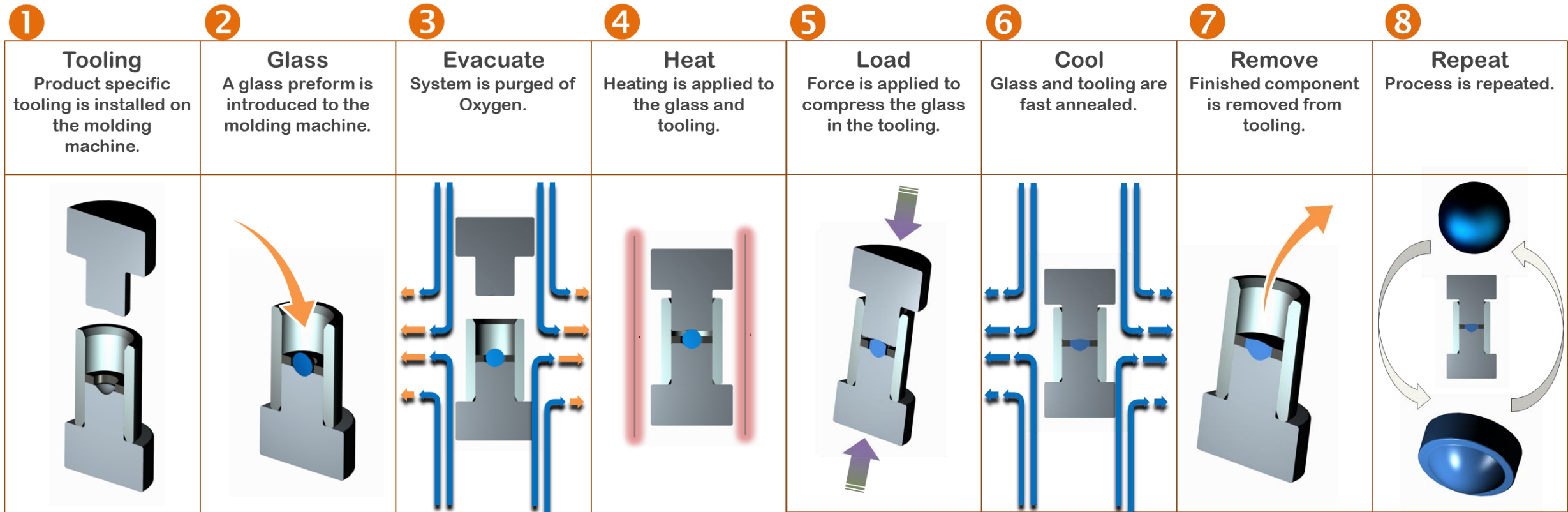


Fiber Collimators



- High throughput manufacturing process enables high-volume, low-cost, and small form factor lenses
- High temperature compression-molding in a controlled environment enables good repeatability
- Precision tooling components enable tight tolerances, such as alignment and form error
- Common applications for PGM:
 - Laser collimation
 - Fiber coupling
 - Compact imaging systems (ex. endoscopy)
 - Quantum Cascade Lasers (QCL) for SWIR to LWIR
 - Thermal imaging in MWIR and LWIR





Exclusive License for Infrared Materials

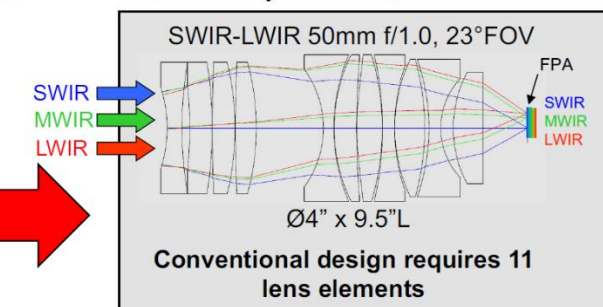
- The Problem of Multispectral Imaging: Need 3 Cameras
 - Infrared imaging is done in different wavebands (SWIR, MWIR, LWIR) to capture images under different conditions. Day, night, fog, clouds, etc.
 - Current solutions are to have separate cameras for each modality (see payload to the right)
- Technological Advances:
 - **Detector technology is advancing** and detectors that can image in multiple wavebands are becoming available
 - But there are a limited number of optical materials that can work in the infrared, so an optical system for multiple wavebands is not feasible
- **Solution: LightPath license from Naval Research Lab (NRL)**
 - **9 New materials designed specifically for multiband imaging.**
- **3 Cameras become 1 or 2... Reducing weight, size, power consumption and cost!**



Prevailing Technology,
Multi-aperture sensor payload



The New Technology,
Common Aperture Multiband Camera

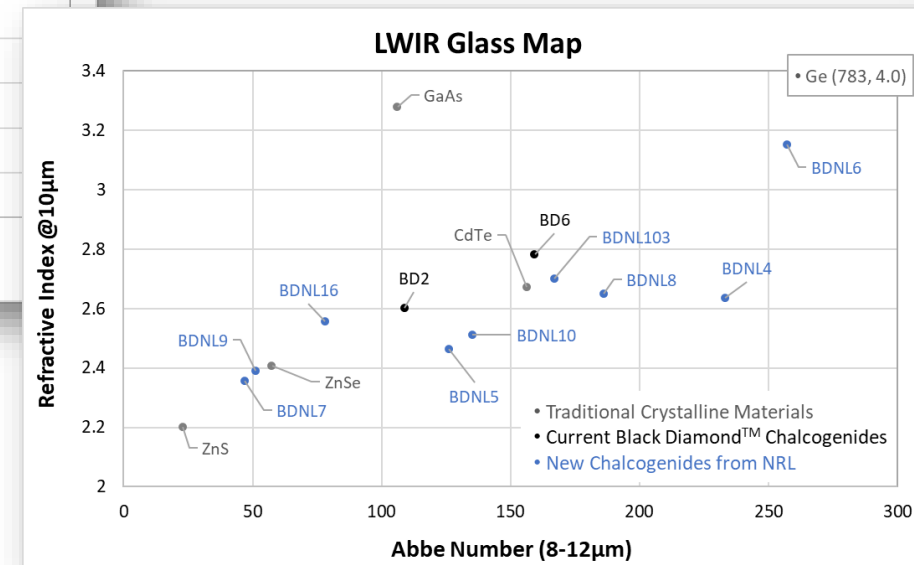
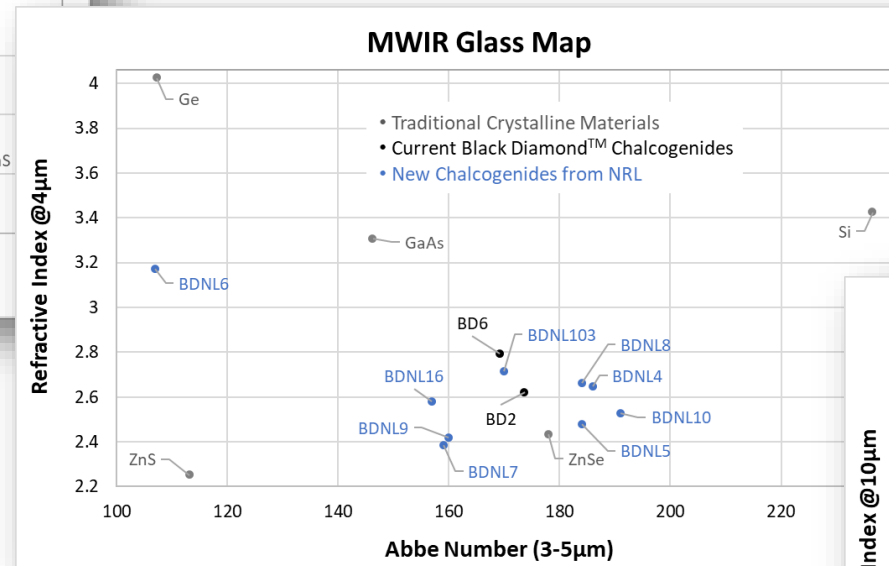
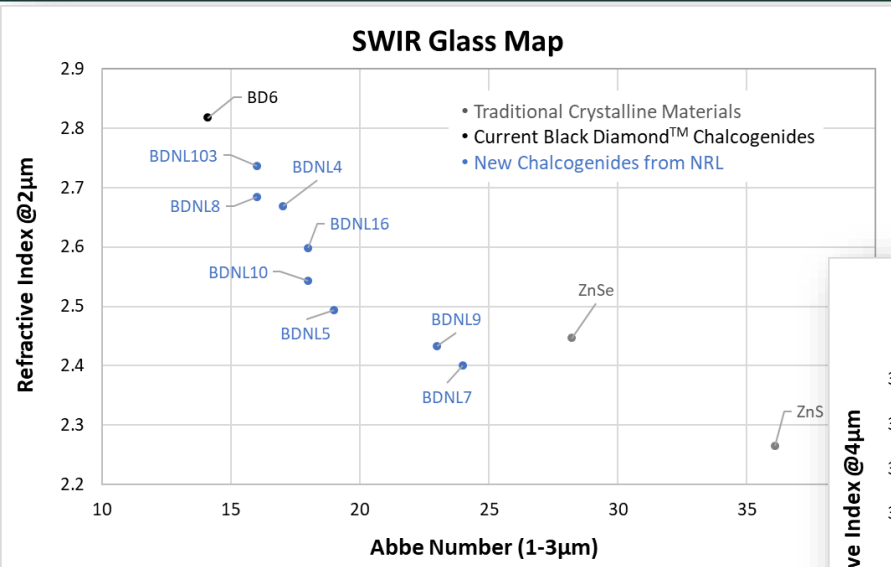


NEW Chalcogenide Materials for Infrared and Multispectral Applications

Glass	NRL Glass	Wavelength range* (μm)	SWIR (1-3 μm)			MWIR (3-5 μm)			LWIR (8-12 μm)			Density (g/cm^3)	T _g ($^{\circ}\text{C}$)	CTE ($\text{ppm}/^{\circ}\text{C}$)
			Index	dn/dT ($\text{ppm}/^{\circ}\text{C}$)	V(1-3)	Index	dn/dT ($\text{ppm}/^{\circ}\text{C}$)	V(1-3)	Index	dn/dT ($\text{ppm}/^{\circ}\text{C}$)	V(1-3)			
BDNL4	NRL-4	0.78 – 17.5	2.66815	-17.3	17	2.64837	-18.6	186	2.63709	-18.3	233	4.479	201	30.2
BDNL5	NRL-5	0.74 – 17.2	2.49378	9.61	19	2.47761	7.62	184	2.46289	6.33	126	4.421	192	26
BDNL6	NRL-6	1.43 – 18.2	3.22366	202	NA	3.17169	169	107	3.15227	160	257	5.234	191	18.3
BDNL7	NRL-7	0.57 – 12.7	2.40106	-4.38	24	2.38657	-7.34	159	2.35760	-8.11	47	3.177	201	25.3
BDNL8	NRL-8	0.79 – 18.9	2.68413	2.97	16	2.66324	1.2	184	2.64996	-0.4	186	4.516	193	25.7
BDNL9	NRL-9	0.61 – 12.8	2.43256	-3.64	23	2.41739	-3.83	160	2.38929	-5.94	51	3.281	197	25.1
BDNL10	NRL-10	0.74 – 17.5	2.54364	27.2	18	2.52625	22.6	191	2.51154	21	135	4.446	191	27
BDNL16	NRL-16	0.74 – 13.0	2.59823	21	18	2.57946	14	157	2.55692	12	78	3.897	182	24
BDNL103	NRL-103	NA	2.73697	65	16	2.71527	61	170	2.70057	58	167	4.54	314	14
BD6	NA	0.83 - 17.5	2.81731	NA	14.1	2.79228	NA	169.2	2.7816	30.5	159.4	4.63	185	22.5
BD2	NA	0.93 - 16.0	2.63338	NA	NA	2.62100	NA	173.7	2.6022	61.1	109	4.66	285	14

*Represents 3dB transmission cutoff wavelength

NEW Chalcogenide Materials for Infrared Applications



Why Partner with LightPath?

Precision molding provides the **most cost-effective method** to produce high-quality and low-cost aspheric optics in high volume.

We offer **superior performance**, a more compact, elegant solution than spherical optics, and by molding we can do it very cost effectively.

We're **vertically integrated** to keep complete control over all of the manufacturing processes and maximize our manufacturing flexibility.

We've led the industry by **pioneering next-generation molding technologies** such as insert molded lenses and freeform optics.

We have **state-of-the-art facilities on three continents**, with in-house engineering support for your custom designs, which we can support in both small and large volumes.

We can help to **improve the performance of your optical system**, lower the cost of your bill of materials and improve your time-to-market.



2022 PRISM AWARD WINNER!



*Presented by SPIE and Photonics Media at Photonics West 2022
for Category of Manufacturing and Test*



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