GLOBAL OPTICS

Ge
Germanium

🔷 Key Properties of Germanium (Ge)

🌈 Infrared Transmission: Excellent transmission from ~2 µm to 14 µm — ideal for MWIR and LWIR optical systems.

🔍 High Refractive Index: ~4.0 at 10 µm — provides strong focusing power for compact infrared optics.

🛡️ Non-Hygroscopic & Chemically Stable: Unaffected by moisture and most environmental conditions.

🔥 High Thermal Stability: Performs reliably up to ~100°C; absorbs strongly in the visible region, appearing opaque and metallic-grey.

⚙️ High Density & Brittleness: Mechanically strong but brittle — requires careful handling and mounting.

🌡️ Temperature-Sensitive Transmission: Transmission decreases above ~100°C due to increased absorption from intrinsic carriers.

🔬 Precision Optical Quality: Available with AR or DLC coatings optimized for 3–5 µm and 8–12 µm spectral bands.

Unit 6, Branksome Business Park,
Bourne Valley Rd, Poole BH12 1DW

+44 (0) 1202 767476
info@globalopticsuk.com
www.globalopticsuk.com

GLOBAL OPTICS

🧩 Applications of Germanium (Ge)

🌡️ Infrared Windows and Lenses: Commonly used in thermal imaging, night vision, and infrared camera systems operating in the 2–14 µm range due to its excellent transmission and durability.

🧪 FTIR Spectroscopy and Gas Analysis: Ideal for use in spectroscopy cells, beam splitters, and sample windows covering mid-IR wavelengths.

💡 Thermal Imaging and Surveillance Systems: Extensively used in MWIR and LWIR optical assemblies for defense, automotive, and industrial thermal cameras.

🛰️ Defense, Aerospace & Environmental Sensing: Germanium optics are integrated into high-performance sensor systems where mechanical strength and chemical stability are critical.

🔬 Laser Optics and Beam Steering: Used for high-power CO_2 laser components, reflectors, and lenses when coated with DLC or AR coatings to minimize absorption.

⚙️ Optical Systems for Industrial & Medical Use: Germanium's high refractive index enables compact optical designs in process monitoring, temperature sensing, and diagnostic instruments.

Unit 6, Branksome Business Park,
Bourne Valley Rd, Poole BH12 1DW

+44 (0) 1202 767476
info@globalopticsuk.com
www.globalopticsuk.com

GLOBAL OPTICS

Technical Parameters of Germanium (Ge)

Property	Typical Value
ransmission Range	~2 µm to 14 µm (MWIR to LWIR)
Refractive Index	~4.0 @ 10 µm
Density	5.33 g/cm³
Hardness (Knoop)	~780 kg/mm²
Melting Point	937 °C
Thermal Expansion	~6.1 × 10^{-6}/°C @ 20–300 °C
Thermal Conductivity	~60 W/m·K @ 293 K
Crystal Structure	Cubic (Diamond)
Hygroscopic	No — non-hygroscopic and chemically stable
Chemical Formula	Ge
Laser Damage Threshold	~25 MW/cm² CW @ 10.6 µm (typical)
Applications	Thermal imaging, FTIR spectroscopy, CO_2 laser optics, surveillance, aerospace, infrared sensors
Coating Compatibility	AR and DLC coatings for 3–5 µm & 8–12 µm, broadband or single-band IR applications

Germanium (Ge) is a dense, crystalline infrared optical material prized for its high refractive index (~4.0 at 10 µm) and excellent transmission from 2 µm to 14 µm.

It is opaque in the visible range but offers outstanding performance across the mid- and far-infrared, making it ideal for thermal imaging, spectroscopy, and CO_2 laser systems.

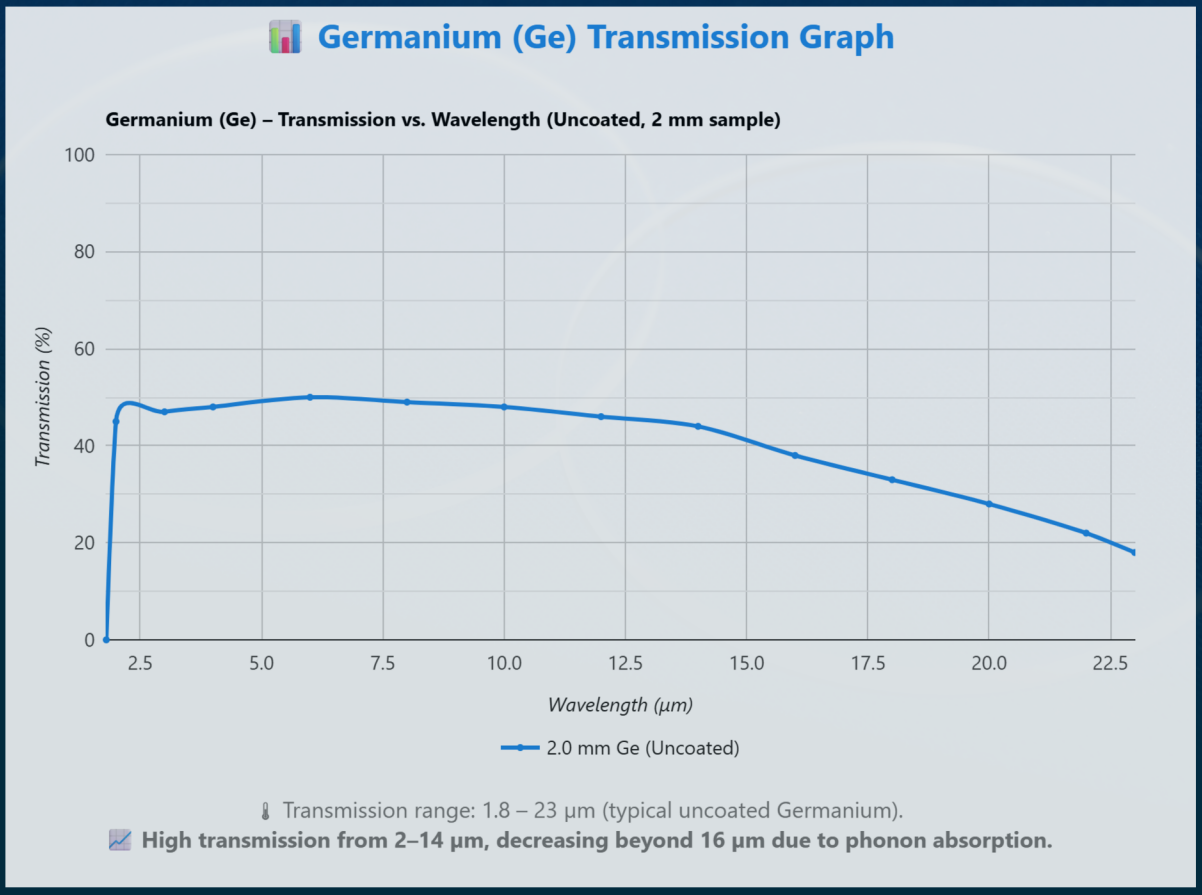
With high hardness, good chemical stability, and a low dispersion, Germanium is commonly used for windows, lenses, and prisms in infrared optics and thermal camera assemblies.

However, due to its high density (5.33 g/cm³) and thermal sensitivity (dn/dT ≈ 396 ×10^{-6} /°C), temperature control is important in precision IR applications.

Unit 6, Branksome Business Park,
Bourne Valley Rd, Poole BH12 1DW

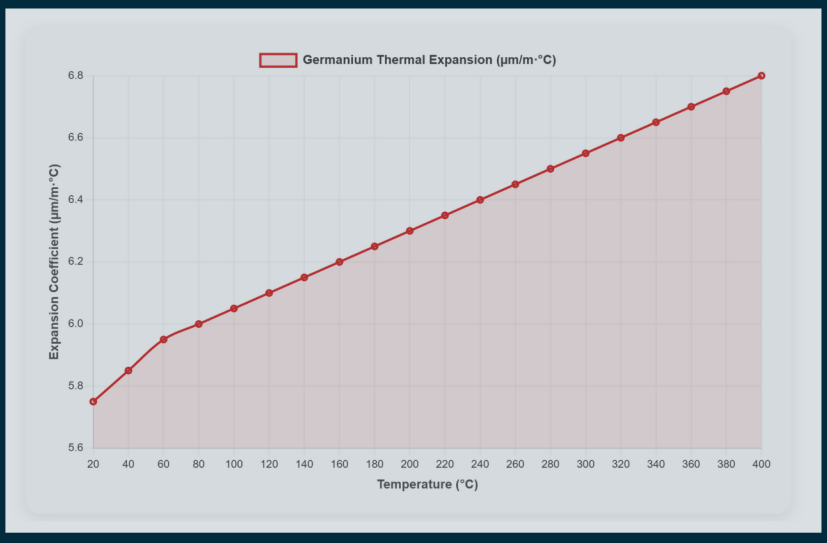
+44 (0) 1202 767476
info@globalopticsuk.com
www.globalopticsuk.com

Germanium (Ge) Transmission Graph



Transmission range: 1.8 – 23 µm (typical uncoated Germanium).

High transmission from 2–14 µm, decreasing beyond 16 µm due to phonon absorption.



Transmission:

Germanium (Ge) offers excellent transmission from ~2 µm to 14 µm, covering the mid- and far-infrared regions.

It is opaque to visible light but provides very high transmission and low absorption in the IR spectrum, making it ideal for thermal imaging, FTIR spectroscopy, and CO_2 laser optics.

With its high refractive index and low dispersion, Germanium delivers superior performance in precision IR lenses and windows where clarity and thermal stability are critical.

Thermal Expansion:

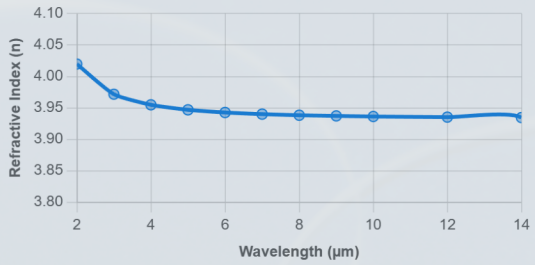
Germanium exhibits a moderate coefficient of thermal expansion, approximately 5.8 × 10^{-6} /°C at 300 K. While it maintains good dimensional stability, its high dn/dT (~396 × 10^{-6} /°C) means refractive index changes noticeably with temperature.

As a result, temperature control is important in precision infrared systems to avoid focus drift. Despite this, Germanium remains mechanically robust and well-suited for IR lenses and windows operating in stable thermal environments.

Unit 6, Branksome Business Park,
Bourne Valley Rd, Poole BH12 1DW

+44 (0) 1202 767476
info@globalopticsuk.com
www.globalopticsuk.com

Refractive Index of Germanium (Ge) vs. Wavelength



Real-world measurement data (CSV loaded dynamically)

Wavelength	Refractive index
2.00	4.0197
3.00	3.9718
4.00	3.9549
5.00	3.9470
6.00	3.9428
7.00	3.9402
8.00	3.9385
9.00	3.9374
10.00	3.9365
12.00	3.9355
14.00	3.9348
16.00	3.9344
18.00	3.9341

FAQ

Q: What is Germanium used for?
A: Germanium (Ge) is extensively used in thermal imaging, infrared optics, and spectroscopy. It is ideal for infrared windows, lenses, and prisms operating in the 2–14 µm range, where it provides excellent transmission and minimal chromatic aberration. Germanium is also widely used in CO_2 laser systems, defense and surveillance sensors, and as a semiconductor material in detectors and transistors. Its high refractive index allows for compact, high-performance IR optical designs.

Q: What is the transmission range of Germanium?
A: Germanium transmits efficiently from approximately 2 µm to 14 µm, covering the MWIR and LWIR regions. It is opaque in the visible spectrum and blocks UV light, making it ideal for dedicated infrared applications such as thermal cameras, spectroscopy, and CO_2 laser optics.

Q: Is Germanium mechanically durable?
A: Yes — Germanium is a hard, dense, and stable material with a Knoop hardness of around 780 kg/mm². However, like many crystalline materials, it is brittle and should be handled carefully to avoid chipping or cracking during fabrication and mounting.

Q: Is Germanium hygroscopic?
A: No — Germanium is non-hygroscopic and chemically inert. It is unaffected by moisture and most environmental conditions, making it suitable for rugged applications in aerospace, defense, and outdoor infrared systems.

Unit 6, Branksome Business Park,
Bourne Valley Rd, Poole BH12 1DW

+44 (0) 1202 767476
info@globalopticsuk.com
www.globalopticsuk.com