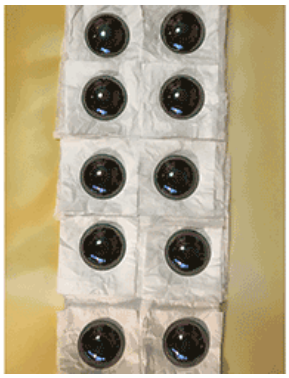
Germanium domes for thermal imaging

(Especially for defense and aerospace)

- **Wide wavelength range of 2-14 μm**
- **Especially for defense, security and aerospace application**

Germanium domes is a special type of windows which is ideal for IR applications(especially for defense and aerospace application) with its broad transmission range and opacity in the visible portion of the spectrum. Germanium domes is commonly used in IR thermal imaging camears typically operating in the 2 μm to 14 μm spectral range, covers the LWIR (8-12μm) and MWIR (3-5μm) thermal imaging wavelength range. Germanium windows can be AR coated with Diamond (DLC coating or Hard carbon coating) producing an extremely tough front optic.



SPECIFICATIONS

Specifications	
Materials	Optical grade germanium single crystals
Diameter range	~300mm
Thickness Tolerance	+/-0.2mm (Optional: +/-0.1mm and +/-0.05mm)
Surface Quality	60/40 S/D
Frings (N)	customized
Irregularity (deta N)	customized
Chamfer	0.1~0.3mmx45degree
Coating	AR/AR@7-14μm DLC/AR@7-14μm BBAR/BBAR@3-12μm See the curves below

Note: the domes of other specifications is available upon customer's request.

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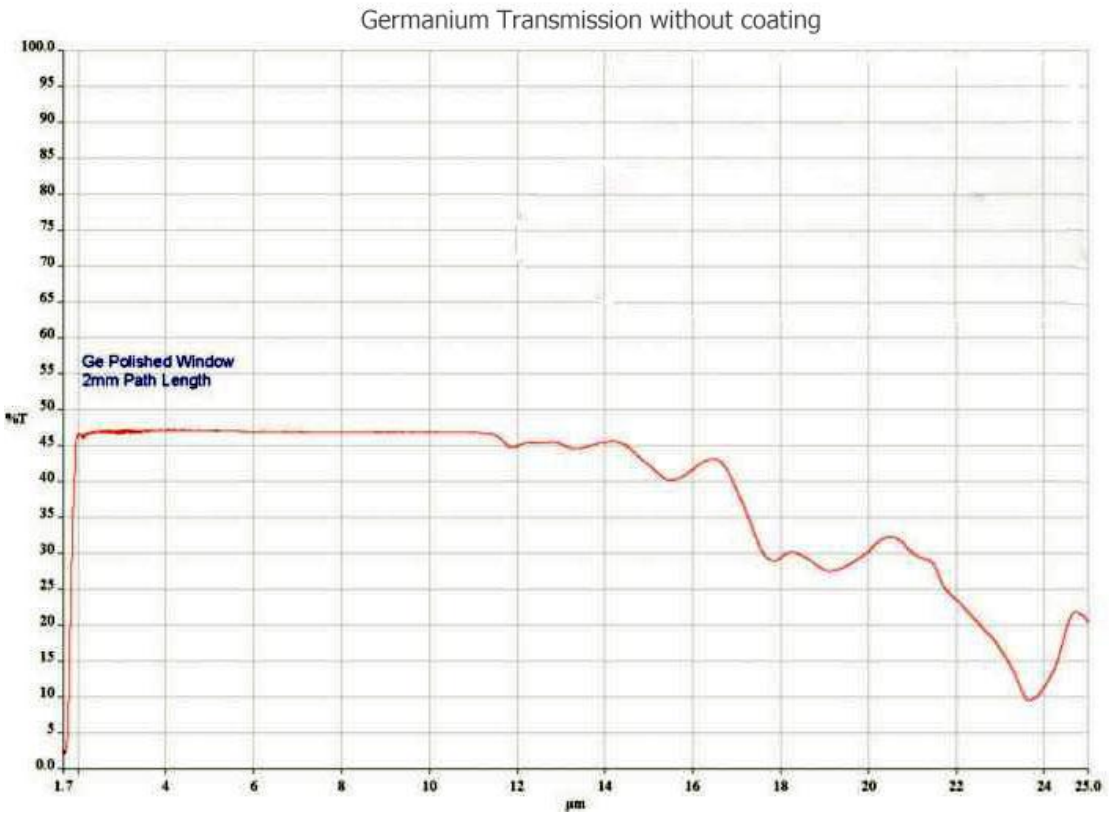
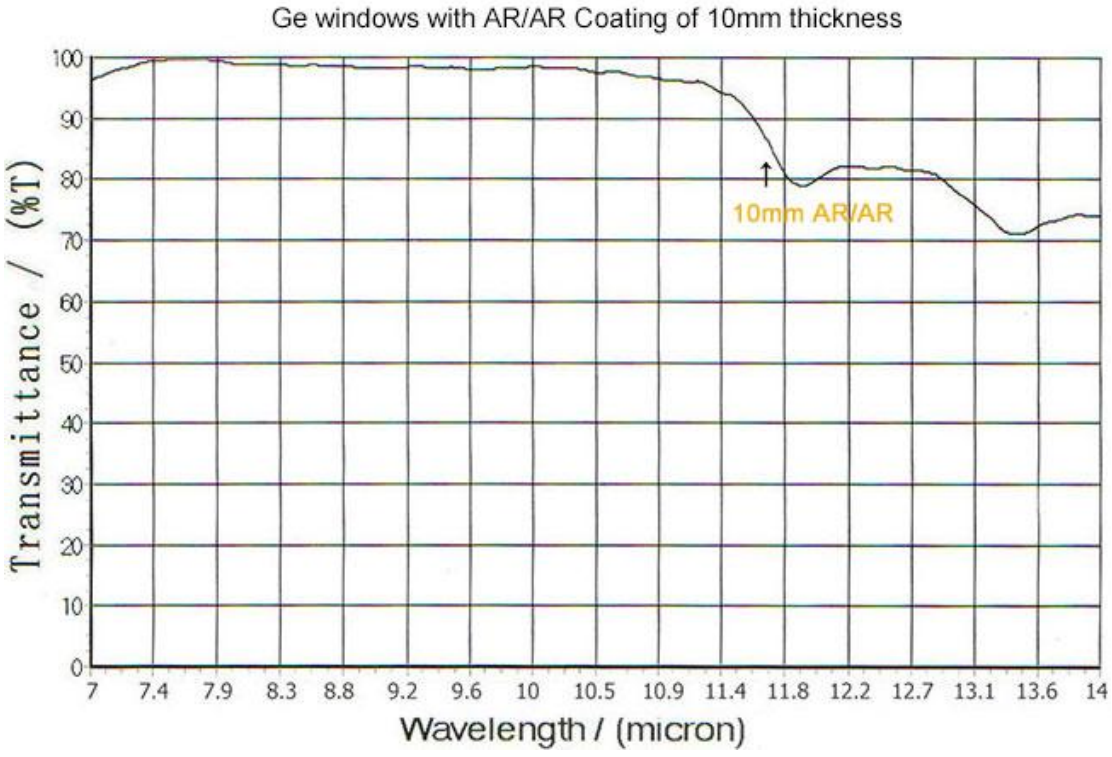
1. Transmission curve 1, transmission of Ge windows with no coating



2. Transmission curve for Ge windows with coating AR/AR of 10mm thickness



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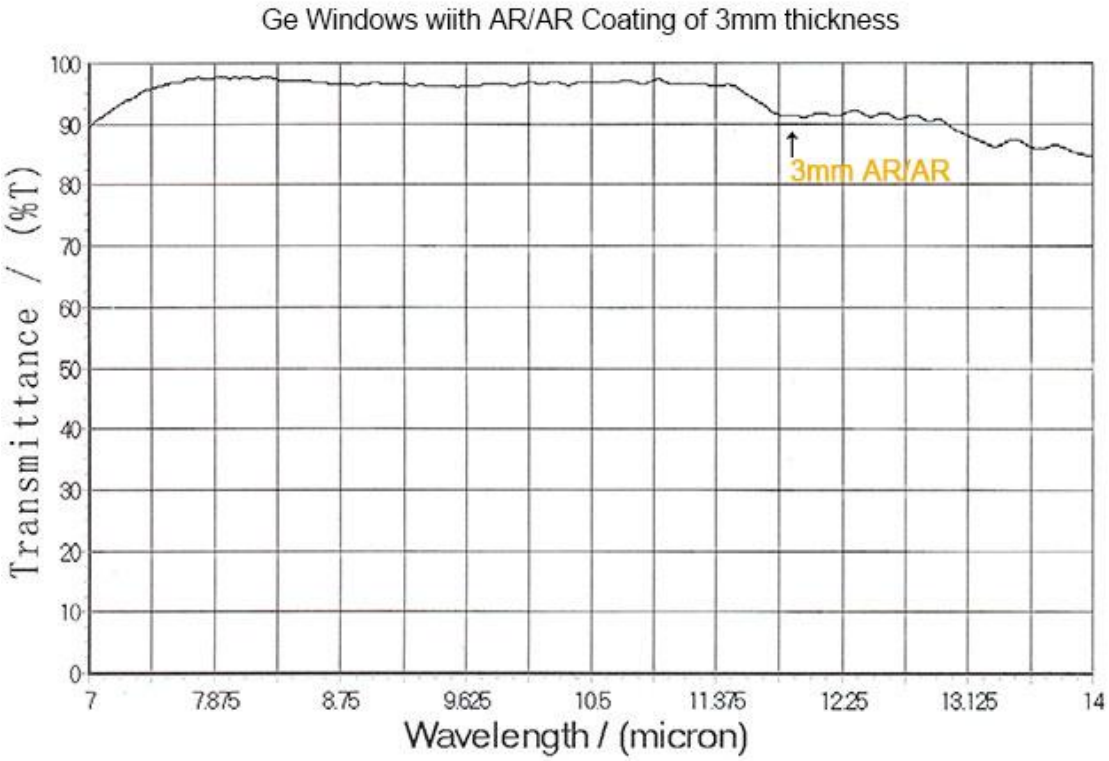
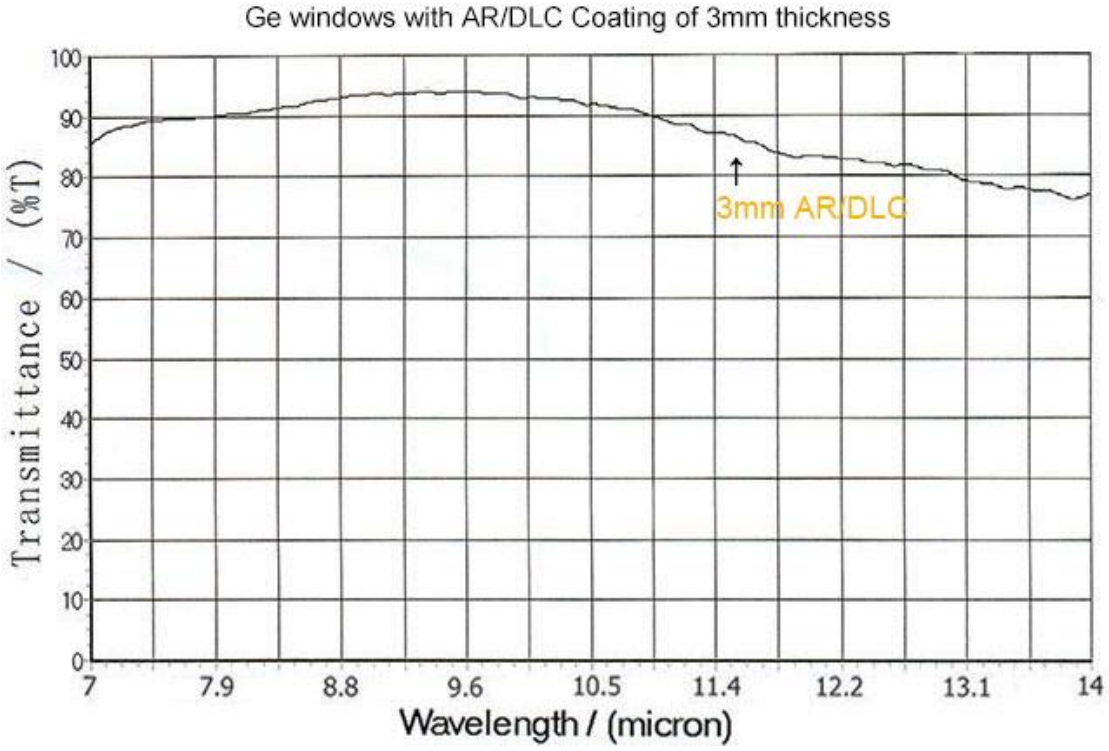
3. Transmission curve for Ge windows with coating AR/AR of 3mm thickness



4. Transmission curve for Ge windows with coating AR/DLC of 3mm thickness



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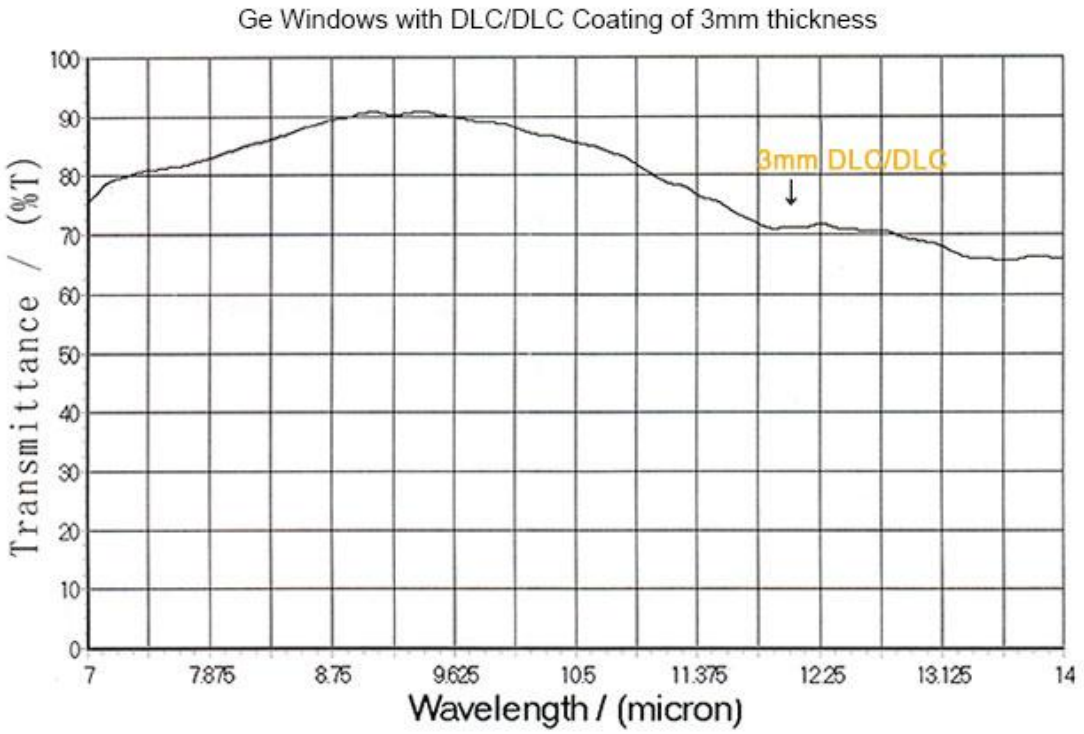
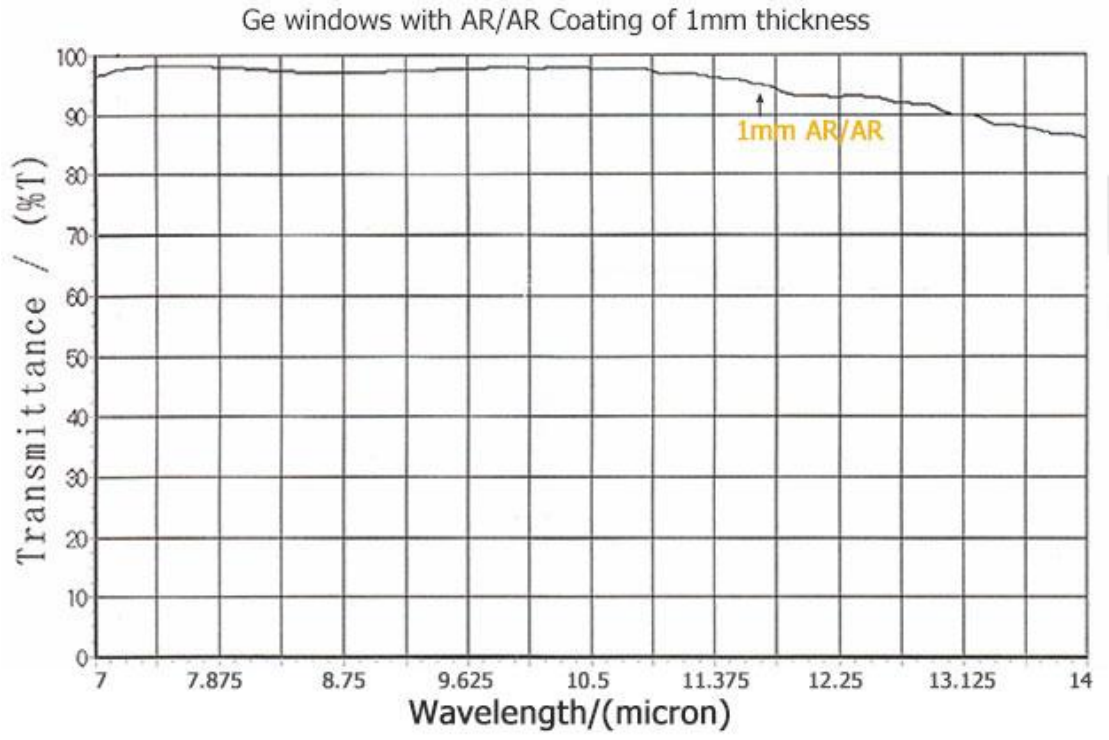
5. Transmission curve for Ge windows with coating DLC/DLC of 3mm thickness



6. Transmission curve for Ge windows with coating AR/AR of 1mm thickness



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Basic Properties

Physical and optical properties	
Transmission Range	1.8 to 23 μm (1)
Refractive Index	4.0026 at 11 μm (1)(2)
Reflection Loss	53% at 11 μm (Two surfaces)
Absorption Coefficient	<0.027 cm-1 @ 10.6 μm
Reststrahlen Peak	n/a
dn/dT	396 x 10-6 /°C (2)(6)
dn/dμ = 0	Almost constant
Density	5.33 g/cc
Melting Point	936 °C (3)
Thermal Conductivity	58.61 W m-1 K-1 at 293K (6)
Thermal Expansion	6.1 x 10-6/°C at 298K (3)(4)(6)
Hardness	Knoop 780
Specific Heat Capacity	310 J Kg-1 K-1 (3)
Dielectric Constant	16.6 at 9.37 GHz at 300K
Youngs Modulus (E)	102.7 GPa (4) (5)
Shear Modulus (G)	67 GPa (4) (5)
Bulk Modulus (K)	77.2 GPa (4)
Elastic Coefficients	C11=129; C12=48.3; C44=67.1 (5)
Apparent Elastic Limit	89.6 MPa (13000 psi)
Poisson Ratio	0.28 (4) (5)
Solubility	Insoluble in water
Molecular Weight	72.59
Class/Structure	Cubic Diamond, Fd3m

Features

- Diameter range: ~ 300mm;
- Fit for both MWIR (3-5 micro) and LWIR (8-12 micro) themal imaging cameras
- Various types of coating:
  AR/AR@7-14um;
  DLC (diamond or hard carbon coating)/AR@7-14um;
  BBAR/BBAR@3-12um;
  Customized coating;

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Application Notes

Germanium (Ge) is a relatively hard, high-density, IR transmitting material that blocks UV and VIS wavelengths but allows IR from 2μm. Germanium has the highest refractive index of commonly available IR-transmitters and has low optical dispersion. This makes it desirable in aspects of lens design where its refractive index allows otherwise impossible specifications to be built. AR coating is recommended.

Germanium transmits over 45% between 2-14μm up to 45^0 C but transmission degrades slowly at 100^0 C then more rapidly above 200^0 C. Exposure to higher temperatures can lead to catastrophic failure in the material so Germanium is unsuitable for use in these conditions. Additionally, its relatively high density should be considered where weight is an issue. Germanium has a hardness of HK780, slightly higher than GaAs with which it shares similar mechanical properties.

Typical applications for Germanium include thermal imaging where the material can be used as a front optic while its index of refraction makes Germanium useful for wide-angle lenses and microscopes. Additionally, Germanium components can be used for FLIR (Forward Looking Infrared) and FTIR (Fourier Transformed Infrared) spectroscopy systems, alongside other analytical instruments.

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