AMTIR-6 (As_2S_3)

Arsenic trisulfide glass (As_2S_3) was first produced commercially in the 1950's. Because of the explosive nature of sulfur reactions, the glass was prepared in an open system, which led to large batch-to-batch variations in the refractive index and related physical properties. In recent years, the open system has fallen out of favor due to environmental considerations. Commercial sources worldwide have ceased production.

During 1990, Amorphous Materials developed a new closed process for making As_2S_3 glass. The process, containing several steps, uses element purification, vapor phase reactions, glass compounding and glass purification steps to cast a homogeneous plate 8" in diameter. The closed nature of the process leads to tightly controlled quality.

Arsenic trisulfide glass has some very unique properties. The light red glass transmits from the visible out to 8µm with no appreciable absorption. For systems operating in the near infrared or the 3-5µm window, the glass is extremely useful for lenses or windows. Generally, use in the 8-l2µm range is not recommended because of intrinsic absorption.

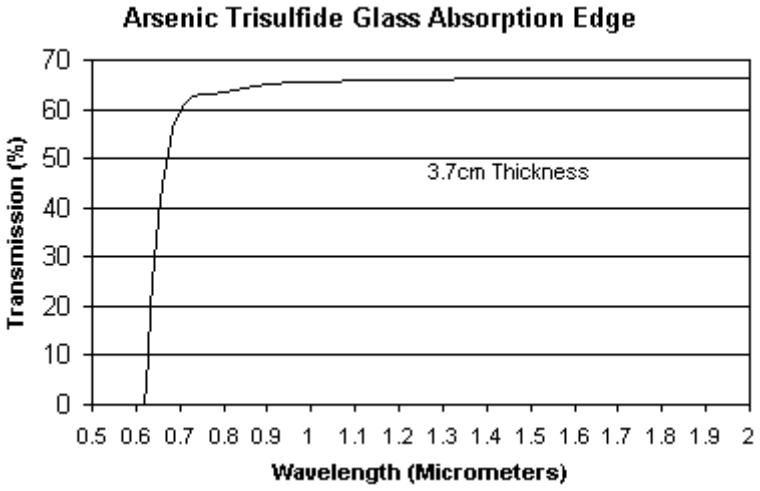
Arsenic trisulfide glass has the lowest thermal change in refractive index of any infrared optical material in use today including germanium, AMTIR-l, AMTIR-3, zinc selenide and zinc sulfide. For this reason, lenses or windows made from As_2S_3 glass do not show optical distortion when subjected to the intense IR radiation from lasers such as YAG, ER/YAG, or CO. The low thermal change in refractive index is thought to be the basis for the fact that 700µm fibers made from As_2S_3 glass have been reported to transmit more than 100 watts of laser energy from a CO laser emitting at 5.4µm.

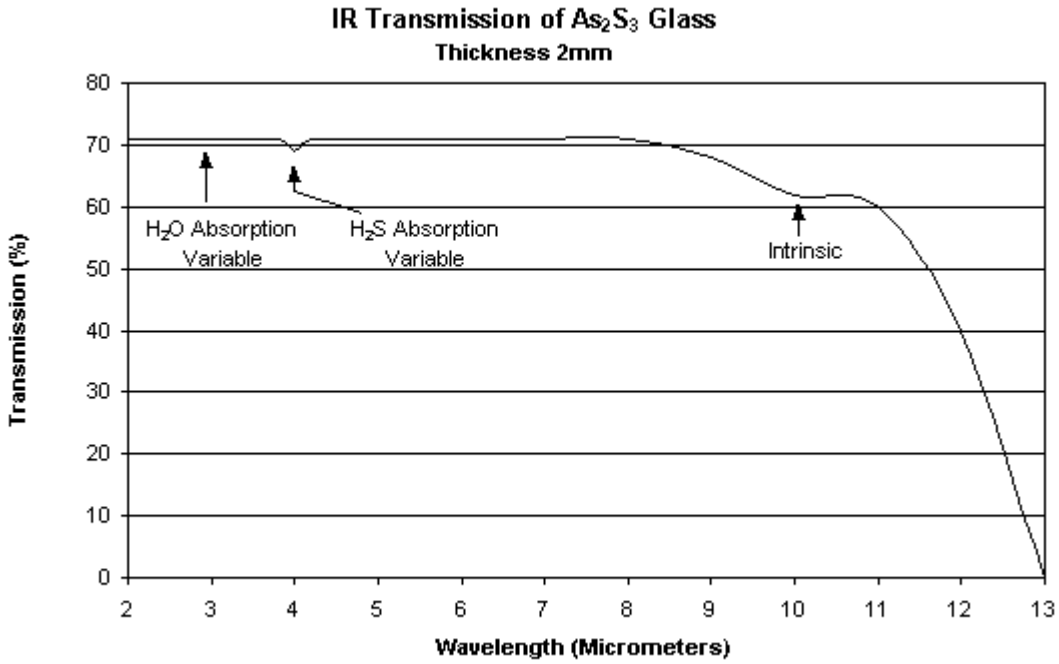
The glass is available in blanks up to 8" in diameter or in slumped plates 12" x 18". As a melt-formed glass, As_2S_3 can be slumped or molded into most any shape or size. Also, Amorphous Materials has developed a process to prepare optical fibers from the glass in diameters ranging from 10-30 mils. The fibers are glass clad/plastic coated or just plastic coated for sensor applications. Lengths up to 100 meters can be obtained.

GENERAL PROPERTIES OF As_2S_3

Composition	$As_{40}S_{60}$ (As_2S_3)
Density	3.2 gms/cm^3
Thermal Expansion	21.4 X $10^{-6}/^{o}C$

Hardness (Knoop)	109
Rupture Modulus	2400 psi
Young's Modulus	2.3×10^6 psi
Shear Modulus	9.2×10^5 psi
Poisson's Ratio	0.24
Thermal Conductivity	4×10^{-4} cal / cm sec $^{\circ}$K
Specific Heat	0.109 cal / gm $^{\circ}$K
Dielectric Constant, 10^3 - 10^6 Hz	8.1
Softening Point	208ºC
Upper Use Temperature	150°C
Glass Transition Temperature	180°C
Annealing Temperature	170°C





REFRACTIVE INDEX AND ABSORPTION COEFFICIENT FOR As_2S_3, 25ºC		
WAVELENGTH µm	**REFRACTIVE INDEX**	**ABSORPTION COEFFICIENT CM^{-1}**
0.6439	2.5976+	0.42
0.7065	2.5586+	0.13
1.014	2.4757+	0.01
1.530	2.4380+	0.01
1.970	2.4268+	0.01
3.0	2.4152	0.03*
4.0	2.4116	0.03*
5.0	2.4074	0.006
6.0	2.4034	0.005
7.0	2.3989	0.020
8.0	2.3937	0.036

+ Malitson, Rodney, King, J. Opt. Soc. Amer. 48 633 (1958) *H_2O, H_2S Absorption Variable.

Precise refractive index values are obtained by performing minimum deviation measurements on prisms fabricated from standard production plates. Values 3-

8µm are 1991 results. Batch to batch variation has been shown to be less than ± 0.003.

As_2S_3 THERMAL CHANGE IN REFRACTIVE INDEX	
Wavelength µm	**$\Delta n/\Delta T \times 10^6$ / ºC**
5	-8.6 (25→ -78ºC)
	+9.3 (20→ 65ºC)

CHEMICAL PROPERTIES	
INORGANIC SOLVENTS	**ORGANIC SOLVENTS**
Insoluble in water	No change after exposure of polished surfaces for several days to:
Insoluble in non-oxidizing acids	gasoline, toluol
Insoluble in concentrated hydrochloric acid (no effect after 12 hours)	alcohol, acetone
Attacked by strong alkaline solutions	

Arsenic Trisulfide Absorption