Diamond (C) - Cubic Carbon

Diamond is available as single crystal (Type IIa) natural or synthetic or as CVD film. Single crystal is available economically up to about 4mm diameter. CVD diamond of 75mm diameter is available. The IR transmission has a range of absorptions in the mid-IR between 2.5 and 7µm due to inherent lattice resonance. The UV transmission may be limited to 350nm in poorer quality samples. Single crystal diamond is selected into four forms: Ia ~98% of natural yield (>100ppm Nitrogen - yellow)
Ib ~0.1% of natural yield (~100ppm Nitrogen)
IIa ~2% of natural yield (1ppm Nitrogen)
IIb - Synthetic only (100ppm boron for electronic applications)

Only Type IIa is used for optical applications. CVD diamond transmission and characteristics are very similar to Type IIa.

APPLICATIONS: Diamond is used for transmission windows and domes.

Transmission Range	300nm to 2.5µm and 7µm to >100µm (1)
Refractive Index	2.4175 @ 0.589µm (1)
Reflection Loss	30% @ 0.589µm
Absorption Coefficient	~0.09 cm^{-1} @ 10.6µm
Reststrahlen Peak	n/a
dn/dT	30 x 10^{-6} K^{-1} @ 300K (3)
dn/dµ = 0	n/a
Density	3.51
Melting Point	3497°C (Oxidises in air at 700°C - see note)
Thermal Conductivity	2600 W m^{-1} K^{-1} @ 273K (2)
Thermal Expansion	1 x 10^{-6} K^{-1} at 293K
Hardness	Knoop 5700 to 10400
Specific Heat Capacity	502 J Kg^{-1} K^{-1} @ 300K (4)
Dielectric Constant	5.68 @ 1.68Mhz at 300K (2)
Youngs Modulus (E)	1050 GPa
Shear Modulus (G)	n/a
Bulk Modulus (K)	442 GPa
Elastic Coefficients	C_{11}=1076; C_{12}=125; C_{44}=577
Apparent Elastic Limit	276 MPa
Poisson Ratio	0.16 to 0.29
Solubility	Insoluble in water
Molecular Weight	12.01
Class/Structure	Cubic Diamond, Fd3m

Note:Being a form of carbon, diamond oxidises in air over 700°C. In the absence of oxygen such as in a flow of argon gas, diamond can be heated to 1700°C. The surface blackens but can be recovered by polishing.

(1) Handbook Optical Constants, ed Palik, V1, ISBN 0-12-544420-6
(2) Properties of Polycrystalline Diamond, Sussmann et. al. Diamond & Rel. Mat. 3(1994) 303-312
(3) Fontenella et. al. App. Optics **16**, 2949 (1977)
(4) Slack & Bartram J.Appl. Phys. **46**, 89 (1975)

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µm	No	µm	No	µm	No
0.232	2.6917	0.298	2.5429	.405	2.4626
0.589	2.4175	0.656	2.4104	1.00	2.3905
2.0	2.3813	3.0	2.3795	4.0	2.3787
5.0	2.3783	6.0	2.3779	10.0	2.3765
20	2.3741