THE SPECTRA OF LONGITUDINAL AND TRANSVERSE DIELECTRIC CONSTANTS OF GRAPHITE

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Graphite is a uniaxial absorbing crystal. Reflectance at normal incidence from the basal planes has yielded the transverse optical constants.[1,2] The simplest experiments to obtain the longitudinal optical constants would involve reflections at normal incidence from the (hk0) faces; one of the extreme values of the reflectance, the minimum in the case of graphite, is a function of the optical parameters along the optic axis only. Unfortunately, in the case of graphite, these faces are not available and experiments involving oblique incidence of polarized light at the basal planes or normal incidence of polarized light on other crystal faces must be used. The usual method of analyzing these data by means of the uniaxial indicatrix is not valid for an absorbing crystal such as graphite, and equations developed by one of us[3] have been used to analyze the existing data. It has been found that the longitudinal index of refraction is essentially a constant from the ultraviolet to the infrared and the absorption index is essentially zero over this range. The results are summarized in the table below.

The Optical Properties of Hexagonal Graphite at 5461 A

Optical Property*	On the x-y plane	Along the z (optic) axis
Refractive index, n	2.15	1.81
Absorption index, χ	0.66	Not detectable
Dielectric constant, ϵ	2.61	3.28
Conductivity, σ	1.68×10^{15} sec.$^{-1}$	Not detectable
Reflectance in air, R	0.280	0.083
Emissivity, 1-R	0.720	0.917

*ϵ and σ are defined by $\epsilon = n^2(1-\chi^2)$, $\sigma = n^2\nu$.

A systematic investigation of the anisotropy of the emissivity of graphite was recently made by Autio and Scala.[4] Analysis of their data showed that the dependence of emissivity in the infrared region on the orientation of the emitting surface is well explained by the recently developed equations. Emissivity data below 3 microns, however, show substantial disagreement with these equations and reported reflectance results.

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2. Taft, E. A. and Phillipp, H. R. Phys. Rev., 138, A197, (1965).
3. S. Ergun, Nature 213, 135 (Jan. 14, 1967).
4. Autio, G. W. and Scala, E., Carbon 4, 13 (1966).