OPTICAL CONSTANTS OF BASALTIC GLASS FROM 0.0173 TO 50 μm

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ABSTRACT. Pollack et al. [*Icarus* **19**, 372 (1973)] have reported the optical constants for obsidian, basalt, andesite and basaltic glass over the wavelength range 0.2 to 50 μm, and Lamy [*Icarus* **34**, 68 (1978)] reported the optical constants from 0.10 to 0.44 μm for obsidian, basalt, and basaltic glass. We have revised the former measurements for basaltic glass and extended them into the extreme UV to 0.0173 μm.

1. INTRODUCTION

The major constituents of interplanetary and circumstellar dusts are silicates and carbonaceous materials. Analysis of stratospheric interplanetary dust particles shows chondritic elemental abundances and confirms the silicate mineral identification. The spectra of the majority of collected interplanetary dust particles are dominated by olivines, pyroxenes and layer-lattice silicates (Sandford and Walker, 1985). Comets also contain mixtures of the different crystalline silicates which may vary from comet to comet and even within a comet (Sandford, 1988). Thus the measurement of the optical constants of naturally occurring rocks and glasses will be valuable for studies of the absorption, emission, and scattering properties of rock surfaces, atmospheric dust and interplanetary and interstellar dust grains.

2. METHOD

The real (n) and imaginary (k) parts of the complex refractive index of basaltic glass have been determined from a combination of measurements.

A Seya-Namoika monochromator is employed to measure near normal reflectivity R_n from 0.1033 to 0.6 μm. An infrared spectrometer is used to measure R_n from 2 to 20 μm. Pollack et al. (1973) measured the reflectance of basaltic glass from 0.2 to 50 μm. To 20 μm, the Pollack et al. data agree with our results. For the short wavelength region in the vacuum and extreme UV from 0.0173 to 0.1689 μm, a McPherson Model 247 grazing incidence monochromator was used. The value R_n is low in this region and therefore, we measured the reflectivity as a function of angle of incidence to obtain n and k. The n and k values were then used to calculate R_n. From all these measurements combined with the R_n values of Pollack et al. from 20 to 50 μm, a composite R_n curve was obtained from 0.0173 to 50 μm. This composite curve was then used to obtain n and k over the entire wavelength range by Kramers-Kronig analysis.

A.C. Levasseur-Regourd and H. Hasegawa (eds.), Origin and Evolution of Interplanetary Dust, 102–104.

Ellipsometry is less affected by non-specularity of the reflecting surface. Using ellipsometry to determine *n* independently from 0.4 to 2.0 μm allowed us to determine a correction factor for R_n, which was slightly low because of microscopic roughness. Thus all R_n values were multiplied by 1.06 allowing a more accurate computation of the optical constants.

3. RESULTS

In Figure 1 the *n* and *k* values obtained by the above analysis are compared with results of Pollack et al. (1973).

Values of *n* and *k* presented here for 0.0173 μm $\leq \lambda \leq$ 50 μm show peak values of *k* = 1.0 at 23 μm, 1.1 at 9.9 μm, and 0.76 at 0.080 μm. Normal incidence reflectance at 0.5 μm is 0.066, comparable to values observed for the Moon.

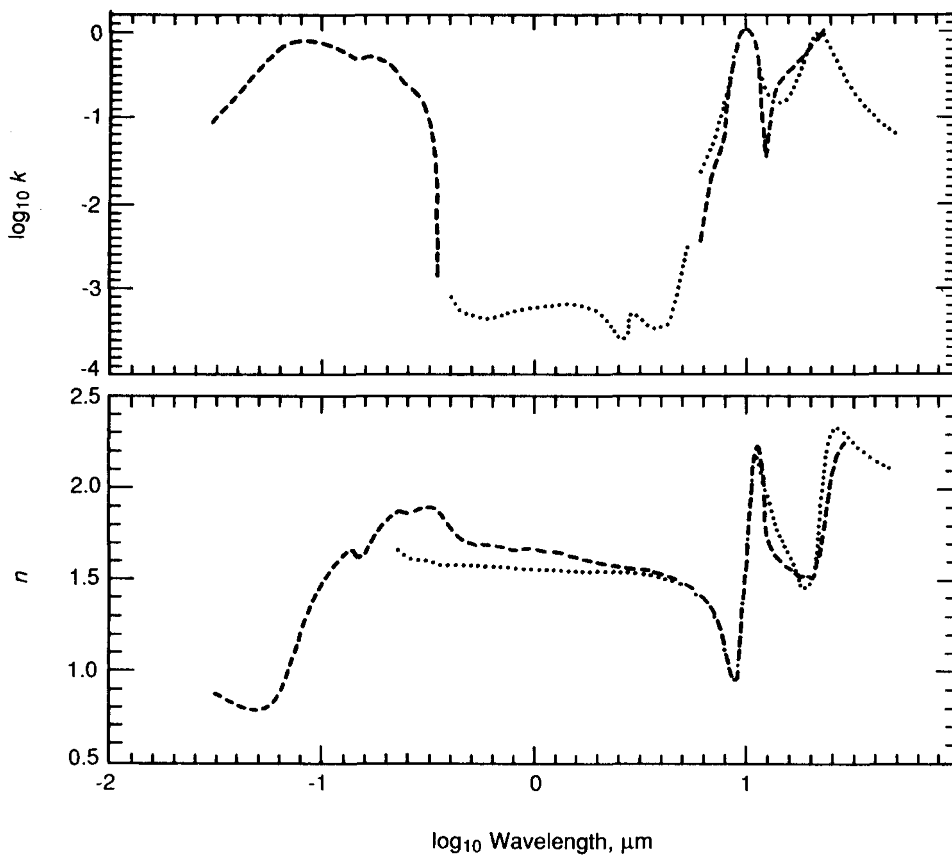

Figure 1. Optical constants of basaltic glass obtained in this work (dashed lines) and those determined by Pollack *et al.* (1973) (dotted lines) are shown. The present measurements extend the constants to the EUV and thus allow a more reliable determination of *n* and *k* via the Kramers-Kronig method.

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