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NASA TECH BRIEF

Thermal Conductivity and Dielectric Constant of Silicate Materials

A report has been prepared, detailing an analytical and experimental investigation of the thermal conductivity and dielectric constant of nonmetallic materials. Principal emphasis was placed on evaluating the mechanisms of heat transfer in evacuated silicate powders and in establishing the complex dielectric constant of these materials.

Experimental measurements of the complex dielectric constant of glass beads, powdered pumice, powdered basalt, and solid glass, pumice, and basalt were made at wavelengths of 3.2 cm and 1.2 cm over the temperature range from 77°K to 400°K. The thermal conductivity of these materials and quartz powders was measured using the line heat source method at gas pressures of 10^{-8} to 10^{-9} torr and at temperatures ranging from 150° to 400°K.

The dielectric constants of the silicate powders measured vary from 1.9 to 2.9. The loss tangents of these materials vary from about 0.004 to 0.030. The dielectric constants of the solid silicates from which the powders were prepared range from 5.4 to 8.6.

The effective thermal conductivities of the evacuated powders of particle size 5–75 microns vary from about 4×10^{-6} w/cm°C to near 40×10^{-6} w/cm°C over the temperature range from 150° to 400°K, and can be represented by the sum of a constant term and a term which has a cubic temperature dependence. The ratio of the radiation to solid conduction contributions to effective thermal conductivity varies from less than 0.1 to over 5 depending upon the powder size, composition, and temperature.

Experimental measurements and results are related to postulated lunar surface materials. The dielectric parameters are important for the interpretation of radioastronomical and radar observations of lunar and planetary surface properties.

Note:

Copies of the report may be obtained from:
Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
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Patent status:

No patent action is contemplated by NASA.

Source: A. E. Wechsler and I. Simon
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