ELECTRICAL PROPERTIES OF SAMPLE 70215 IN THE TEMPERATURE RANGE OF 100° to 373°K, Román Alvarez, Instituto de Geofísica, UNAM, México 20, D.F.

Dielectric permittivity, loss tangent, and dc conductivity of solid sample 70215,14 have been measured at temperatures of 100°, 298°, 315°, and 373°K. Measurements were performed at a pressure of 1 torr of N_2 or in vacuums of $\sim 10^{-7}$ to 10^{-8} torr; the sample was never exposed to the atmosphere. Dielectric properties were obtained in the 30 Hz to 100 KHz frequency range. The basic experimental procedure has been reported elsewhere (Alvarez, 1973a). In comparison with other lunar material this sample presents a rather high dc conductivity. Sample 70215 has been described (Lunar Sample Info. Cat., Apollo 17, 1973) as a fine-grained basalt with a groundmass (48% of rock) of Ilmenite (?), Pyroxene, and Plagioclase, and phenocrysts (52% of rock) of Ilmenite (?), Olivene, and Pyroxene. The results obtained may help characterize materials in the regolith and in the upper layers of the lunar basement.

Figure 1(a) shows the dielectric permittivity data. The temperature sequence is indicated in the legend of the figure; the corresponding information for tan δ appears in Figure 1(b). Values of dielectric permittivity at 100KHz vary from 6.25 at 100°K to 8.18 at 373°K; the lower frequencies, however, show a considerably larger scatter with temperature. This behavior is typical of dielectrics with non-negligible ohmic conductivities, in contact with metallic electrodes (Alvarez, 1973b). Clustering of the data at the higher frequencies suggests that such an effect becomes negligible above 100 KHz and, thus, representative values of κ' may be taken at this frequency for temperatures of 298°K and above. The data at 100°K appears to be free of dc conductivity effects; consequently, all reported values are considered representative of the sample properties at this temperature. Tan δ variations do not exceed one order of magnitude in the temperature range analyzed.

Figure 2 is a plot of dc conductivity versus the reciprocal temperature with applied voltage as a parameter. Based on the data at the higher temperatures we have assumed a region of linear variation (thick, straight line), from which an apparent energy gap of 0.53 eV has been computed. If the sample were a crystalline semiconductor this temperature region would correspond to an intrinsic conduction; however, from the sample composition it is obvious that we are dealing with a multicrystalline system, possibly to be regarded as an amorphous semiconductor, and we must refrain from labeling such a region as of intrinsic conduction.

The behavior in the low-temperature region would suggest a change to extrinsic conduction (i.e., by impurities) if the sample were a crystalline specimen; however, it could also be explained in terms of thermally assisted tunnelling, after the conduction model for amorphous semiconductors proposed by Davis and Mott (1970). Unfortunately only one conductivity value was ob-

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tained in the low-temperature region; more data at low temperatures is needed to pin down the actual electrical classification of the sample. The dashed lines indicate only a possible behavior between room temperature and 77°K (i.e., between values of 3.35 and 12.98 for 1000/T°K); they may be in great discrepancy from actual conductivity values in such a region. The sample presents a non-ohmic behavior in the temperature range analyzed; it is evidenced by increasing dc conductivities with increasing applied voltages. Conductivity values for voltages of 500 and 1000 volts, and temperature of 373°K were greater than 10^{-7} $(\Omega\text{-m})^{-1}$; they were not determined owing to limitations in the measuring range of the resistivity meter.

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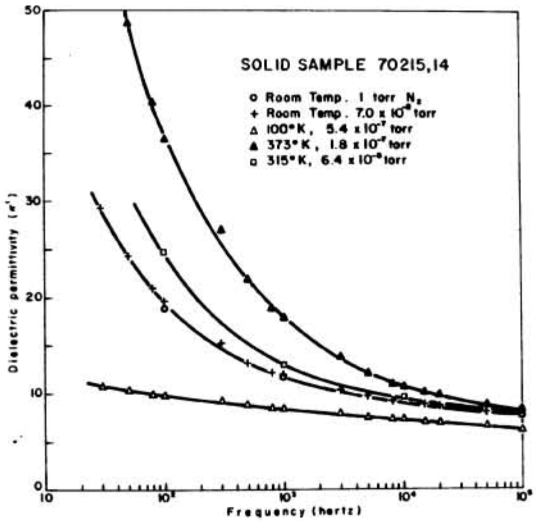

Fig. 1(a)

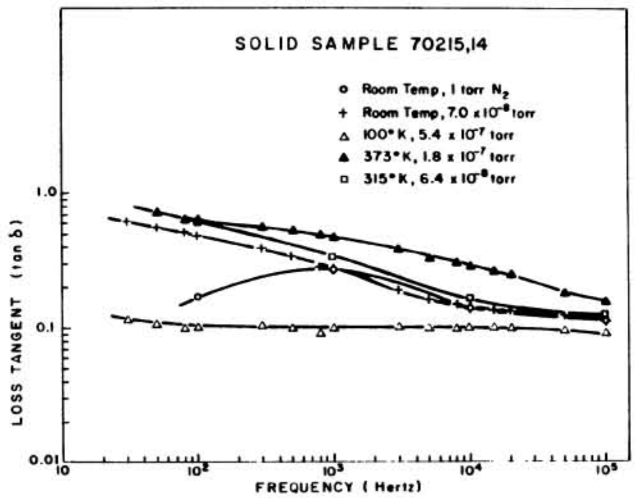

Fig. 1(b)

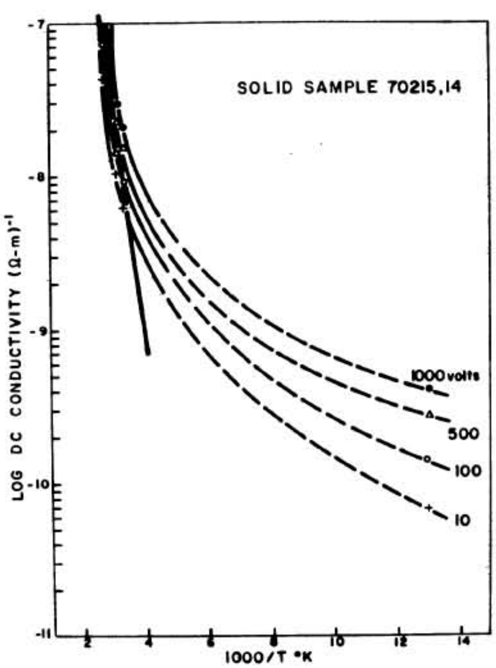

Fig. 2