VII. TRANSPORT PHENOMENA IN SOLIDS

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A. THE ANISOTROPY RATIO OF ELECTRICAL CONDUCTIVITY IN GRAPHITE

Anantamahidol Foundation Fellowship

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This research, conducted in collaboration with the M. I. T. Center for Materials Science and Engineering, has been completed, and the results submitted to the Department of Physics on January 22, 1974, in partial fulfillment of the requirements for the degree of Doctor of Philosophy. A summary of the thesis follows.

The electrical conductivities in the c-direction of well-oriented pyrolytic graphite have been measured at zero frequency and at 23 GHz, at room temperature, 77°K and 4.2°K. The results of these measurements, interpreted according to band theory, indicate that the average relaxation time in the c-direction (τ_c) is very small at all these temperatures. An upper bound value for τ_c at 4.2°K is estimated to be 6×10^{-13} s. Similar measurements were also performed on the basal plane of pyrolytic graphite. From these measurements the average relaxation time in the basal plane (τ_a) at 4.2°K is determined to be 6.3×10^{-12} s.

The analysis of the scattering mechanisms for carriers in graphite due to both electron-phonon interactions and small-scale lattice defects shows that the value of τ_c and τ_a should be comparable at 4.2°K. The difference of the value of τ_c and τ_a at 4.2°K obtained from the measurements indicates that the pyrolytic graphite has a structural defect that reduces the motion of the carriers in the c-direction.