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The Chemical Aspects of Semiconductive Compounds

H. AKAMATU and H. INOKUCHI

Introduction

A number of organic compounds that have relatively low electrical resistivity in the solid state have been found in this decade. It is believed that in those compounds the conduction is an electronic one. This has been proved from the following behaviors, which are closely related to each other.

The resistivity ρ decreases with rising temperature T , and it can be expressed as

$$\rho = \rho_0 \exp (e/2kT)$$

where k is the Boltzmann constant, ρ_0 is a constant for each compound, and $e/2$ is the activation energy for conductance. Conveniently, e is called as "energy gap," since it is presumed to be the energy interval for excitation from a bound state to a free conductive state. Thus, the temperature dependence for resistivity is predominantly determined by the number of electrons that can contribute to the conductance.

The resistivity decreases with illumination of light. The photoconductivity depends on the wavelength of incident light, and it has been proved, for several compounds, to reproduce the spectral response of optical absorption in the organic solid. Furthermore, the light quanta at the threshold of the spectral response of photoconductivity are found to be nearly in agreement with the value of energy gap that is observed thermally.

Recently, the photovoltaic effect has been observed in several junctions between metals and organic compounds.

All these behaviors prove that these compounds can be adequately called "organic semiconductors." Since they are made of