IV. SOLID STATE PHYSICS

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RESEARCH OBJECTIVES

1. Soft X-ray Spectroscopy

The soft X-ray spectroscopy program has as its objective the experimental study of the structure of the conduction band of electrons in a series of metals, particularly the alkalis, alkaline earths, and some of the transition metals. The filled portion of such a band can be studied by observing the emission spectrum produced by transitions from this band to the nearest sharp levels below this band. In most metals this corresponds to an energy in the range of 15-250 ev (wavelengths in the range 50-900A), so that the technique of extreme ultraviolet vacuum spectroscopy is applied. The energy width of these bands usually lies in the range of 2-10 ev. Present effort is directed to the measurement of the copper and nickel bands in a series of copper-nickel alloys of various compositions. A more detailed description of the procedures will be found in the Quarterly Progress Report of January 15, 1954, page 9.

G. G. Harvey

2. Microwave Study of Semiconductors

One of the general aims of the research on microwave study of semiconductors is to apply the methods and general point of view of the microwave gaseous discharge work to those problems involving semiconductors wherever it seems profitable.

S. C. Brown

3. Elastic Constants of Single Crystals

The development of high-speed computers and the accuracy of experimentally obtained low-temperature specific heats have led to a revival of interest in the theory of lattice dynamics. The vibrational frequency spectrum and the bulk thermodynamic properties of a crystalline material can be computed by a Born-von Kárman calculation based on interatomic force constants derived from the adiabatic elastic constants of a single crystal. Since the specific heat at low temperatures is most sensitive to the parameters of the lattice model employed, calculations that use the elastic constants at liquid-helium temperatures are of the greatest interest.

The adiabatic elastic constants of a crystalline substance can be calculated from the velocities of propagation of ultrasonic waves along various crystallographic axes. Pulsed-circuit techniques provide a convenient method for measuring these velocities. Measurements of elastic constants for several metals, intermetallic compounds, and inorganic salts are being carried out. In particular, work continues on the problem of the frequency spectrum of hexagonal close-packed metals.

C. W. Garland