

III. PHYSICAL CHEMISTRY

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RESEARCH OBJECTIVES

In recent years there has been a revival of interest in lattice vibrations and the theory of lattice dynamics. The dispersion curves, vibrational frequency spectrum, and the bulk thermodynamic properties of a crystalline material can be computed by a Born-von Kármán calculation based on interatomic force constants. The adiabatic elastic constants of a single crystal may be measured with high precision, and provide data for evaluating these force constants. Since many properties are more sensitive at low temperatures to the parameters of the force model employed, calculations based on the elastic constants at liquid-helium temperature are of great interest.

The elastic constants of a crystal may be computed from the velocities of ultrasonic waves propagated along various crystallographic axes. Pulsed-circuit techniques provide a convenient method for measuring such velocities. Low-temperature measurements are being carried out on metals, intermetallic compounds, and inorganic salts. Thus far, special emphasis has been given to studies of hexagonal close-packed metals, some of which are highly anisotropic.

In connection with calculations based on lattice-dynamical models, it is vital to have precise heat capacity data in the region below 20°K. Calorimetric work is being carried out in the region 1°K-20°K with liquid helium and liquid hydrogen used as refrigerants. This region is also of particular interest for studying magnetic transitions, electronic specific heats, the nature of surface contributions to C_v for high-area solids, and anisotropic lattice effects.

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