

V. ELASTIC AND THERMAL PROPERTIES OF SOLIDS

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RESEARCH OBJECTIVES

There is a variety of problems in the physics and chemistry of solids in which phonons (lattice vibrations) play an important role. The theory of lattice dynamics can be used to calculate many bulk properties of a crystalline material if appropriate interatomic force constants are known. The adiabatic elastic constants of a single crystal, which can be measured with high precision by ultrasonic pulse techniques, provide direct information about the dispersion curves and frequency spectrum at low frequencies, and thus determine the low-temperature thermal properties. They also provide a way of testing or evaluating the force constant parameters in various force models of a solid.

Recently, attention has been focussed on the elastic properties of crystals near lambda-point transitions. There are "anomalous" changes in the elastic constants of a solid near the critical temperature for an order-disorder transition; such changes are related to the detailed structural changes that occur and to the nature of the interatomic forces involved.

Experiments performed in the past year showed that there are important variations in the elastic constants of NH_4Cl around the lambda-point transition. These variations are caused partly by the change in the volume of the lattice which occurs at the lambda-point transition. To resolve these contributions, the pressure dependence of the elastic constants of NH_4Cl will be studied at several temperatures. A high-pressure system capable of achieving pressures up to 10,000 atmospheres has been built for this study. A large constant-temperature bath was built in order to obtain good control of the temperature down to -30°C . To improve the accuracy of the measurements, the ultrasonic pulse method of H. J. McSkimin was adopted. Preliminary measurements of the elastic constants of NH_4Cl as a function of pressure at room temperature have been made.

NH_4Br and K_2SnCl_6 have lambda-point transitions at a convenient temperature. Crystals of NH_4Br and K_2SnCl_6 are being grown. The elastic constants of these crystals will be measured as a function of temperature and pressure and the results compared with those for NH_4Cl .

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Publications

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