scattering. The use of the Debye temperature in estimating umklapp-scattering[1] is risky unless details of the vibrational spectrum are known. The data of Haynes[12] indicate that the situation for silicon should be similar to that of germanium; furthermore the temperature dependence of θ_D [15] for lead and gray tin indicates roughly a similar behavior, while that of diamond is probably more nearly normal.

The high-temperature results (not corrected for radiation losses in Fig. 1) approach a difference corresponding to a constant isotopic thermal resistance of roughly 0.15 watt^{-1} cm deg. This is the kind of behavior expected and should be helpful in connection with other work in determining phonon-phonon scattering times.

We wish particularly to acknowledge the skillful contribution of those[2] responsible for the purification and growth of the crystal. We are indebted to Dr. N. B. Hannay for encouragement and stimulation in starting this research. During the course of the work we have profited from informative discussions with Dr. C. Herring and Dr. G. A. Slack.

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Structure of the α and β Forms of Solid He^3†

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TWO solid forms of He^3, designated α and β, were recently reported[1] to exist below and above, respectively, a transition line which intersects the melting curve at 3.15°K and 141 kg/cm^2. To gain some insight into the nature of this transition, we have undertaken to investigate the structure of these two forms by x-ray diffraction. The beryllium capillary into which the helium was solidified and the associated diffraction and cryogenic apparatus were those that have been used in the study[2] of the structure of He^4.

The structures were determined by using the Laue and the Debye-Scherrer-Hull methods. He^3, like He^4, readily forms large crystals, and in several runs we were able to obtain a Laue diffraction pattern from only a single crystal. It is much more difficult to grow helium crystals small enough for a suitable powder pattern. The powder lines produced were always spotty and ill-defined. Also, because of the large zero-point vibrations of the atoms, the decline of the intensity of the diffraction lines with increasing angle was so steep that not many lines could be observed.

The Laue reflections of the α form of He^3 were indexed on the basis of a cubic lattice. The reflections observed were of the forms of {110}, {200}, and {121}. There were no reflections for which the sum of the indices was odd. It was therefore concluded that the α form has the body-centered cubic structure. In the diffraction photographs of coarse powders at 1.9°K and under a pressure of 100 kg/cm^2, the reflection from (110), the only one that could be observed, gave the length of the cube axis $A=4.01\pm0.03$ A. The density of the solid calculated from this size unit cell is 0.154 ± 0.004 g/cm^3. The value derived by the extrapolation to these conditions from the directly measured densities[1] is 0.1515 ± 0.0002 g/cm^3.

The β form was found to have the hexagonal closest-packed structure. The Laue reflections that were obtained were of the forms of {100}, {002}, {101}, {102}, {103}, {110}, {112}, and {201}. No reflections could be seen for which $h+2k$ was equal to $3n$ when l was odd. The lengths of the axes of the unit cell were determined from the (100), (002), and (101) reflections from a powder at 3.3°K and under a pressure of 183 kg/cm^2 to be $A=3.46\pm0.03$ A and $C=5.60\pm0.03$ A. The density computed from these dimensions is 0.172 ± 0.004 g/cm^3. The density extrapolated from the directly measured values[1] is 0.1694 ± 0.0003 g/cm^3.

A more complete and extensive report will be submitted later.

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