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$(\mu_2-\mu_1^2)>0$. Therefore, at least in principle, the minimization of $(\mu_2-\mu_1^2)$ provides a method of obtaining all the eigenvalues and eigenvectors.

G. Kron[4] has recently made use of Rayleigh's estimate of the frequency in connection with electric circuit models for the vibration of polyatomic molecules.

[1] Research Associate on the American Petroleum Institute Research Project 44 on the "Collection, Analysis, and Calculation of Data on the Properties of Hydrocarbons," at the National Bureau of Standards.
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The Preparation of Mixed Thallium Bromide-Iodide for Infra-Red Transmission

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MIXED thallium bromide-iodide crystals were synthesized in Germany for use in military infra-red optical instruments. Superior chemical and mechanical stability and the increased range of infra-red transmission of these crystals make them appear promising for a variety of infra-red applications.

The composition of the material was reported in a foreign technical mission report by Dr. Wallace Brode, but the method of preparation was not discussed. Crystals of 42 mole percent TlBr-58 mole percent TlI, having properties similar to those reported for the German material, have been synthesized at the Naval Research Laboratory by crystallization from a melt of the same composition.

Transmission measurements of a plate of the material 2 mm thick over the spectral range 0.5 to 14μ were kindly furnished by Dr. J. A. Sanderson of this laboratory. The observed transmission rose rapidly from approximately 0 percent at 0.5μ to 50 percent at 1μ and to approximately 67 percent from 10 to 14μ. Although precise transmission measurements have not been performed beyond 14μ on the present specimens, the German results reported by Brode showed constant transmission factors of about 67 percent from 2μ to 30μ with transmission decreasing at longer wavelengths to zero percent at 70μ. The light loss is caused largely by reflection, since the index of refraction of the crystal is nearly 2.4 at 10μ.

The crystals were grown from a melt using a modification of the technique developed by Bridgman[1] for growing single crystals of metals. The furnace is a vertical tubular resistance type similar to that used by Stockbarger[2] for growing single crystals of lithium fluoride. The upper section and the lower section are separated by an insulating baffle, and the temperature in the two sections is independently controlled, the baffle serving to increase the gradient in the region where growth takes place.

A mixture of the desired composition is melted in a cylindrical platinum or Pyrex crucible with a conical bottom, for which an angle of 60° has been found satisfactory. A single crystal will result provided only one nucleus is formed in the tip of the crucible; or if several nuclei form, if only one is favorably oriented to grow along the axis of the crucible.

The growth process is controlled by the temperature gradient maintained, and the rate at which the crucible is lowered through the furnace. For homogeneous growth, relatively free of strains, a sharp temperature difference is needed, and the rate of passage through the gradient must be sufficiently slow that crystallization takes place at the point of the temperature gradient in a plane across the whole surface of the solid-melt interface. Too rapid lowering causes crystallization to proceed up the sides of the boule leaving the center molten, and results in multi-crystalline formation. For this material the temperature in the upper section of the furnace is held at approximately 470°C with variations of 5°C not noticeably affecting the quality of the crystal. No heat is used in the lower section of the furnace which is open at the bottom. A lowering rate of 7 hours per inch has given excellent crystals one inch in diameter, and 32 hours per inch has proved satisfactory for two-inch diameters.

The system TlBr-TlI is characterized by a complete solid solution with a minimum temperature at a composition close to 50 mole percent. The region of minimum temperature is relatively broad, and the properties of the crystal appear not to change rapidly with small changes in composition. With sufficiently pure material, single crystals form very readily.

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