The Dielectric Constant of Solid Hydrogen Sulfide

BY J. D. KEMP AND G. H. DENISON

Preliminary measurements have been made on the variation of the dielectric constant of solid hydrogen sulfide with temperature. Heat capacity measurements made in this Laboratory by Professor W. F. Giauque and Dr. R. W. Blue[1] have shown the existence of three crystalline modifications of hydrogen sulfide. It was therefore of interest to learn whether any rotational motion of the electric moments of the molecules in the crystal was taken up at the transitions.

A heterodyne beat method similar to that described by Zahn[2] with the oscillators operating on a wave length of 649 meters was used for the measurement of the dielectric constant. The test condenser (cap. 150 $\mu\mu$f) consisted of three concentric cylinders of gold rigidly separated by four glass rods cutting diametrically through them. The condenser was sealed in a glass cylinder and the temperature controlled by an apparatus similar to that used by Giauque and Wiebe,[3] the gold condenser replacing their calorimeter. A copper–constantan thermocouple was used for the temperature measurement.

The value of the dielectric constant below the lower transition at 103.5° K. is about 2.9 and above the lower transition for the second modification about 9, a discontinuous change taking place at the temperature of the transition. At the upper transition at about 126.3°K., there is apparently no marked change of the dielectric constant taking place. The value of the constant for the liquid at the melting point 187.6°K. is about 9.4. The accuracy of the measurements in the solid state is probably no better than 10% due to the effect of the large cracks encountered in warming the hydrogen sulfide.

From the results given above it appears that there is little or no rotation of the electric moment of the hydrogen sulfide molecule below the lower transition. At this transition a change in crystalline form must take place permitting rotation of the electric moments and from the large change in the dielectric constant it can be concluded that the molecules go from a state of little or no rotation of the electric moment to one of almost complete rotational freedom of the electric moment. This is further verified by the facts that at the upper transition there is no great difference between the dielectric constants of the two crystalline modifications of hydrogen sulfide concerned in the transition and that the value of the dielectric constant for the liquid at the melting point is of the same magnitude as the values for the crystalline modifications above the lower transition.

CONTRIBUTION FROM THE
CHEMICAL LABORATORY OF THE
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA

RECEIVED OCTOBER 3, 1932
PUBLISHED JANUARY 11, 1933

(1) Not yet published.
(2) Zahn, *Phys. Rev.*, **24**, 400 (1924).
(3) Giauque and Wiebe, THIS JOURNAL, **50**, 161 (1928).