The Conductance of Salt Crystals

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LETTERS TO THE EDITOR

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The Conductance of Salt Crystals

Recently Jost[1] has derived an expression for the conductance of salt crystals by postulating in detail the exact mechanism involved in the transport of ions through the crystal. The expression obtained by Jost does not appear adequate to account for the conductance behavior of various salts throughout the whole range of temperature, and if it can be shown that the same form of expression could be obtained by very general considerations, then it would appear that the mechanism postulated by Jost is not necessarily the correct one.

We find it possible to obtain the Jost equation by assuming that when an ion becomes activated it moves a certain average distance $\bar{x}$ before it loses its mobility. The number of ions activated per cubic centimeter per second, is given by the expression originally used by one of the authors[2] in the theory of unimolecular reactions $\nu n_0 e^{-Q/RT}$. Here ν is the frequency of the ion vibration in the lattice, n_0 is the number of ions per cubic centimeter, and Q may be identified with $E/2+U$ in Jost's formula. The diffusion coefficient D is then given by the expression $\frac{1}{2}\bar{x}^2\nu e^{-Q/RT}$, and when reasonable numerical values are introduced the value obtained for D is within the same order of magnitude as Jost's value.

It is not assumed that the conductance of salt crystals can be described completely in terms of expressions as simple as the one given above, but we do believe that any *reasonable* mechanism that may be postulated will lead to essentially the same type of formula.

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[1] Jost, J. Chem. Phys. **1**, 466 (1933).
[2] Rodebush, J. Am. Chem. Soc. **45**, 606 (1923); J. Chem. Phys. **1**, 440 (1933).

Vibrations of Benzene and Raman Spectra of Benzene-d and Benzene-d_2

In Table I we give the preliminary results of measurements, which we were performing on benzene-d and p-benzene-d_2, while Wood[1] published Raman frequencies of benzene-d_6. Experimental error cannot account for the increase from 2270 (C_6H_5D) to 2279 ($C_6H_4D_2$). Several lines of p-benzene-d_2 are more diffuse than the corresponding lines of benzene-d, indicating perhaps an equilibrium between the three isomers of benzene-d_2.

TABLE I.

C_6H_6	C_6H_5D	p-$C_6H_4D_2$	C_6H_6	C_6H_5D	p-$C_6H_4D_2$
3059 cm^{-1}	3059 cm^{-1}	3053 cm^{-1}	— cm^{-1}	1007 cm^{-1}	1008 cm^{-1}
3047	2270	2279	991	980	979
1606	1593	1587	849	851	848
1584	1571	1565	—	—	638?
1174	1176	1176	606	602	602

TABLE II.

D	i	$\prod_i \nu_i(D)/\prod_i \nu_i(C_6H_6)$		
		exp. (according to Wilson)	exp. (with $\nu_9 = 1178$, $\nu_{10} = 849$)	calc. (ref. 2)
p-$C_6H_4D_2$	1, 2, 6, 7, 8, 9	0.723	0.725	0.7075
	10	1.002	0.999	1.0000
C_6D_6	1, 2	0.715	0.715	0.7075
	6, 7, 8, 9	0.541	0.514	0.5005
	10	0.741	0.780	0.7761

Applying a relation between the frequencies of isotope molecules, previously derived and proved in the case of deuterochloroform,[2] to Wood's results and to our own, we can test Wilson's[3] correlations of the benzene frequencies to the vibrations. The discrepancies between experimental and calculated values indicate, that not all correlations can be correct. (See Table II.) Indeed, the exchange of the correlations of frequencies 9 and 10 yields satisfying agreement. The agreement yields a confirmation of Wood's correlations of frequencies 1, 2, 6, 7, 8 and 8.

We have begun with measurements on other isotopes of benzene. Dr. Ph. Gross, Vienna, to whom the authors are indebted for directing their attention to the preparation of the two benzenes, will shortly report on measurements of the vapor pressures.

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October 25, 1935.

[1] R. W. Wood, J. Chem. Phys. **3**, 444 (1935).
[2] O. Redlich, Zeits. f. physik. Chemie **B28**, 371 (1935).
[3] E. B. Wilson, Jr., Phys. Rev. **46**, 146 (1934); cf. also ibid. **45**, 706 (1934).