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UNCLASSIFIED
Dielectric Properties and the Structure of Matter

Charles F. Smyth, Project Leader
Report No. 32
Periodic Status Report
April 1 - June 30
1953

Department of Chemistry
Princeton University

U.S. Navy Department
Office of Naval Research
Mr. A Di Giacomo, after one year on the Project as an Assistant in Research and two years of collaboration with the Project program on a fellowship, has received his Ph.D. degree and taken a position with E.I. Du Pont de Nemours & Co. The results of most of his investigations of dipole moments and molecular orientation in solids will be prepared for publication during the next year.

Further alterations have been made in the apparatus for the investigation of crystalline solids at 3.2 cm. wavelength. The apparatus has been extensively recalibrated and measurements have been started. An appreciable loss has been found in the low temperature solid phase of t-butyl chloride, which may be due to traces of hydrogen chloride. Work has been started upon dl-camphor.

Measurements of dielectric constant and dielectric loss at 1.2 cm. wavelength have been made by Mr. R.S. Holland on solutions of 2,2-dinitropropane in heptane and nujol solutions, and on 2,2-dichloropropane in heptane solution in a continuation of the study of the dielectric properties of substituted methanes. The results of the measurements on the 2,2-dinitropropane - heptane system have been data combined with refractive index data and obtained by Dr. G.N. Roberts at wavelengths of 6.6, 10 and 30 cm. to yield Cole and Cole plots at temperatures of 2°, 20° and 40°. The following values of the distribution constant $\alpha$ and critical wavelength $\lambda_m$ were obtained:

- $2° \quad \alpha = 0.01 \quad \lambda_m = 0.70 \text{ cm.}$
- $20° \quad \alpha = 0.02 \quad \lambda_m = 0.56 \text{ cm.}$
- $40° \quad \alpha = 0.01 \quad \lambda_m = 0.49 \text{ cm.}$
Complete calculations have not yet been made on the other two systems, however, the data on the 2,2-dinitropropane-nujol system seem to indicate a critical wavelength of slightly over 1.2 cm., and also a considerable atomic polarization, since the refractive index point does not agree well with the microwave points. However, this discrepancy may be due to some other effect, since the refractive index point agrees well with the microwave points when heptane is used as the solvent.

Mr. A. Tulinskie has obtained a dipole moment $0.42 \times 10^{-18}$ and an atomic polarization 7.9 cc. for perfluorodiethyl ether in the vapor state, values which are consistent with those reported in the last Periodic Status Report for perfluorodimethyl ether. An apparently consistent series of measurements gave for perfluoropro-pylene a moment value 0.46 and an atomic polarization 14.3, which is so high that the measurements will be repeated.
Scientific Papers July 1 - June 30, 1953


"The Dipole Moments and Structures of cis- and trans-1,2-Dichlorocyclohexane," by A. Tulinski, A. Di Giacomo and C.F. Smyth. Accepted for publication by the Journal of the American Chemical Society.

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