In the above, 1) we let the light be projected on the region of the grating which extends from $y=0$ to $y=l$,

2) we let the focal-lengths of the lenses placed before and behind the grating be f_A and f_B respectively,

and 3) $\varepsilon=+1$ (or -1), according as θ is the angle formed with the positive sense (or the negative sense) of the x-axis.

From (1), we can derive

i) the inclination of the system of spectra as a whole,

ii) the change of the distance between two spectra of different orders,

iii) the symmetry of the intensity distribution of spectra,

iv) the defect of some spectra of certain orders owing to the internal structure of the grating, etc.,

when we rotate the diffraction grating and we could ascertain the almost perfect agreement between theory and experiment.

In our method a rotating diffration grating is situated parallel to the propagation direction of ultrasonic wave in Fraunhofer's diffracting region, and two kinds of spectra diffracted by both the ultrasonic wave and the diffration grating are obtained. At a certain value: $\theta=\theta_0$, the two spectrum distributions in the x-direction agree with each other, and then the velocity of ultrasonic sound is determined by

$$V=N\cdot\Lambda=N\cdot d\cdot\operatorname{cosec}\theta_0\,. \qquad (2)$$

Thus we can expect to obtain the direct reading of the sound velocity. The formula (2) has been shown to agree perfectly with the experimental results for the samples $CHCl_3$, C_6H_6, $C_5H_{11}OH$, $C_3H_5(OH)_3$, $(C_2H_5)_2O$, HCl, C_2H_5OH and H_2O with the frequency 4 Mc/s and at t=30°C as we reported previously.

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2. New Methods of Dielectric Measurement in the Centimeter Wave Region II

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In the previous papers (This Bulletin, 31, 108 (1953); 31, No. 7, (1953)), the authors have proposed several new methods for dielectric measurement using the wave guide in the centimeter wave region. These methods contain as special cases both the method by S. Roberts and A. von Hippel and that by W. H. Surber and G. E. Crouch which have been well used so far, and we have performed the experiment on $C_{15}H_{31}CH_2OH$ by three methods out of our proposed methods.

Our methods are such that we measure Γ_i (VSWR) and x_{0i} (the position of E_{min}

measured from the front face of the sample) in the air column before the sample for two appropriate values of l_i $(i=1,2)$ (lengths of the air column behind the sample). Thus, as the end of the sample is not necessarily open or short circuited, the following various methods are produced by an adequate combinations of two positions (l_i) of the terminating plate:

(General Method) l_1 and l_2: arbitrary,

(Method 1) $l_1=(2n+1)\frac{\lambda_g}{4}$, $x_{02}=(2n+1)\frac{\lambda_g}{4}$,

(Method 2) $l_1=(2n+1)\frac{\lambda_g}{4}$, $x_{02}=n\frac{\lambda_g}{2}$,

(Method 3) $l_1=(2n+1)\frac{\lambda_g}{4}$, $l_2=n\frac{\lambda_g}{2}$,

(Method 4) $x_{01}=(2n+1)\frac{\lambda_g}{4}$, $l_2=n\frac{\lambda_g}{2}$,

(Method 5) $x_{01}=n\frac{\lambda_g}{2}$, $l_2=n\frac{\lambda_g}{2}$,

(Method 6) $x_{01}=(2n+1)\frac{\lambda_g}{4}$, $x_{02}=n\frac{\lambda_g}{2}$

and (Method 7) $x_{01}=(4n-1)\frac{\lambda_g}{8}$, $x_{02}=(4n+1)\frac{\lambda_g}{8}$,

where Method 2, 4 and 6 have been experimentally ascertained as reported in our previous papers and Method 7 is the new one here proposed.

This time, our experiments have been performed with the frequency 9450 MC ($\lambda=3.172$ cm) on $C_{15}H_{31}CH_2OH$ by General Method and Method 6 and 7. Method 6 which was already experimentally verified has been adopted in addition for the purpose of comparison. The reasonable value of $\varepsilon^*\equiv\varepsilon'(1-j\tan\delta)$ has been obtained: $\varepsilon'=2.3$ and $\tan\delta\simeq 0.15$. The explicit expressions of ε^* are respectively as follows:

$$\varepsilon'=\left[1-\left(\frac{\lambda}{\lambda_0}\right)^2\right]\frac{PR+QS}{R^2+S^2}+\left(\frac{\lambda}{\lambda_0}\right)^2,\quad \varepsilon''=\left[1-\left(\frac{\lambda}{\lambda_0}\right)^2\right]\frac{PS-QR}{R^2+S^2} \tag{1}$$

where

(General Method)

$$\left.\begin{aligned} P&\equiv(\Gamma_2-\Gamma_1)(\theta_1\theta_2+1)-(k_1-k_2)(\Gamma_2\theta_1+\Gamma_1\theta_2)\\ Q&\equiv(\theta_2-\theta_1)(\Gamma_1\Gamma_2-1)+(k_1-k_2)(\theta_1\theta_2-\Gamma_1\Gamma_2)\\ R&\equiv k_2k_1(\Gamma_1-\Gamma_2)(\theta_1\theta_2+1)-(k_1-k_2)(\Gamma_2\theta_1+\Gamma_2\theta_2)\\ S&\equiv k_1k_2(\theta_1-\theta_2)(\Gamma_2\Gamma_2-1)+(k_1-k_2)(\Gamma_1\Gamma_2\theta_1\theta_2-1)\end{aligned}\right\}, \tag{2}$$

(Method 7)

$$\left.\begin{aligned} P&\equiv(k_2-k_1)(\Gamma_1-\Gamma_2),\quad Q\equiv 2(\Gamma_1\Gamma_2-1)-(k_1-k_2)(1+\Gamma_1\Gamma_2)\\ R&\equiv(k_2-k_1)\Gamma_1,\qquad\quad S\equiv k_1k_2(\Gamma_1\Gamma_2-1)\end{aligned}\right\} \tag{3}$$

and (Method 6)

$$\left.\begin{aligned} P &\equiv (k_2-k_1)\Gamma_2, \qquad Q \equiv (1-\Gamma_1\Gamma_2) \\ R &\equiv (k_2-k_1)\Gamma_1, \qquad S \equiv k_1k_2(\Gamma_1\Gamma_2-1) \end{aligned}\right\} \quad (4)$$

with $\theta_i \equiv \tan \frac{2\pi}{\lambda_g} x_{0i}$ and $k_i \equiv \tan \frac{2\pi}{\lambda_g} l_i$.

In the above experiments, we have ascertained that especially Method 6 is still most practical as mentioned previously and moreover General Method is expressed in a pretty complicated form but is characterized by its merit that l_i can be selected so that little errors as possible attend the measurement because l_1 and l_2 are arbitrary.

As for the vicinity of large $|k_i|$ in which large errors accompany the measurement, Method 7 out of methods 1-7 is most convenient to avoid it.

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3. Preparation of Single Crystals of High Meltnig Point Metals and Alloys Oriented in Any Crystallographic Direction

Production of Molybdenum Resistance Vacuum Furnace

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One of the authors has previously succeeded in preparing single crystals oriented in any crystallographic direction with nickel and low silicon steel by the modification of the Bridgman method, using the vacuum Tammann furnace. In that case, the charging of the poly-crystals grown from the single crystal seed was smoothly performed in the shape of wire or ribbon, owing to the plasticity of these materials. However, in the brittle materials (e. g. silicon steel containing the silicon more than five percent), the charging is difficult, as the brittle materials cannot be deformed. The vacuum of the used furnace was also not so high.

Therefore, under the plan of preparing single crystals of brittle materials oriented in any crystallographic direction, by means of charging the brittle materials in the state of small blocks into the upper part of the porcelain tube shown in Fig. 1 and performing both the melting of charges and the preparing of single crystals at the same time, a molybdenum resistance vacuum furnace was produced in order to obtain an equilibrium high temperature region over a long distance and also to obtain a higher vacuum than before.