graph (Fig. 1), and the visibility of even a faint trace is little affected by the illumination.

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Unusual Doubling of Spectral Lines

WHEN we were taking spectra of a high-frequency operated interrupted a.c. arc with the Zeiss autocollimation camera (Försterling set of 3 prisms, f = 1,300 mm.), a doubling of spectral lines was observed. The distances of the components increase with increasing refractive indices n and decreasing λ. It was ascertained that the trouble was due to oscillations of the prisms, which were in perfect synchronization as to period and phase with the cycles of the light source. These oscillations were caused by the vibrations of the housing of the arc source, which was placed too near the support of the spectrograph.

Such an explanation, however, seemed at first inconceivable, as differential deviations caused by oscillating prisms at minimum deviation should be zero for the region of the minimum rays and very inconspicuous in the other parts of the spectrum. But since there is also a Pellin–Broca prism of constant deviation in the prism set, things turned out rather differently. The reason for the difference is that the variation of the deviation ϑ with the variation of the incident angle α_1 is different for ordinary prisms and for Pellin–Broca types, namely,

$$\frac{d\vartheta}{d\alpha_1} = 1 \pm \frac{d\alpha_2}{d\alpha_1},$$

where the plus sign holds for ordinary prisms and the minus for the Pellin–Broca type (α_2 being the angle of the outgoing ray). The differential quotient $d\alpha_2/d\alpha_1$ is found to be

$$\frac{d\alpha_2}{d\alpha_1} = - \frac{\cos\alpha_1 \cos\beta_2}{\cos\beta_1 \cos\alpha_2},$$

β_1 and β_2 being the refracted angles within the prism. This quotient is equal to -1 for the ray of minimum deviation, and equal to a quantity $A_1 = f(\gamma, n_0, \Delta n)$ for rays the index of refraction of which differs from that of the minimum deviation (n_0) by Δn. We found, approximately,

$$\frac{d\alpha_2}{d\alpha_1} \doteq - \frac{1}{1 + C_0 \Delta n} = A_1,$$

where

$$C_0 = \frac{2 \sin^2 \gamma/2 \; (1 - n_0^2)}{n_0 \cos^2 \gamma/2 \; (1 - n_0^2 \sin^2 \gamma/2)},$$

γ being the refracting angle of the prism, and n_0 the refractive index of the ray which is at minimum deviation. For 60° prisms C_0 reduces to

$$C_0 = \frac{8(1 - n_0^2)}{3\, n_0 (4 - n_0^2)}.$$

A_1 holds only for a single prism. If there are several prisms of the same refracting angle and the same material, then for the prism k

$$A_k = \frac{1}{1 + (2k - 1)\, C_0 \Delta n}.$$

For calculating the amplitude of the prism oscillation from the displacements of the spectral lines only the region of the λ_0 of the minimum deviation has to be considered. In addition, only prisms of constant deviation give a contribution to the effect in the sense that

$$d\vartheta = 2 d\alpha_1.$$

In the present case these amplitudes range between 3·5″ for the original position of the arc source when the effect was first observed, to about 8·5″ for a position where the housing of the generator was purposely pressed against the support of the spectrograph.

A fuller account will be published in *Ricerche Spettroscopiche.*

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A Graphical Method of analysing Creep Curves

THE retarded elastic extension of a high polymer under load can be represented by a series of Voigt elements, each consisting of a spring and dashpot in parallel. With each element is associated a retardation time, and a series of Voigt elements therefore gives rise to a spectrum of retardation times. This spectrum can be obtained from a creep curve by a method due to Alfrey[1]. In his method the extension is plotted against log-time, and the slope of this curve when plotted against log-time gives a close approximation to the spectrum.

When applying Alfrey's method to some creep curves of polyester, it was found that the spectra obtained were similar in outline to a Gaussian curve, confirming a suggestion by Weichert[2] that such a distribution of retardation times explained satisfactorily the creep curves of some rubbers. The graphical method of analysis described below still uses the assumption of a Gaussian log-normal distribution, but eliminates the need for tedious graphical differentiation and numerical calculations. It provides a simple way of evaluating the three constants involved and has been used to analyse the creep curves of polyesters, poly*iso*butylene, polythene and other high polymers. In all cases the experimental curves lie very close to those that can be calculated using the values of the three constants.

Applying Alfrey's method to a creep curve and assuming the resulting distribution to be Gaussian when plotted on a log-time scale, then it can be shown that

$$\frac{t d\gamma}{dt} = \frac{ch}{\sqrt{\pi}} \exp - \left(h \log \frac{t}{\tau_m}\right)^2,$$

where γ is strain, t is time, τ_m is maximum of the Gaussian curve, h is $1/\sqrt{2}\,\sigma$, σ is standard deviation of the Gaussian curve and c is a constant.

When integrated from $t = 0$ to $t = t$ this gives:

$$\gamma = c/2 \; (1 \pm \operatorname{erf} h \log t/\tau_m),$$