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The absorption of X-rays by photographic films.

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Generalized projections have recently been used by the writer to determine the distortion of some aromatic hydrocarbons. The study by Grenville-Wells (1955) of the variation of the film factor (for Cu $K\alpha$ radiation) of Ilford G Industrial X-ray film with the angle of incidence has been most useful in the intensity estimation of non-equatorial layer-line reflexions. The considerable difference between observed and calculated film factors, found by Grenville-Wells, appears to be larger than the likely experimental error. This discrepancy may possibly be due to neglecting the absorption of energy by the photo-chemical effect (Cox & Shaw, 1930).

It is difficult to estimate the loss of intensity from an X-ray beam due to this cause. Let us therefore assume as a very rough first approximation that this loss is proportional to the incident intensity I_0. Hence the intensity of the X-rays, after passing through a film, is

$$I = I_0(1-C)\exp\left[-\mu t \sec \nu\right],$$

where C is the constant of proportionality determined by the nature of the photographic emulsion, μt is the sum of the separate products of the linear absorption coefficients with the thicknesses of black paper, emulsion and film base, and ν is the angle the incident X-rays make with the normal to the film.

Therefore the film factor is given by

$$R = \frac{I_0}{I} = \left(\frac{1}{1-C}\right)\exp\left[\mu t \sec \nu\right]$$

(C was assumed equal to zero in Grenville-Wells's analysis).

A good straight line was obtained on plotting ln R against sec ν, when the experimental results of Grenville-Wells were used. From this graph the constants C and μt were determined. It was thus found that the variation of R with ν could best be represented by

$$R = 1{\cdot}29\exp\left[0{\cdot}942\sec \nu\right].$$

The values of R calculated according to this equation are given in Table 1. The discrepancy between observed and calculated values is 2·2%, while the two suggested fits to Grenville-Wells's equation give discrepancies of 8·4% (μt = 1·20) and 6·0% (μt = 1·15).

Table 1

ν (°)	sec ν	R(obs.)	R(calc.) C=0·225 μt=0·942	G.-W.'s R(calc.) i.e. C=0, μt=1·20	G.-W.'s R(calc.) i.e. C=0, μt=1·15
0·0	1·000	3·33	3·31	3·20	3·05
6·6	1·007	3·33	3·33	3·35	3·18
13·8	1·030	3·33	3·40	3·44	3·27
20·8	1·070	3·64	3·54	3·61	3·42
28·4	1·137	4·00	3·76	3·92	3·69
35·1	1·222	~4·00	4·08	4·34	4·08
45·8	1·434	5·00	4·98	5·60	5·21
57·0	1·836	7·50	7·28	9·06	8·25

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On the visual estimation of X-ray reflexion intensities from upper-level Weissenberg photographs. II. Charts for the correction of reflexion spot extension.

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The extension and contraction of X-ray reflexion spots recorded on normal-beam and equi-inclination-angle upper-level Weissenberg photographs was discussed in Part I (Phillips, 1954), where it was shown that for a well adjusted instrument and a crystal with length l given by

$$S > l > S\Re_1/(\Re_1+\Re_2) \quad (28)$$

the fractional increase in area of an extended reflexion spot is given by

$$W = \frac{A+\Delta A}{A} = 1+\frac{180}{\pi}\cdot\frac{\zeta}{[\{4\xi^2-(\zeta^2+\xi^2)^2\}^{\frac{1}{2}}\{\Re_1/(1-\zeta^2)^{\frac{3}{2}}+\Re_2\}]} \quad (29)$$

for photographs taken in the normal-beam setting, and

$$W = \frac{A+\Delta A}{A} = 1+\frac{180}{4\pi}\cdot\frac{\zeta(\xi_m^2/\xi^2-1)^{\frac{1}{2}}}{\{\Re_1/(1-\zeta^2/4)^{\frac{1}{2}}+\Re_2\}} \quad (30)$$

for photographs taken in the equi-inclination-angle setting. (S is the diameter of the pinholes in a two-pinhole collimating system; $\Re_1$ and $\Re_2$ are respectively the camera radius and the first pinhole-to-crystal distance measured in millimetres; A is the spot area of a reflexion recorded without camera translation and ζ, ξ are conventional reciprocal-lattice coordinates. The equation numbers refer to Part I.) The areas of 'contracted' reflexion spots are not so simply expressed since they reach a minimum value when $\Delta A = A$ and then increase again as ΔA increases, an effect which seems to have been ignored in many investigations.

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