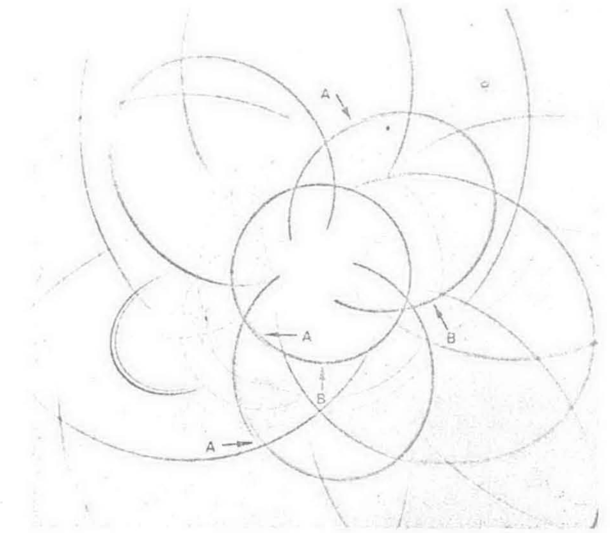

FIG. 4. Single exposure photograph of deformed tungsten crystal. Local lattice misorientation at A and line broadening at B give evidence of inhomogeneous strains.

the elliptical pattern. Consequently, the kinking and the displacement of line segments are directly associated with local lattice misorientation. This misorientation can be determined when the specimen-to-film distance, the displacement of the line segments, and their respective distances from the center of the film are known. The divergent beam method may, therefore, also be viewed as an x-ray topography method. The most precise measurements are obtained from reflections with large θ values, permitting one to detect lattice misorientations as small as 0.05°.

Local line broadening, indicated by arrows in Fig. 4, is a manifestation of inhomogeneous strains. If such line broadening occurs, the strain analysis can be extended to include intensity studies of the line profile. These are carried out by means of a microdensitometric tracing of the line profile across the broadened region. The intensity data thus obtained serve as the basis of a Fourier transform analysis.[8]

5. INCOMPLETE ELLIPSES

The crystallographic orientation of the reflecting specimen surface and its distance from the target are generally chosen so that a number of complete ellipses appear on the film. In some cases, however, extraneous crystallographic considerations predetermine the orientation of specimen faces. Some, or even most of the ellipses may then be incomplete; parts of them may fall within the central hole of the film or be blocked out by the shadow of the target. Such ellipses cannot be used for the computation of d spacings by the methods previously described. The decrease in the number of measurable d spacings, in turn, impairs the accuracy of the strain analysis, or even (if it falls below six) renders it impossible. The difficulty may be circumvented by the use of a composite target emitting two different characteristic wavelengths. Such a target has been produced, for instance, by using an iron foil plated with cobalt. The radiation emitted contains in this case $\mathrm{Co}K_\alpha$ and $\mathrm{Fe}K_\alpha$. It is convenient, though not necessary, that the intensities of the two characteristic radiations be made approximately equal by a suitable choice of the plating thickness. Two superimposed exposures at different film-to-specimen distances are required and the film shift between the two exposures must be known precisely. Figure 5 is a pattern of incomplete ellipses produced in this manner with a composite target.

The method of computation of d spacings is given in Appendix B.

6. RESULTS

As anticipated, no significant difference in d values among the various (hkl) planes of a form was found in the unstrained tungsten crystal. Therefore, for each $\{hkl\}$ form investigated, the average d value $\bar{d}$ was determined and these values are listed in Table I.

It will be recalled that the d spacing is obtained from α by Eq. (5) and that α in turn is obtained from the slope parameters m_1 and m_2 by Eqs. (3) and (4). The standard errors of the slopes introduced by the physical measurements results in standard errors of α which in turn propagate as standard errors of d. The average of this standard error in d for each $\{hkl\}$ form, denoted by $\bar{\sigma}_d$, was determined and is also listed in Table I. Details concerning the calculation of the propagation of errors are discussed in Appendix A.

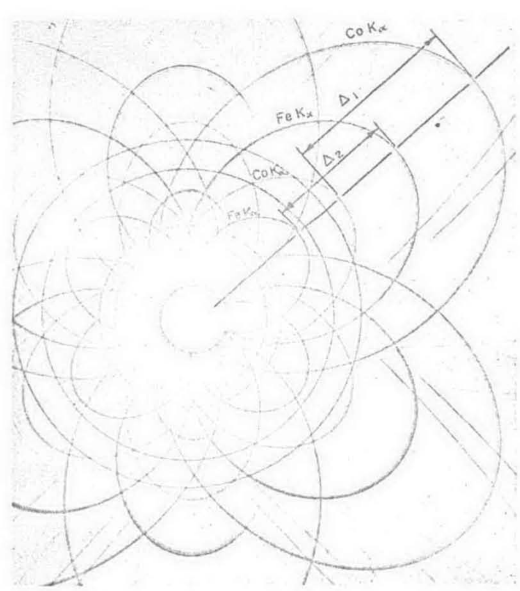

FIG. 5. Double exposure photograph of Ni–25% Fe single crystal. FeK and CoK radiations were employed for analysis of incomplete pattern.

[8] J. J. Slade in Conf. VI Intern. Union of Crystallographers, Rome, September, 1963 [Acta Cryst. 16, A104 (1963)].