Acta Cryst. (1974). A**30**, 852

A technique for Berg–Barrett stereo topography.*

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(*Received* 29 *March* 1974; *accepted* 30 *May* 1974)

A stereo pair of Berg–Barrett topographs of an (0001) surface of zinc is obtained with a single exposure. One topograph is the $0\bar{1}13$ reflection while the other is the $10\bar{1}3$ and an 84° stereo separation angle results. Errors due to dislocation displacements which might occur between two successive topographs are eliminated, and correction for geometric image distortions is not required.

This note describes a technique for obtaining a stereo pair of Berg–Barrett topographs with a single exposure. This technique was developed to measure the depth of dislocations observed near a cleaved (0001) surface of zinc. The dislocations were introduced by scratching the surface with an Al_2O_3 whisker, and were parallel to the cleaved surface over most of their length. The scratch was made in the $[1\bar{1}00]$ direction and produced dislocations with a $\frac{1}{3}[11\bar{2}0]$ Burgers vector.

The image width of the dislocations in Berg–Barrett topographs is typically about 5μm, and the dislocation depth to be measured is of the same order as the image width. It is therefore necessary to use a large stereo angle and to minimize errors that conventional techniques might introduce in order to obtain significant depth measurements.

Two sources of error are image distortion and dislocation motion which takes place during the exposure of successive topographs in a stereo pair. Image distortion is introduced when the film or plate is placed parallel to the incident beam rather than parallel to the surface of the crystal (this is done to minimize the specimen-to-film distance for maximum resolution). Distortions may be determined from the X-ray geometry and the correction factor for stereo measurements calculated. Corrections for image distortion are not necessary in the technique described below. Errors due to small dislocation displacements are eliminated because the two images which comprise the stereo pair are obtained simultaneously.

Another possible source of error is introduced when the dislocation image is shifted with respect to the dislocation position and the shift is different in the two topographs. Theoretical calculations of the image position with respect to the dislocation have not been made for the Berg–Barrett geometry employed here so this error cannot be evaluated at the present time.

The Berg–Barrett camera system employed by Turner, Vreeland & Pope (1968) was used in this study. The crystal and X-ray geometry which was used is shown in the stereographic projection of Fig. 1. The incident beam χ reflects from two $\{10\bar{1}3\}$ planes with poles **g** and **h** whose reflection loci are plotted. Reflected beams $\mathbf{K_g}$ and $\mathbf{K_h}$ have an 84° stereo separation angle. Two images from a 1 mm wide × 15 mm long crystal formed by $\mathbf{K_g}$ and $\mathbf{K_h}$, were recorded on a Kodak high-resolution plate. An enlarged print on Dupont Cronopaque containing the two images was then produced on which stereo measurements could be made. Measurements are made perpendicular to χ and the measurement direction is accurately determined by a line connecting a common point in the two images. There is no distortion of a line in the image which is perpendicular to χ since that line on the high-resolution plate was parallel to the surface of the crystal. A print containing the two images is shown in Fig. 2.

Measurements were made of the positions of different dislocation images on an enlarged print (using reference points where dislocations or sub-boundaries met the surface). Dislocation depths of about 5μm below the surface were calculated from these measurements. The topographs may not reveal all of the dislocations produced by scratching. Studies are under way to determine the range of depths below an (0001) surface of zinc in which dislocations can be imaged in Berg–Barrett topographs.

* This work was supported by the U.S. Atomic Energy Commission.

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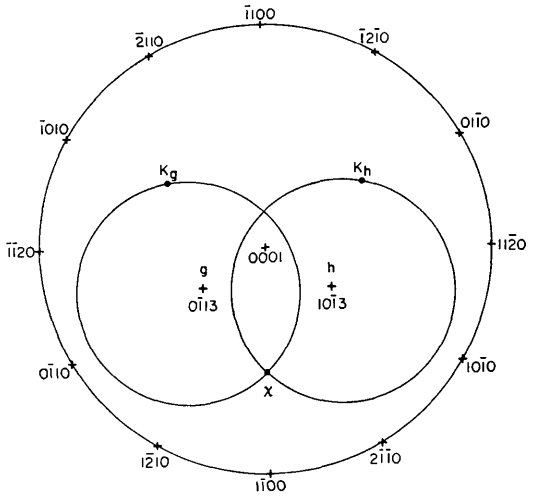

Fig. 1. Stereographic (0001) projection for zinc showing reflection loci for Co $K\alpha$ from $(0\bar{1}13)$ and $(10\bar{1}3)$ planes with poles g and **h**. With incident beam χ, the two reflected beams $\mathbf{K_g}$ and $\mathbf{K_h}$ have an 84° stereo separation angle. The scratch direction was $[1\bar{1}00]$ which produced dislocations with a $\frac{1}{3}$ $[11\bar{2}0]$ Burgers vector.

References

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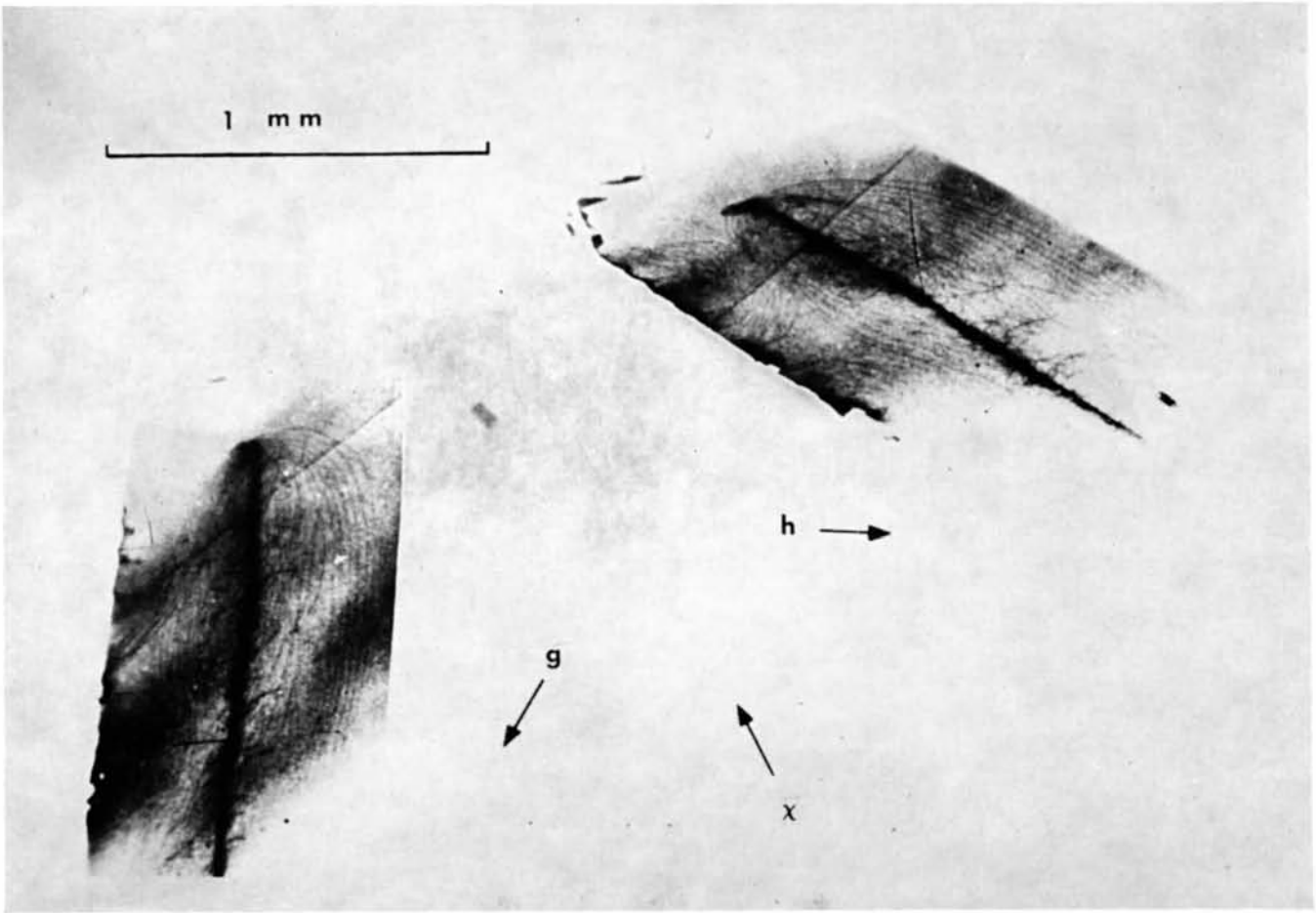

Fig. 2. Images formed by simultaneous reflections $\mathbf{K_g}$ and $\mathbf{K_h}$.

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