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Paterson M S. X-ray diffraction by face-centered cubic crystals with deformation faults. *J. Appl. Phys.* 23:805-11, 1952.
[Institute for the Study of Metals, University of Chicago, IL]

The X-ray diffraction effects were calculated for face-centered cubic crystals containing stacking faults introduced by deformation (as distinct from growth faults). This enabled the positions, widths, and intensities of the X-ray diffraction lines to be predicted as a function of the density of faults. Practical applications were also discussed. [The *SCI*® indicates that this paper has been cited in over 285 publications.]

X-Ray Diffraction and the Density of Faults

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While I was spending a year at the Institute for the Study of Metals, University of Chicago, in 1950-1951 as a postdoctoral fellow, I was working in association with Professor C.S. Barrett. He had been doing experimental work on stacking faults in deformed metals, and so, with his encouragement, I set out to sort out the theory of such effects. The 1952 paper was the result. In the following years this subject attracted a good deal of attention.[1-3] Many years later a distinguished US researcher in X-ray diffraction studies told me that he had refereed the paper and had thought of recommending against its publication because the predicted effects would not be observable. As it turned out, he and one of his students were subsequently the first to publish a paper on experimental observations that fit the theory, so he was glad that he had not turned down my paper.

Stacking faults in crystals can, in general, occur either as a result of "mistakes" incorporated in the growth of crystals or as a result of plastic deformation by which the faults are generated subsequent to growth. My paper concerned the latter type, in the case of face-centered cubic crystals such as copper. Such faults could arise either when deformation took place under conditions where a polymorphic transformation was incipient or when dislocations dissociated. In the latter case, the dissociation is related to the energy of the fault surface, and so the X-ray effects were used as a means of getting information about the extent to which the dislocations were dissociated. This was the principal source of such information before the development of transmission electron microscope methods.

One of the reasons for the attention the paper received was that, in a timely way, the earliest work on transmission electron microscopy of thin metal foils began soon after its publication, and much of this early work was on deformed stainless steel, which contained the sort of stacking faults with which the theory dealt.[4] So, it turned out to be relevant in dealing with the electron diffraction observations of these defects in the electron microscope.

Although I was involved in some work on the broadening of X-ray diffraction lines in deformed calcite rocks in the 1950s, I have moved away from X-ray work since that time and have not kept up with its development. However, my impression is that apart from perhaps some continuing interest for electron microscopy, this is not an area that is of great current interest, although my paper still gets quoted in a number of contexts.[5,6] Perhaps one could say that it belongs to a classical phase rather than to a modern phase of the subject. Direct observation in the electron microscope would now be the preferred approach to the study of deformation faults in crystals.

1. **Warren B E & Warekois E P.** Measurements of stacking faults in cold-worked alpha brass. *J. Appl. Phys.* 24:951-2, 1953. (Cited 25 times.)
2. **Christian J W & Spreadborough J.** Stacking faults and dislocations in copper-aluminium and cobalt-nickel alloys. *Proc. Phys. Soc. London Sect. B* 70:1151-61, 1957. (Cited 25 times.)
3. **Warren B E.** *X-ray diffraction.* Reading, MA: Addison-Wesley, 1969. 381 p. (Cited 530 times.)
4. **Whelan M J, Hirsch P B, Horne R W & Bollmann W.** Dislocations and stacking faults in stainless steel. *Proc. Roy. Soc. London Ser. A* 240:524-38, 1957. (Cited 140 times.)
5. **Ganin E, Weiss B Z & Komem Y.** Martensitic transformation in Cu-2Be alloys induced by explosive cladding. *Met. Trans. A—Phys. Met. Mater. Sc.* 17:1885-90, 1986.
6. **Neumann D A, Zabel H, Fischer R & Morkoç H.** Structural properties of GaAs on (001) oriented Si and Ge substrates. *J. Appl. Phys.* 61:1023-9, 1987.

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