Title
AN OPTICAL DIFFRACTION STUDY OF THE STACKING SEQUENCES IN SILICON CARBIDE

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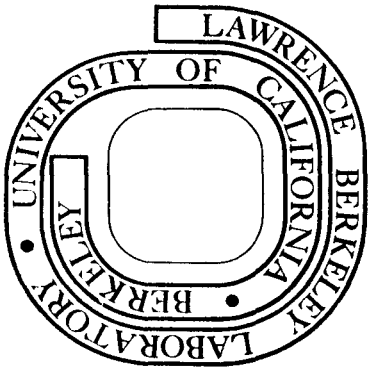

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DISCLAIMER

AN OPTICAL DIFFRACTION STUDY OF THE STACKING SEQUENCES IN SILICON CARBIDE

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The basic crystal structure of silicon carbide can be conveniently represented by the close packing of spheres having approximately nearest neighbour interactions, such that each silicon atom is surrounded by four carbon atoms with a tetrahedral coordination and vice-versa. Any observed structure can then be described, by analogy with the close-packed layer stacking in simple face centered cubic structures, simply by the stacking sequence of the close packed planes on the three possible stacking position, A,B, and C, where any one of these layers actually represents a composite of one layer of silicon atoms and one layer of carbon atoms. A consequence of this close packing of spheres with nearest-neighbour interactions is that the energy of the assemblage does not depend on their stacking sequence, and would result in the case of silicon carbide of a structure showing a complete disordering in one dimension. Although such a one dimensional disordering has been seen in CVD (chemical vapour deposition) SiC (1) and in hot pressed SiC (2), it is more usual to see a large number of different stacking variants within any one grain. In the work to be described here we have been using a combination of lattice fringe imaging by electron microscopy and optical diffraction to identify stacking periodicities in a hot pressed silicon carbide developed by General Electric (Schenectady).

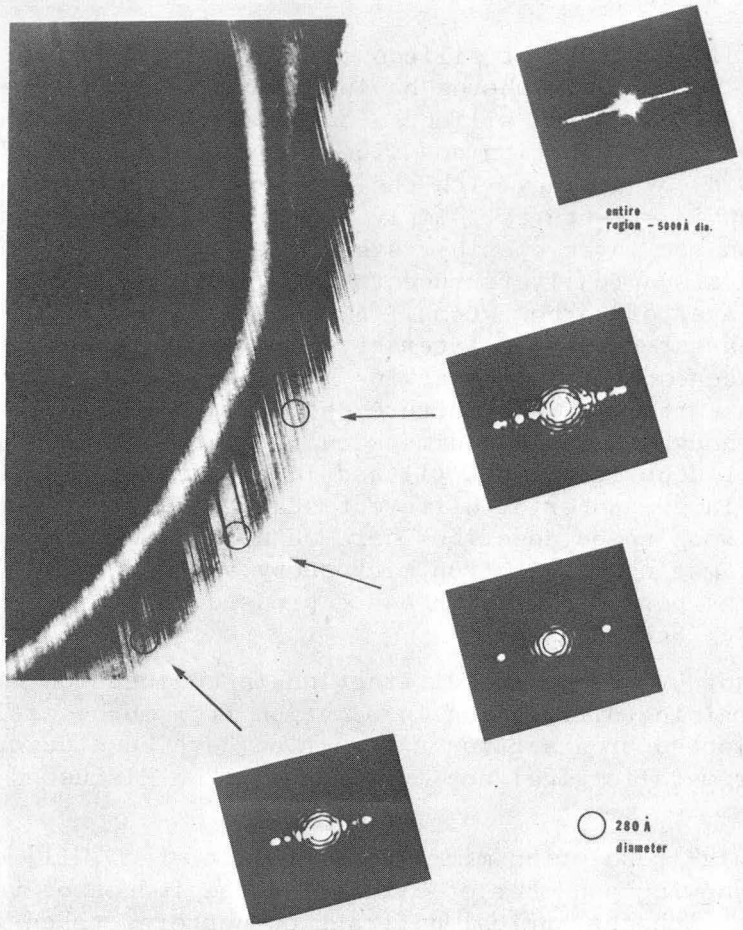
The advantages of using optical diffraction in conjunction with lattice imaging for obtaining diffraction information from much smaller areas than is possible by selected area section diffraction have been described elsewhere (3) and further metallurgical applications will be discussed in these proceedings.

Figure 1 is a high resolution micrograph of part of a [011] oriented silicon carbide grain showing a number of direct lattice images of various periodicities together with the optical diffraction patterns taken from the areas of the micrograph indicated. For comparison, Fig. 2 is the [111] reciprocal lattice row of the electron diffraction pattern from the same area. This complex electron diffraction reciprocal row is typical of the diffraction patterns from this type of silicon carbide, and it is obvious that deduction of the individual periodicities present from such a pattern is extremely difficult. However, the optical diffraction patterns indicate the periodicities present in a very clear manner, and also show where in the image they occur. Analysis of a series of optical diffraction patterns from the micrograph reveals the presence of stacking variants corresponding to five, seven, eight, nine, ten, thirteen, sixteen and twenty composite Si-C close packed layers within this single region of the material (Fig. 3). The authors are grateful to the NSF and the ERDA for support of this work.

1. H. Sato and S. Shinozaki, Mats. Res. Bull., 10, (1975) 257.
2. D. R. Clarke, (1976) to be published.
3. R. Sinclair, R. Gronsky and G. Thomas, (1976), Acta Met. in press.

Figure Captions

1. [011] oriented silicon carbide grain with the optical diffraction patterns from the areas encircled.
2. The [111] reciprocal lattice row of the electron diffraction pattern of Fig. 1.
3. 1/R plot of the reflections in the optical diffraction patterns indicating periodicities present.



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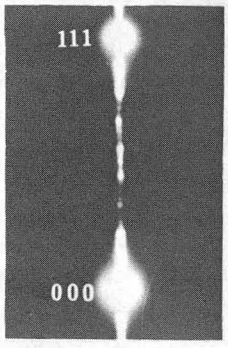

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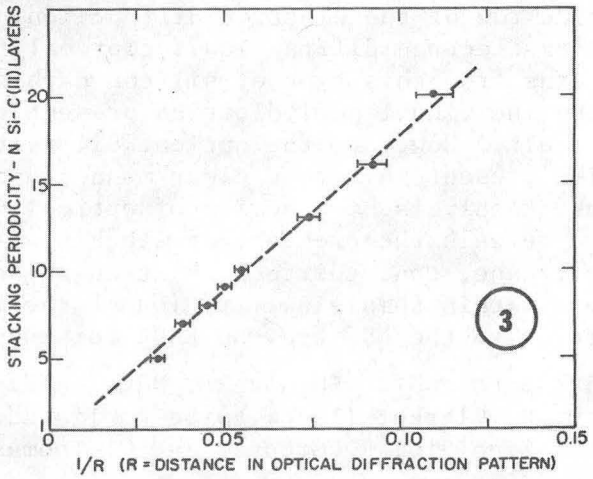

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