05.1–71 INFLUENCE OF MAGNETIC FIELDS ON THE HALF-INTEGER BRAGG REFLECTIONS IN MAGNETITE. By

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The organizing process of charge ordering associated with the internal lattice deformations due to the simultaneous condensation of a few phonon mode remains unsolved now, since studies on the Verwey transition of magnetite at about 120K ($\simeq T_v$) by electron diffraction (1) and neutron diffraction (2) induce doubt on the validity of the transition scheme as originally proposed by Verwey (3). In connection with this subject, the field dependence of half-integer reflexions ($44\bar{1}/2$) and ($\bar{4}41/2$) resulting from Δ_5 mode distortions was investigated by intensity measurements and rapid X-ray topography with use of white SR X-ray in KEK. The crystal used here is a (110) triangle shape plate of several millimeter and 174 μm in thickness. Transmission Laue patterns for $\bar{h}h\ell$ series were observed (Fig.1). All spots were indexed by comparing them with computer generated pattern. In order to orientate and retain the monoclinic c-axis, this was field-cooled through T_v under 2.3kOe being off by 50° from [001] direction in view of the magnetocrystalline anisotropy. The intensity of the half-integer reflexions measured by a solid state detector varies with the change of magnetic fields up to 2.3kOe. However, its variation remains to be systematically understood. A very faint Bragg reflexion ($\bar{4}4\bar{1}$) was detected at least below 66K which should be attributed to one of several X-mode distortions. This closely relates with the crystal structure below T_v. In topographic image of the super spot ($44\bar{1}/2$), sharp fine striation patterns parallel to [$1\bar{1}0$] direction were observed. These patterns are observable in ($\bar{h}h\ell$)($\ell \neq 0$) reflexions. Detailed report will be presented including the results of X-ray topography and the extended work.

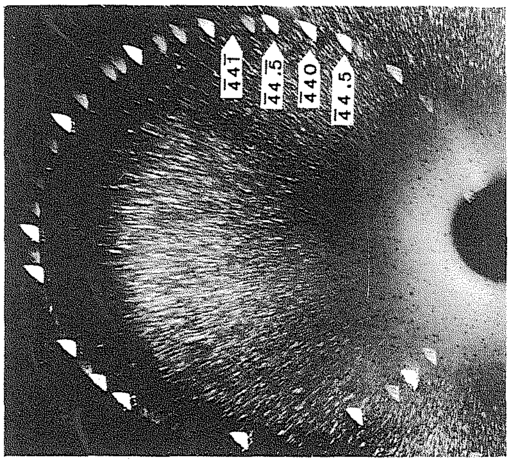

Fig.1 $\bar{h}h\ell$ series including half integer spots.

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05.1–72 X-RAY DIFFRACTION STUDY OF THE MECHANISM OF 3C TO 6H TRANSFORMATION IN SiC.

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It is known that single crystals of 3C or ABC ... modification of silicon carbide undergo solid state transformation to the 6H or ABCACB ... structure when annealed at temperatures above 1600°C. The transformation commences with a statistical insertion of stacking faults in the 3C-structure giving rise to characteristic diffuse streaks on diffraction patterns. As the transformation proceeds further, new reflections characteristic of the 6H structure become discernible along the streaked-rows. The present investigation was undertaken to study the mechanism of 3C to 6H transformation in SiC by determining the nature and distribution of stacking faults effecting the transformation.

Solid state transformations in SiC can take place either through a non-random insertion of deformation faults resulting from slip of parts of the crystal past each other through partial slip vectors or through a non-random insertion of layer displacement faults involving disruption of normal stacking sequence for a pair of layers leaving distant layers unaffected (Pandey et al. Proc.Roy.Soc.London (1980) A369, 435; ibid 451; ibid 463). The 3C to 6H transformation by the deformation mechanism would require consecutive basal slip through (1/6)⟨$11\bar{2}$⟩ vectors on three successive layers followed by no slip on three subsequent layers as depicted below:

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Initial Structure (3C)  : ABCABCABCABC ...
                              CABCABCA ...
                              BCABCAB ...
                                ABCABC ...
                                    CA ...
                                     B ...
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Resulting Structure (6H): ABCACB,ABCACB,...

The desired basal-slip can take place by the passage of Shockley partials in accordance with the suggestion of Ogbuji et al. (J.Am.Cer.Soc. (1981), 64, 91). On the other hand in layer displacement mechanism, the interchange in orientation of a pair of neighbouring layers as a unit process is required after every four layers of the 3C structure in a manner depicted below:

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Initial Structure   (3C) :  ABCABCABCABC ...
Resulting Structure (6H) :  ABCACBABCACB ...
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The displacement of a pair of layers as a unit process can take place by a diffusional rearrangement of atoms. In order to make a choice between the two possibilities, we have developed the theory of diffraction from 3C crystals undergoing transformation to the 6H structure through a non-random insertion of deformation and layer displacement faults separately. From a comparison of the theoretically predicted diffraction effects with those experimentally observed, it is concluded that the 3C to 6H transformation in SiC takes place by the layer displacement mechanism.