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Mechanical twinning in white tin.

By R. Clark, G. B. Craig and B. Chalmers, *Department of Metallurgical Engineering, University of Toronto, Toronto 5, Canada*

Introduction

The twinning plane in white tin has been variously reported as {331} (Schmid & Boas, 1935; Barrett, 1943; Elam, 1935) and also as {301} (Chalmers, 1935). The present investigation was undertaken to ascertain the reason for this discrepancy.

Experimental procedure

Chemically pure tin (99·987 % Sn) was used to grow single crystals by means of the technique of Chalmers (1940). The orientation of the specimens was controlled in order to have conditions favourable for twinning by impact and by stretching. (An orientation suitable for twinning by impact is not suitable for twinning in tension.) Twins were produced by impact (Chalmers, 1935) in two specimens, and by stretching in one other crystal. The crystallographic relationship between the parent crystal and the twin bands was determined from back-reflexion Laue photographs analysed by means of a technique described by Greninger (1935). Fig. 1 shows the points of incidence (*A* and *B*) of the X-ray beam, which was normal to the axis of a specimen twinned by impact.

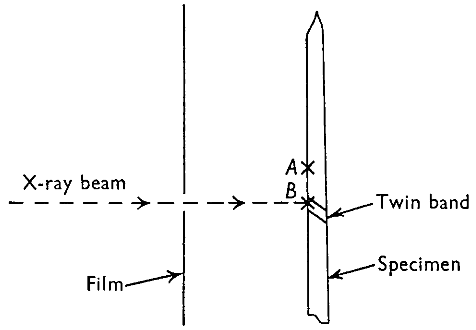

Fig. 1. X-ray geometry.

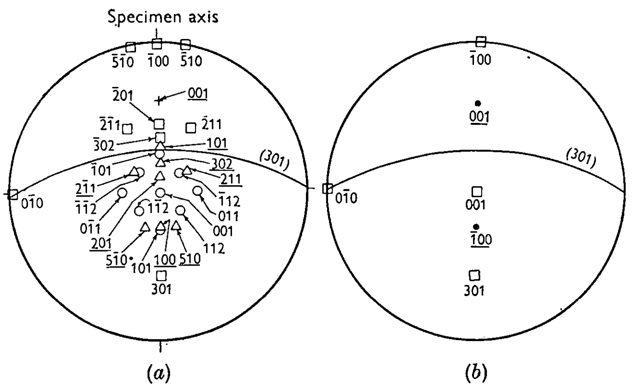

Fig. 2. Stereographic projections showing (*a*) the relative orientation of the twinned crystal section, and (*b*) a twinned crystal orientation derived from reflexion of the standard projection across a (301) plane. Symbols: (*a*) △ observed poles of twin band; + pole of twin band calculated from observed poles; ○ observed poles of parent crystal; □ poles of parent crystal calculated from observed poles. (*b*) □ poles of standard 001 projection; • poles of (301) twin orientation.

The stereographic projection in Fig. 2(*a*) shows the crystallographic relationship between the twinned and untwinned crystals, the orientation of the latter being nearly identical with that of a standard (001) projection of body-centred tetragonal tin with $a = 5{\cdot}8194$ and $c = 3{\cdot}1753$ A. (Barrett, 1943). It can be seen that the equivalent planes are mirror images in a (301) plane. Fig. 2(*b*) shows the (301) twin orientation of a standard (001) projection which agrees with the experimental evidence given in Fig. 2(*a*).

Discussion

The X-ray investigation substantiated the results of Chalmers (1935). However, examination of the work of Mügge (1917, 1927) and of Tanaka & Kamio (1931) revealed how the discrepancy between {331} and {301} twinning arose.

Tanaka & Kamio considered a tetragonal diamond-like structure with cell dimensions $a = 8{\cdot}22$ and $c = 3{\cdot}17$ A. (van Arkel, 1924). The same disposition of atoms can, however, be referred to a smaller body-centred tetragonal cell with $a = 5{\cdot}8194$ and $c = 3{\cdot}1753$ A. (Barrett, 1943). This means that there has not been any change in the relative position of the atoms, but simply a different choice of axes. It is therefore concluded that the discrepancy between the two twin planes arose with the acceptance of the body-centred tetragonal lattice without revision of the Miller indices of the twinning plane.

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An exception to Friedel's law in electron diffraction. II. Theoretical consideration.

By Kazutake Kohra, *Department of Applied Physics, Faculty of Engineering, Kyushu University, Fukuoka, Japan*, Ryozi Uyeda, *Physical Institute, Nagoya University, Nagoya, Japan* and Shizuo Miyake, *Tokyo Institute of Technology, Oh-Okayama, Meguro-ku, Japan*

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In the previous note, Miyake & Uyeda (1950) reported an observation that Friedel's law ceases to hold in electron diffraction by the cleavage face (110) of zincblende: the intensities of (*hhk*) and $(hh\bar{k})$ reflexions are not equal when