quite well with previous work on material with a low dislocation count [4]. The graphs show a clear decrease in luminescence efficiency with increasing dislocation density, with the effect stronger at 300 K than at the lower temperatures. This would seem to confirm the view expressed above concerning the scanning electron microscope pictures. The dark spot at the point of emergence of the dislocation is a real dislocation effect, but the bright halo surrounding it is due to the secondary effect of the doping in the vicinity of a dislocation being different to that in the bulk of the material.

The results at 300 K can be compared to the mechanical polishing work of ref [3]. In Fig. 2 the reduction in luminescence for the range 10^3 to 5×10^7 cm^{-2} is about 30. In the mechanical polishing work, over a similar range of etch-pit densities, the reduction was a factor of about 100. It would appear, therefore, that a major part of the reduction in luminescence in a mechanically-polished specimen is due to dislocations introduced during polishing.

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Electron-microscopic evidence of transformation-induced lattice defects in grey tin

Electron-microscopic observation of grey tin (α-phase, diamond structure) has never been reported because of the difficulty of preparing a specimen thin enough for transmission electron microscopy, in contrast with the ease of preparing thin films of white tin (β-phase, tetragonal structure) by vacuum evaporation or electrolytic polishing of massive samples. We tried several preparation techniques for the purpose of electron-microscopic observation of the $\alpha \leftrightarrow \beta$ transformation process, the atomic mechanism of which has not yet been established [1].

Transformation in thin vacuum-evaporated films of white tin to the grey form was not observed, but in foils electrolytically polished following mechanical thinning of pure white tin* the transformation was successfully observed by keeping the white tin in contact with grey tin granules at about − 20° C as usual [1]. A mixed solution of perchloric acid and acetic acid (1:4) and 10 V d.c. were used for the polishing of the beaten foils of white tin. The thin parts of the polished white tin foils were sufficiently transparent to 100 kV electrons and many dislocations, sometimes piled up, were visible in it, in addition to many extinction contours due to equal thickness and equal bending. In the electron diffraction pattern, however, neither streaks nor extra spots appeared.

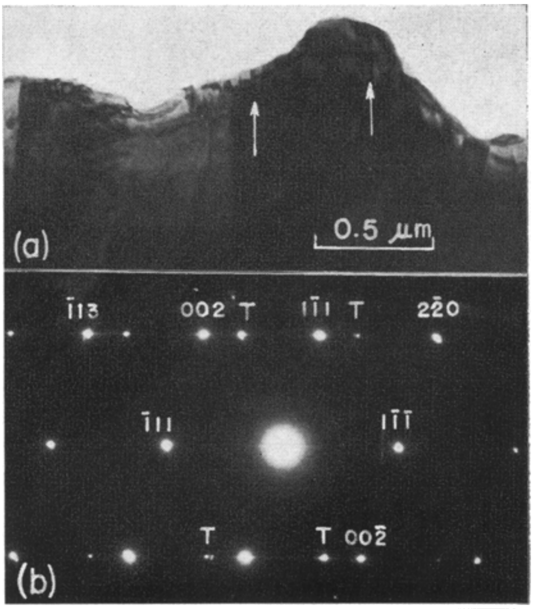

Figure 1 Transmission electron micrograph of grey tin showing lattice defects (a), and the corresponding electron diffraction pattern (b), at 100 kV.

*Zone-refined by Materials Research Corporation, New York.

On the other hand, different kinds of defects are induced in the grey tin during the transformation, as shown in Fig. 1. The image (a), which is in the 110 orientation as seen in the corresponding diffraction pattern (b), shows many defects, mostly rectangular in shape as indicated with the arrows, and the diffraction pattern gives rise to clear streaks in the ⟨111⟩ direction and extra spots marked "T". The {002} spots which are forbidden for the diamond structure appear by double diffraction and the extra spots seem to be {111} twin spots because they are at one-third of the distance between the original spots of the untwinned lattice as expected for the case of cubic lattices [2]. The streaking may be caused by stacking faults or alternatively by microtwins. In fact, diffraction patterns which showed similar streaks but no extra spots were also observed.

Fig. 2 shows an example of surface structure of the grey tin spontaneously fractured by the large increase in volume. We can see a large number of fine ripples formed by fracture and many narrow parallel bands (interpreted as microtwin lamellae) obliquely intersecting the ripples. The width of these bands is widely distributed ranging from a few thousand to a few hundred Ångstroms and even narrower. The fact that the ripples interruptedly disappear on the edges of the bands clearly demonstrates the repeating structure of the microtwin.

It is concluded from these facts that many lattice defects, mainly microtwins and stacking faults, are introduced in the grey tin during the $\beta \rightarrow \alpha$ transformation. The lattice defects are very similar to those in some martensites of Fe-Ni alloys and high carbon steels, and thus the $\beta \rightarrow \alpha$ transformation can be considered to be done martensitically.

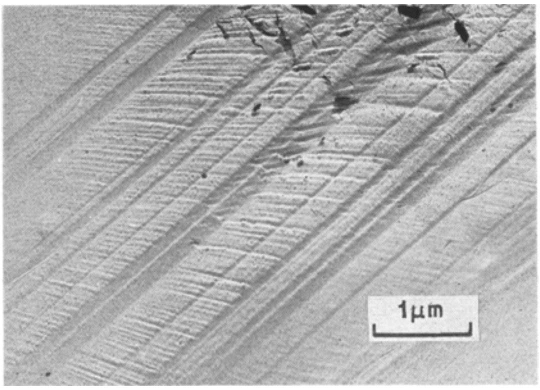

Figure 2 Surface structure of fractured grey tin showing fine ripples and parallel twin bands.

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Short Notices

Surface and Defect Properties of Solids

M. W. Roberts and J. M. Thomas
(editors and senior reporters) and others
(A Specialist Periodical Report). Vol. 1.
The Chemical Society, London, 1972. 264 pp. £6.00

This volume is sub-headed "A Review of the Literature Published between January 1970 and April 1971", but in fact the reviews published here cover a longer time-span and are more in the nature of interpretative essays than the subheading suggests, and all the better for it.

For readers of *Journal of Materials Science* the *pièce de résistance* is a remarkable essay by J. S. Anderson on "Shear Structures and Nonstoicheiometry" (one day, an opinion poll should be organized on the spelling of that dread word). The essay deals entirely with transition metal oxides (though a few other substances, such as the alloy Ni_3Mo, are known to behave similarly), and explains very clearly and fully how planar