LETTERS TO THE EDITOR

On the Tetragonality of CuAu I Type Superlattice Structure of Strain-Induced Martensite in Cu-Zn Alloy

(Received March 13, 1971)

In Cu–Zn alloy system, the CuAu I type superlattice structure is obtained by strain-induced transformation of the quenched β-phase with low Zn composition[(1)(2)]. This transformation is martensitic and the resulting martensite crystals contain fine transformation twins and stacking faults[(2)]. In the present work, it is shown that the tetragonality of the CuAu I type superlattice structure of this martensite varies from martensite crystal to martensite crystal, and it is suggested that the variation of the tetragonality is not due to the change in the long-range order parameter but due to a condition to minimize the distortion at the habit plane in the martensitic transformation.

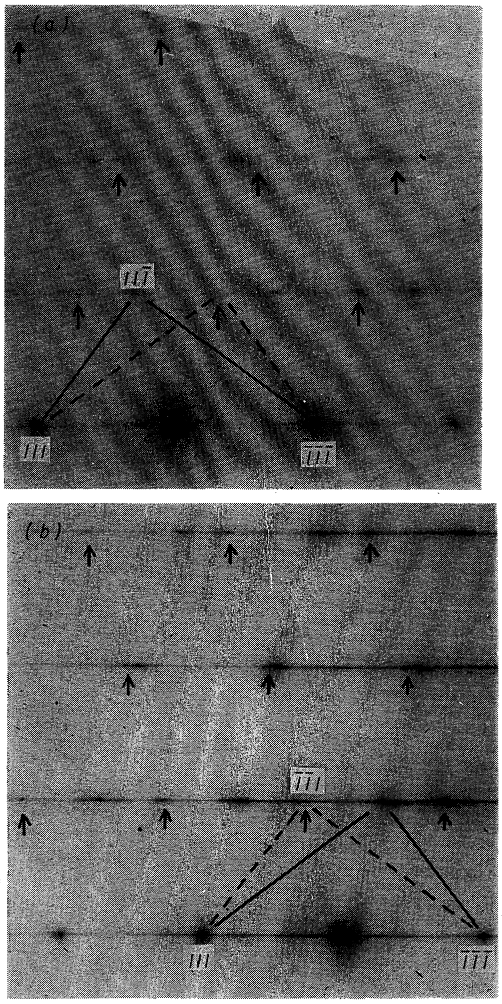

Photo. 1 Electron diffraction patterns of the martensite crystals containing fine transformation twins. Twin spots are indicated by arrows. The twinning plane is (111). The axial ratios c/a are 0.961 for (a) and 0.936 for (b). Zone axes : $[1\bar{1}0]_m$ and $[\bar{1}10)_t$ in (a), $[\bar{1}10]_m$ and $[1\bar{1}0]_t$ in (b).

Photos. 1 (a) and (b) show electron diffraction patterns of the above mentioned martensite of Cu–40.6 at% Zn alloy, each pattern being taken from a different crystal. Both of these patterns contain diffraction spots due to the twins, which are indicated by arrows in the photographs. The axial ratio c/a of the crystal structure is evidently different between Photos. 1 (a) and (b), namely, $c/a=0.961$ for (a) and $c/a=0.936$ for (b). This difference in the value of c/a can easily be recognized in the photographs by the difference in the distances between the matrix spots and the twin spots along the direction normal to the (111) plane. The values of c/a observed in various martensite crystals were in the range of $0.92\sim0.97$.

Now let us consider why the tetragonality of the martensite crystal varies from crystal to crystal. The tetragonality in the CuAu I type superlattice structure usually varies with the long-range order parameter S. In the present case, the existence of stacking faults in the martensite crystal may affect the order parameter S and accordingly change the tetragonality. However, the observed faulting does not seem to have caused an appreciable change in the tetragonality, for there was no consistent correlation between the tetragonality and the extent of the faulting in a martensite crystal. For example, the axial ratio c/a for Photo. 1 (b) is smaller than for Photo. 1 (a), although the faulting seems to be more severe in (b) than in (a) judging from the diffuseness of diffraction spots. If the stacking faults in these crystals affected the tetragonality, the less faulted one of the two crystals would have a smaller value of c/a.

On the other hand, from the examination of the electron micrographs corresponding to the diffraction patterns of Photos. 1 (a) and (b), it was found that the volume fraction of the transformation twin in the martensite crystal for Photo. 1 (b) was smaller than for Photo. 1 (a). The similar examinations of many martensite crystals showed the existence of a qualitative correlation that the volume fraction of the twin in one martensite crystal decreased with decreasing value of c/a. Such a correlation is predicted by the phenomenological theory of the martensitic transformation. Since this theory is based on the assumption that the interface

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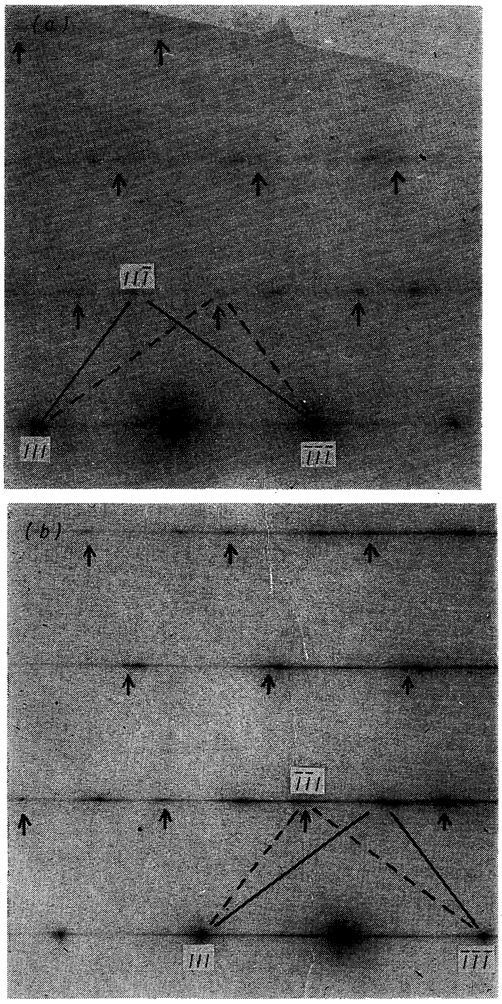

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between the parent and the martensite crystals, namely the habit plane, should be a plane of zero average distortion[3], the existence of the correlation consistent with this theory suggests that the tetragonality of the martensite crystal varies with the volume fraction of the transformation twin so as to minimize the distortion at the habit plane.

(3) M. S. Wechsler, D. S. Lieberman and T. A. Read : Trans. AIME, **197** (1953), 1503.

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