compared with the observations of Fahlenbrach and co-workers. It is concluded that the observed anisotropy can be rationalized in terms of the slip-induced directional order theory.

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APPENDIX

1. CALCULATION OF BB-PAIRS RESULTING FROM $\{110\}\langle 111\rangle$ SLIP IN A $B2$ STRUCTURE

(a) *Long-range order — nearest-neighbor case*

The long-range ordered $B2$ structure, Fig. 1(a), consists of two simple cubic sublattices α and β. The total number of BB nearest-neighbor atom pairs in any direction is given by

$$N_{BB} = N_{\alpha\beta} P_{BB}(\alpha\beta) + N_{\alpha\alpha} P_{BB}(\alpha\alpha) + N_{\beta\beta} P_{BB}(\beta\beta), \quad \text{(A1)}$$

where $N_{\alpha\beta}$, $N_{\alpha\alpha}$, and $N_{\beta\beta}$ are the number of bonds joining α and β, α and α, and β with β sites, respectively; and $P_{BB}(\alpha\beta)$, $P_{BB}(\alpha\alpha)$ and $P_{BB}(\beta\beta)$ are respectively the probabilities of a BB pair associated with $\alpha\beta$, $\alpha\alpha$, and $\beta\beta$ bonds.

From the definition of the Bragg and Williams LRO parameter s[24]

$$s = \frac{r_\alpha - x_A}{1 - x_A} = \frac{r_\beta - x_B}{1 - x_B}, \quad \text{(A2)}$$

where

r_α = fraction of α sites (rightly) occupied by A atoms

r_β = fraction of β sites (rightly) occupied by B atoms

x_A = fraction of A atoms in the lattice

x_B = fraction of B atoms in the lattice,

and the definitions

$w_\alpha = 1 - r_\alpha$ = fraction of α sites (wrongly) occupied by B atoms,

$w_\beta = 1 - r_\beta$ = fraction of β sites (wrongly) occupied by A atoms,

we have[25], for $x_A = x_B = \frac{1}{2}$,

$$\begin{aligned} P_{BB}(\alpha\alpha) &= w_\alpha^2 = \tfrac{1}{4}(1-s)^2 \\ P_{BB}(\beta\beta) &= r_\beta^2 = \tfrac{1}{4}(1+s)^2 \\ P_{BB}(\alpha\beta) &= w_\alpha r_\beta = \tfrac{1}{4}(1-s^2)\,. \end{aligned} \quad \text{(A3)}$$

In the undeformed condition, the distribution of bonds in any of the four nearest-neighbor $\langle 111\rangle$ directions of the two cells of Fig. 1(a), consists of $N_{\alpha\beta} = 4$, $N_{\alpha\alpha} = N_{\beta\beta} = 0$. Hence $N_{BB} = 4P_{BB}(\alpha\beta)$ as calculated from eqn. (A1).

Consider now that a one-step slip has occurred on successive (110) planes in the $[\bar{1}11]$ direction, the configuration of Fig. 1(b) is obtained. In $[\bar{1}11]$ and $[1\bar{1}1]$, which lie on the slip plane, there is no change in pair distribution. Along $[\bar{1}\bar{1}1]$ or $[111]$, which connects the slip planes, the distribution is changed to $N_{\alpha\alpha} = N_{\beta\beta} = 2$, $N_{\alpha\beta} = 0$. Thus the number of BB pairs becomes $N_{BB} = 2P_{BB}(\alpha\alpha) + 2P_{BB}(\beta\beta)$. The increase in BB pairs in $[\bar{1}\bar{1}1]$ or $[111]$ as a result of slip is then

$$\begin{aligned} \Delta N_{BB} &= 2P_{BB}(\alpha\alpha) + 2P_{BB}(\beta\beta) - 4P_{BB}(\alpha\beta) \\ &= 2s^2 \end{aligned} \quad \text{(A4)}$$

upon application of eqns. (A3). Per unit (110) area, we have $\Delta N_{BB} = s^2/a^2\sqrt{2}$. A similar expression has been derived previously by Brown and Herman[26].

(b) *Short-range order — nearest-neighbor case*

In the short-range ordered lattice, the nearest-neighbor bonds are no longer identified by α and β sites. In this case, the number of BB pairs is given by

$$N_{BB} = n\langle P_{BB}\rangle \quad \text{(A5)}$$

where n is the number of bonds and $\langle P_{BB}\rangle$ is the average probability of a bond being a BB pair. The value of $\langle P_{BB}\rangle$ is obtained from the Bethe SRO parameter σ[25]:

$$\sigma = \frac{\langle P_{AB}\rangle - 2x_A x_B}{\langle P_{AB,max}\rangle - 2x_A x_B}, \quad \text{(A6)}$$

where $\langle P_{AB}\rangle$ is the average probability of a bond being AB, and $\langle P_{AB,max}\rangle$ is the value of $\langle P_{AB}\rangle$ at maximum order. For $x_A = x_B = \frac{1}{2}$, $\langle P_{AB,max}\rangle = 1$ and thus

$$\sigma = 2(\langle P_{AB}\rangle - \tfrac{1}{2}) \quad \text{(A7)}$$

The quantities $\langle P_{AB}\rangle$ and $\langle P_{BB}\rangle$ are related by the equation[17]

$$x_B = \langle P_{BB}\rangle + \tfrac{1}{2}\langle P_{AB}\rangle\,. \quad \text{(A8)}$$

Hence

$$\langle P_{BB}\rangle = \tfrac{1}{4}(1-\sigma)\,. \quad \text{(A9)}$$

In the two unit cells of Fig. 1(a), there are $4\langle P_{AB}\rangle = 1-\sigma$ BB pairs in any of the four $\langle 111\rangle$ directions.

After (110)[$\bar{1}11$] slip, Fig. 1(b), the distribution in [$\bar{1}11$] and [$1\bar{1}1$] remains unchanged. In [$\bar{1}\bar{1}1$] or [111], $\sigma=0$. Hence the number of BB pairs induced by slip is $\Delta N_{BB}=\sigma$, or $\sigma/2a^2\sqrt{2}$ per unit (110) area, in the [$\bar{1}\bar{1}1$] or [111] direction.

(*c*) *Long-range order — next-nearest-neighbor case*

There are three ⟨100⟩ next-nearest-neighbor directions. One of these, [001], lies on the slip plane, (110), and is not disturbed by slip. The other two, [010] and [100], will alter the atom pair distribution after slip.

In the two unit cells of Fig. 1(a), we have $N_{\alpha\alpha}=N_{\beta\beta}=2$, $N_{\alpha\beta}=0$ before slip, where $N_{\alpha\alpha}$ etc. are now referred to next-nearest-neighbor bonds. After slip, Fig. 1(b), $N_{\alpha\alpha}=N_{\beta\beta}=0$, $N_{\alpha\beta}=4$ in [010] or [100]. Hence the gain in BB pairs in either of these two directions is

$$\Delta N_{BB}=4P_{BB}(\alpha\beta)-2P_{BB}(\alpha\alpha)-2P_{BB}(\beta\beta)=-2s^2, \tag{A10}$$

or $-s^2/a^2\sqrt{2}$ per unit (110) area.

(*d*) *Short-range order — next-nearest-neighbor case*

For the next-nearest-neighbor case, the value of $\langle P_{AB,max}\rangle$ in eqn. (A6) is zero, as complete order results in like-atom pairs in all NNN bonds. We then have, from eqn. (A6),

$$\sigma_2=1-2\langle P_{AB}\rangle, \tag{A11}$$

with σ_2 denoting the SRO parameter for the NNN case. With the aid of eqn. (A8), eqn. (A11) becomes

$$\langle P_{BB}\rangle=\tfrac{1}{4}(1+\sigma_2). \tag{A12}$$

Thus, from Fig. 1(a), the number of BB pairs in [010] or [100] is $4\langle P_{BB}\rangle=1+\sigma_2$. After slip, $\sigma_2=0$. Hence the number of BB pairs gained by slip is $\Delta N_{BB}=-\sigma_2$, or $-\sigma_2/2a^2\sqrt{2}$ per unit (110) area.

2. CALCULATION OF BB-PAIRS RESULTING FROM {112} ⟨111⟩ SLIP IN A *B*2 STRUCTURE

(*a*) *Long-range order — nearest-neighbor case*

In the undeformed condition, there are two $\alpha\beta$ bonds per unit cell in each of four ⟨111⟩NN directions. After slip, these bonds change to an $\alpha\alpha$ bond and a $\beta\beta$ bond in the three ⟨111⟩ directions other than the slip direction. Hence $\Delta N_{BB}=P_{BB}(\alpha\alpha)+P_{BB}(\beta\beta)-2P_{BB}(\alpha\beta)$. When values of eqns. (A3) are entered, we obtain $\Delta N_{BB}=s^2$, or $s^2/a^2\sqrt{6}$ per unit {112} area.

(*b*) *Short-range order — nearest-neighbor case*

Here, in the undeformed state, the two bonds per cell in each ⟨111⟩ direction contribute $2\langle P_{BB}\rangle$ pairs of BB bonds. From eqn. (A9), $\langle P_{BB}\rangle=(1-\sigma)/4$. After slip, $\sigma=0$ and the gain in BB bonds is $\Delta N_{BB}=\sigma/2$, or $\sigma/2a^2\sqrt{6}$ per unit {112} area, in the three ⟨111⟩ directions other than the slip direction.

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