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

$$N_{\mathrm{BB}} = N_{\alpha\beta} P_{\mathrm{BB}}(\alpha\beta) + N_{\alpha\alpha} P_{\mathrm{BB}}(\alpha\alpha) + N_{\beta\beta} P_{\mathrm{BB}}(\beta\beta), \tag{A1}$$

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 $P_{\mathrm{BB}}(\alpha\beta)$, $P_{\mathrm{BB}}(\alpha\alpha)$ and $P_{\mathrm{BB}}(\beta\beta)$ 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]

$$s = \frac{r_\alpha - x_{\mathrm{A}}}{1-x_{\mathrm{A}}} = \frac{r_\beta - x_{\mathrm{B}}}{1-x_{\mathrm{B}}}, \tag{A2}$$

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 $x_{\mathrm{A}} = x_{\mathrm{B}} = \frac{1}{2}$,

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

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 $N_{\mathrm{BB}}=4P_{\mathrm{BB}}(\alpha\beta)$ 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 $N_{\mathrm{BB}}=2P_{\mathrm{BB}}(\alpha\alpha)+2P_{\mathrm{BB}}(\beta\beta)$. The increase in BB pairs in $[\bar{1}\bar{1}1]$ or $[111]$ as a result of slip is then

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

upon application of eqns. (A3). Per unit (110) area, we have $\Delta N_{\mathrm{BB}} = s^2/a^2\sqrt{2}$. 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

$$N_{\mathrm{BB}} = n\langle P_{\mathrm{BB}}\rangle \tag{A5}$$

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

$$\sigma = \frac{\langle P_{\mathrm{AB}}\rangle - 2x_{\mathrm{A}}x_{\mathrm{B}}}{\langle P_{\mathrm{AB,max}}\rangle - 2x_{\mathrm{A}}x_{\mathrm{B}}}, \tag{A6}$$

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

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

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

$$x_{\mathrm{B}} = \langle P_{\mathrm{BB}}\rangle + \tfrac{1}{2}\langle P_{\mathrm{AB}}\rangle\,. \tag{A8}$$

Hence

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

In the two unit cells of Fig. 1(a), there are $4\langle P_{\mathrm{AB}}\rangle = 1-\sigma$ 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 $\langle 100\rangle$ 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 $\langle 111\rangle$NN directions. After slip, these bonds change to an $\alpha\alpha$ bond and a $\beta\beta$ bond in the three $\langle 111\rangle$ 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 $\langle 111\rangle$ 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 $\langle 111\rangle$ directions other than the slip direction.

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