Slip Systems

7.5 *(a) Define a slip system.*

(b) Do all metals have the same slip system? Why or why not?

Solution

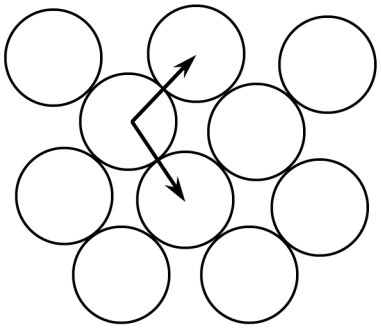
(a) A slip system is a crystallographic plane, and, within that plane, a direction along which dislocation motion (or slip) occurs.

(b) All metals do not have the same slip system. The reason for this is that for most metals, the slip system will consist of the most densely packed crystallographic plane, and within that plane the most closely packed direction. This plane and direction will vary from crystal structure to crystal structure.

7.7 *One slip system for the BCC crystal structure is* $\{110\}\langle 111\rangle$. *In a manner similar to Figure 7.6b, sketch a* $\{110\}$*-type plane for the BCC structure, representing atom positions with circles. Now, using arrows, indicate two different* $\langle 111\rangle$ *slip directions within this plane.*

Solution

Below is shown the atomic packing for a BCC $\{110\}$-type plane. The arrows indicate two different $\langle 111\rangle$-type directions.



7.12 *Consider a metal single crystal oriented such that the normal to the slip plane and the slip direction are at angles of 43.1° and 47.9°, respectively, with the tensile axis. If the critical resolved shear stress is 20.7 MPa (3000 psi), will an applied stress of 45 MPa (6500 psi) cause the single crystal to yield? If not, what stress will be necessary?*

Solution

This problem calls for us to determine whether or not a metal single crystal having a specific orientation and of given critical resolved shear stress will yield. We are given that $\phi = 43.1°$, $\lambda = 47.9°$, and that the values of the critical resolved shear stress and applied tensile stress are 20.7 MPa (3000 psi) and 45 MPa (6500 psi), respectively. From Equation 7.2

$$\tau_R = \sigma \cos\phi \cos\lambda = (45 \text{ MPa})(\cos 43.1°)(\cos 47.9°) = 22.0 \text{ MPa} \quad (3181 \text{ psi})$$

Since the resolved shear stress (22 MPa) is greater than the critical resolved shear stress (20.7 MPa), the single crystal will yield.