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Composites: Teamwork and Synergy in Materials

17–24 Five kilograms of continuous boron fibers are introduced in a unidirectional orientation into 8 kg of an aluminum matrix. Calculate (a) the density of the composite, (b) the modulus of elasticity parallel to the fibers, and (c) the modulus of elasticity perpendicular to the fibers.

Solution:

$$f_B = \frac{5 \text{ kg}/2.3 \text{ g/cm}^3}{5 \text{ kg}/2.3 + 8 \text{ kg}/2.699} = 0.423 \quad f_{Al} = 0.577$$

(a) $\rho_c = f_B\rho_B + f_{Al}\rho_{Al} = (0.423)(2.3) + (0.577)(2.699) = 2.530 \text{ g/cm}^3$

(b) $E_c = f_B E_B + f_{Al}E_{Al} = (0.423)(55 \times 10^6) + (0.577)(10 \times 10^6)$
$= 29 \times 10^6 \text{ psi}$

(c) $1/E_c = f_B/E_B + f_{Al}/E_{Al} = 0.423/55 \times 10^6 + 0.577/10 \times 10^6$
$= 0.0654 \times 10^{-6}$

$E_c = 15.3 \times 10^6 \text{ psi}$