

Question A3, 1997:

Give a brief descriptions of the terms *screw dislocation*, *edge dislocation*, *Burgers vector* and *slip system*.

Show that the elastic strain energy per unit length of a screw dislocation can be expressed as:

$$U \sim \frac{1}{2}GB^2$$

where G is the shear modulus and b the magnitude of the Burgers vector.

An aluminium wire is being pulled through a die so as to reduce its diameter. The tensile stress needed to draw the wire in this way is 20 MPa. Assuming that 1% of the mechanical energy is converted into dislocation strain energy in the drawn wire, and the rest remains in the wire as heat, estimate:

- (a) the increase in dislocation density induced by the drawing process and
- (b) the rise in temperature as the wire passes through the die.

What factors would you expect to limit the maximum reduction in sectional area which could be achieved in a single pass of this type ?

[For Al, $G = 28$ GPa, and $C_v = 3 \times 10^6 J.K^{-1}.m^{-3}$]