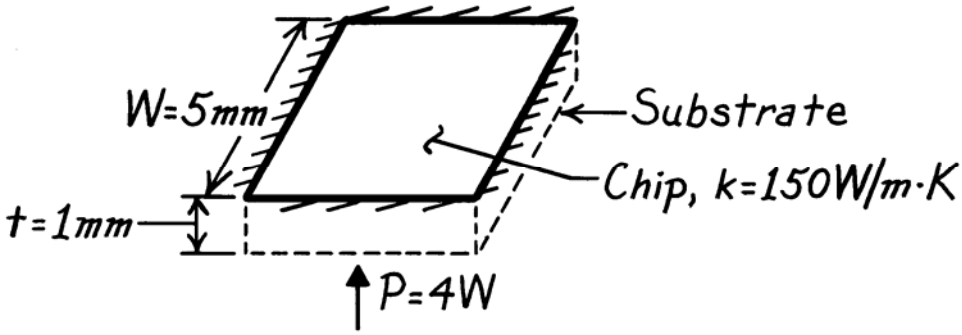
PROBLEM 1.16

KNOWN: Dimensions and thermal conductivity of a chip. Power dissipated on one surface.

FIND: Temperature drop across the chip.

SCHEMATIC:



ASSUMPTIONS: (1) Steady-state conditions, (2) Constant properties, (3) Uniform heat dissipation, (4) Negligible heat loss from back and sides, (5) One-dimensional conduction in chip.

ANALYSIS: All of the electrical power dissipated at the back surface of the chip is transferred by conduction through the chip. Hence, from Fourier's law,

$$P = q = kA\,\frac{\Delta T}{t}$$

or

$$\Delta T = \frac{t \cdot P}{kW^2} = \frac{0.001\ \text{m} \times 4\ \text{W}}{150\ \text{W/m} \cdot \text{K}\left(0.005\ \text{m}\right)^2}$$

$$\Delta T = 1.1^{\circ}\ \text{C}. \qquad <$$

COMMENTS: For fixed P, the temperature drop across the chip decreases with increasing k and W, as well as with decreasing t.