Aparatos Opto-electrónicos

INEL 5205 - Instrumentación - Otoño 2008

Circuitos Opto-electrónicos

- Señal óptica en la entrada o salida
- Aplicaciones
  - Medición de luz
    - Medir posición
    - Imágenes
  - Comunicaciones
    - “Optically-coupled isolators”
    - Controles remotos
    - comunicaciones a través de fibra óptica

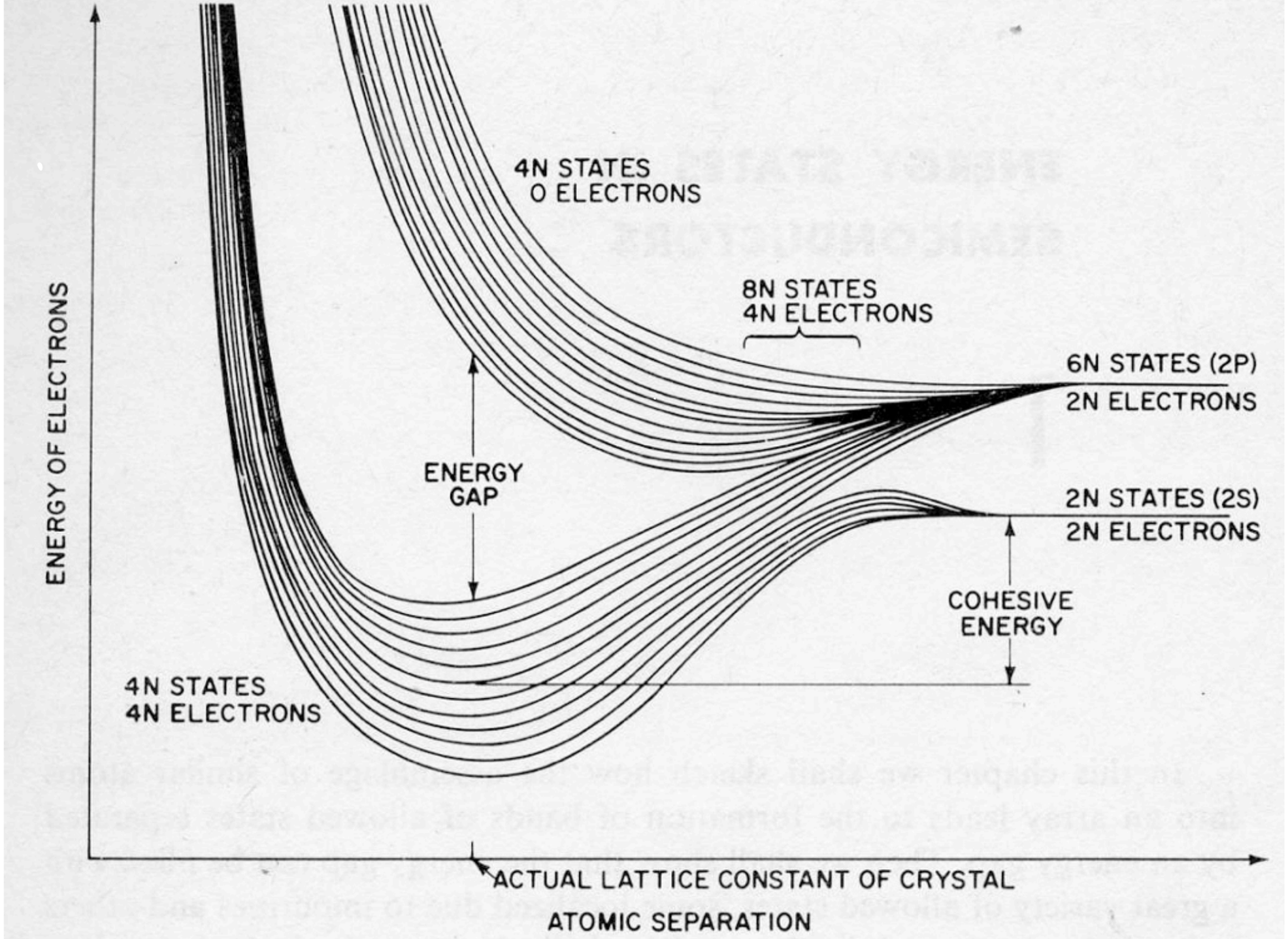
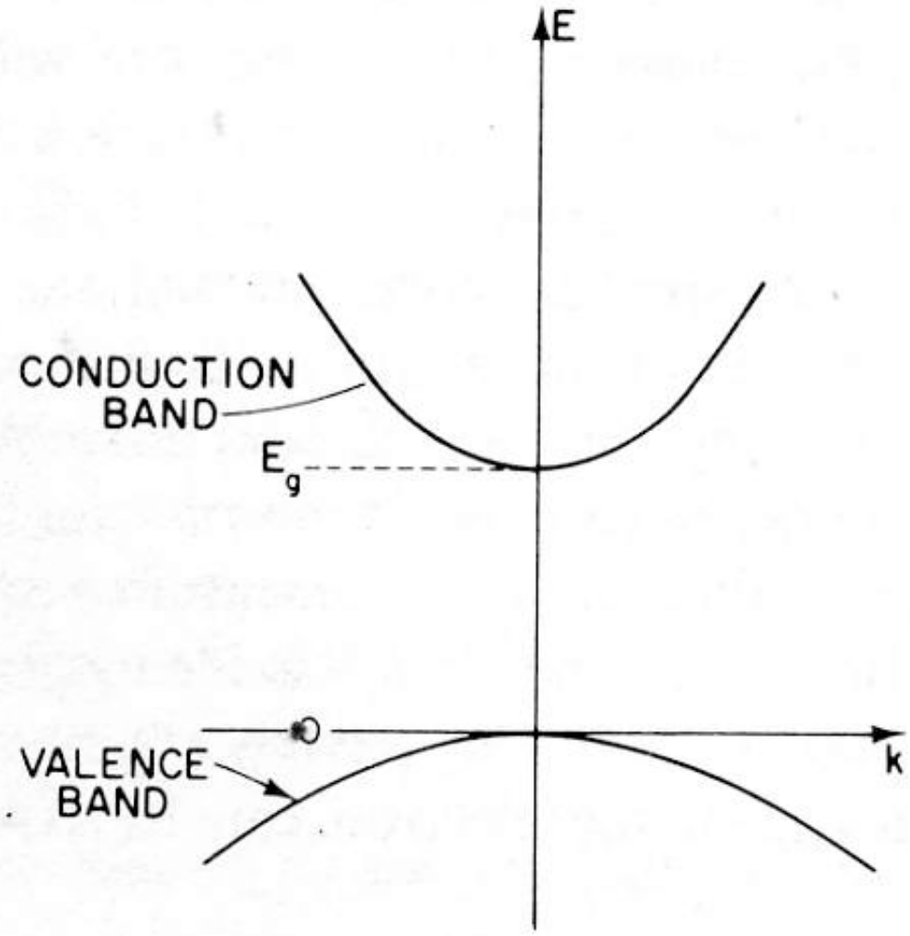
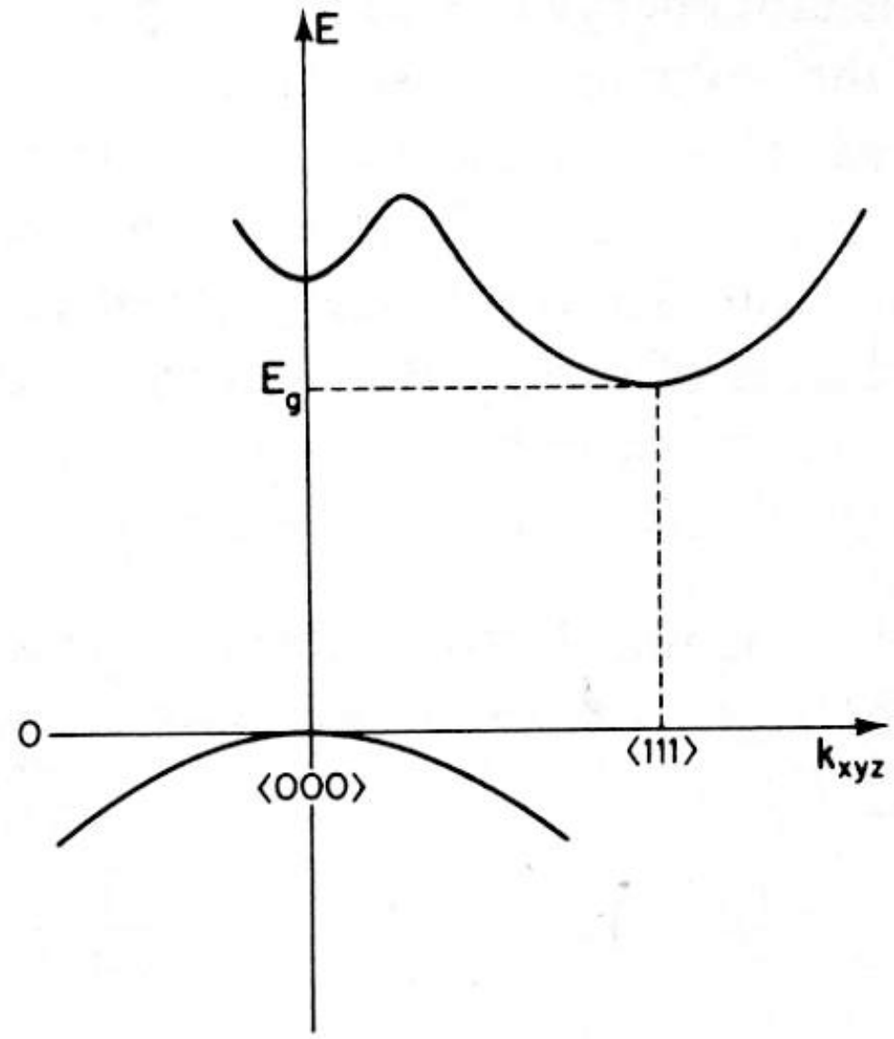


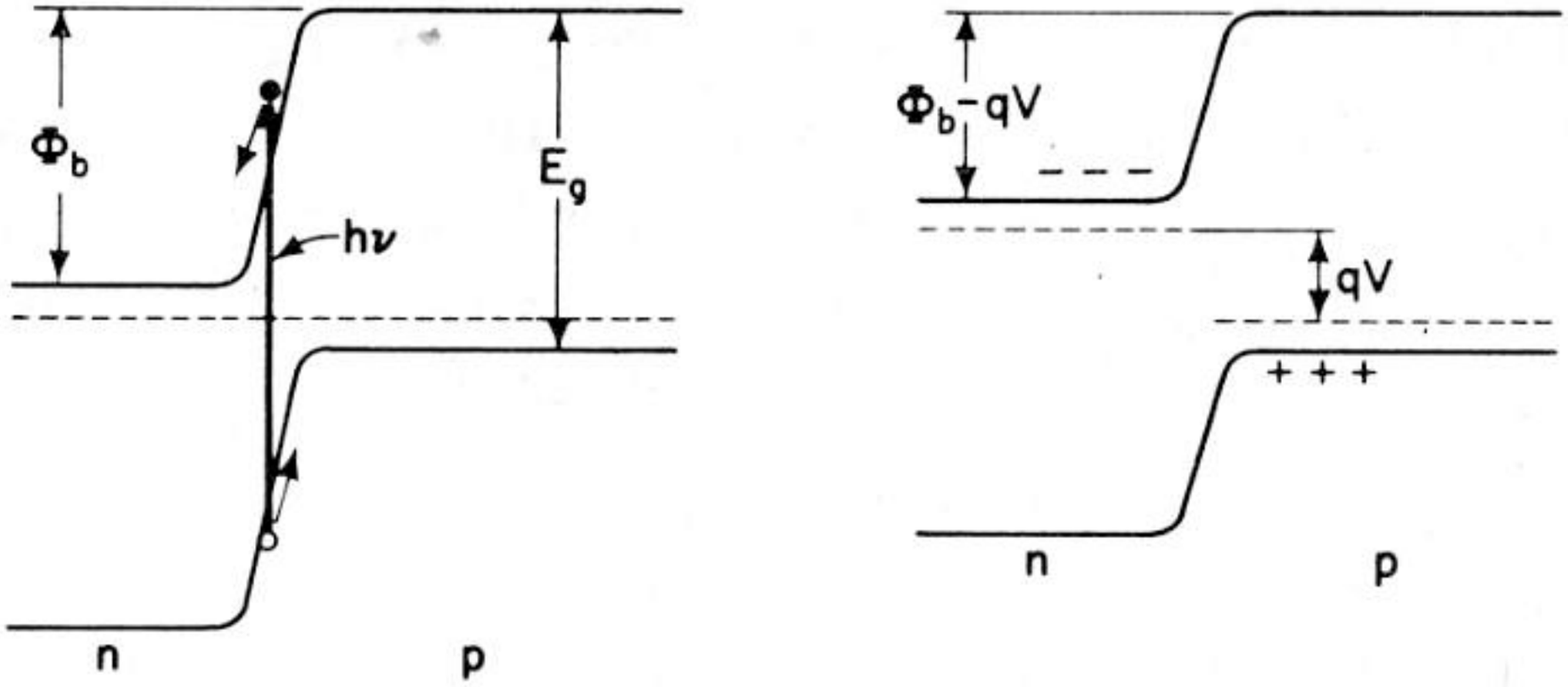
Fig. 1-1 Energy banding of allowed levels in diamond as a function of spacing between atoms.[1]



directo



indirecto



(a) (b)

Fig. 14-1 Generation of a photovoltage V at a p–n junction.

$$I = I_0\left(\exp\frac{qV}{kT} - 1\right)$$

$$I_{SC} = AqG$$

$$I_{LOAD} = I_{SC} - I_0\left(\exp\frac{qV}{kT} - 1\right)$$

$$V_{OC} = \frac{kT}{q}\ln\left(\frac{I_{SC}}{I_O} - 1\right)$$

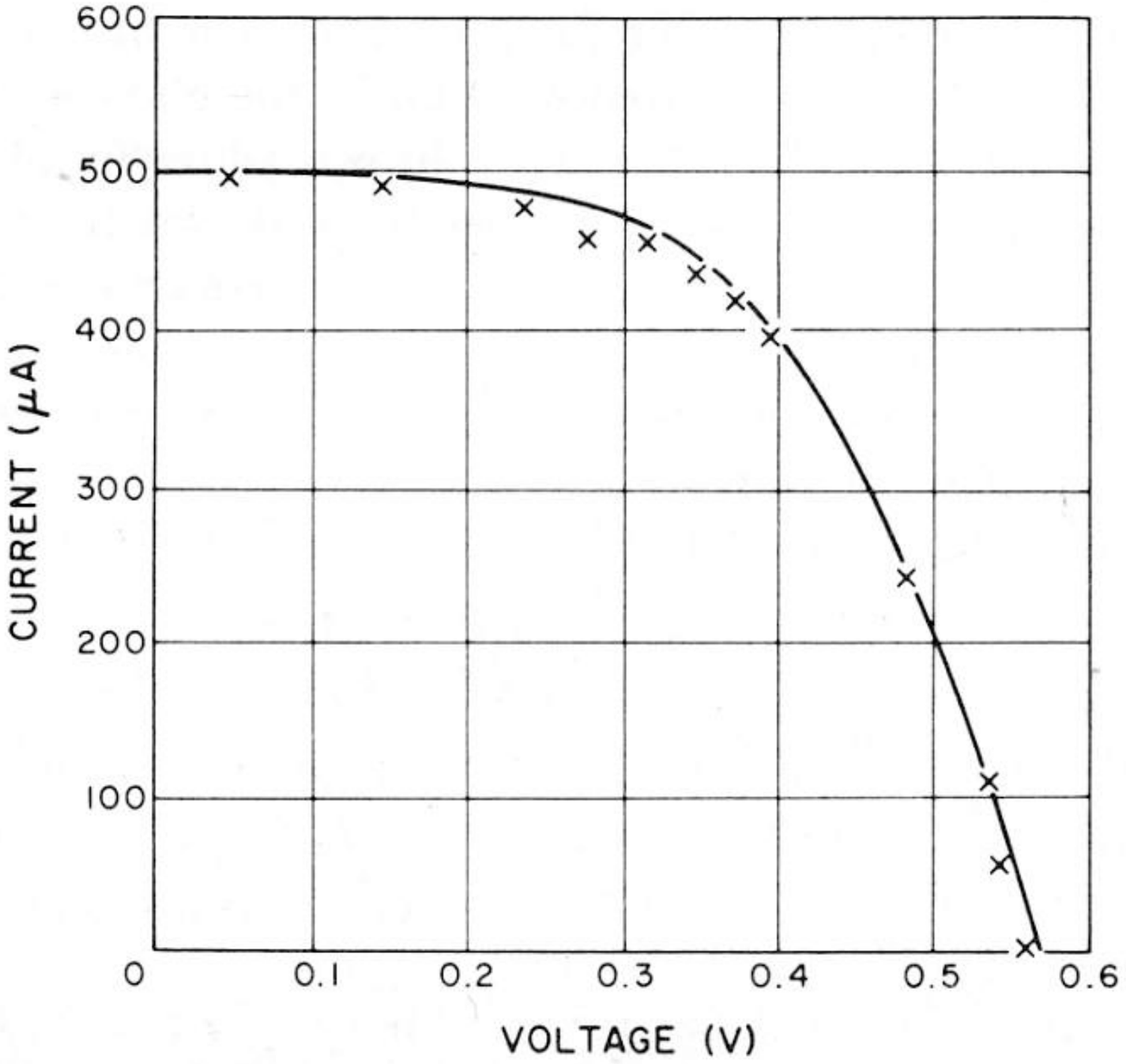


Fig. 14-2 Comparison of the theoretical current–voltage characteristic with experimental results on a GaAs photodiode.[1]

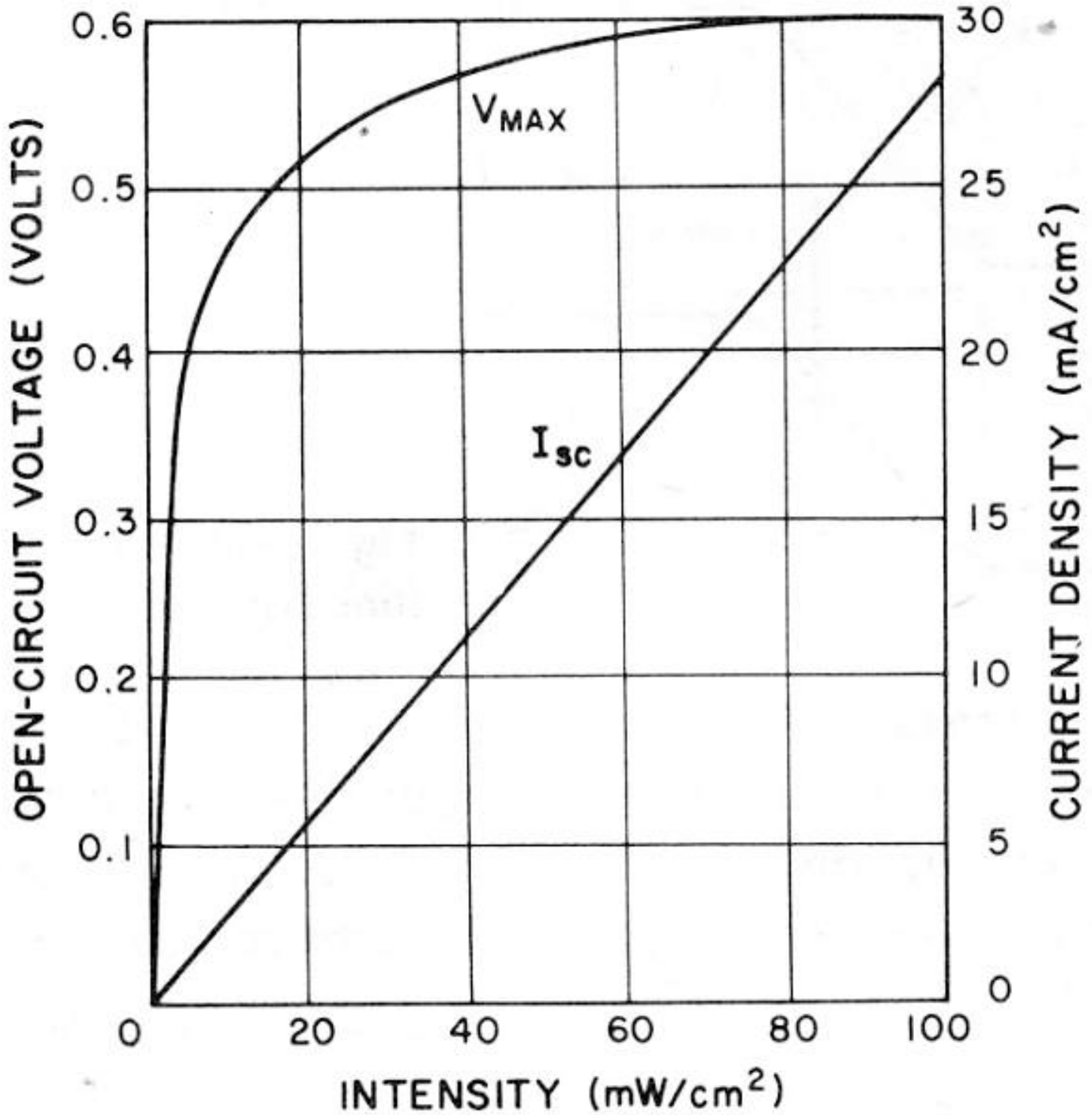
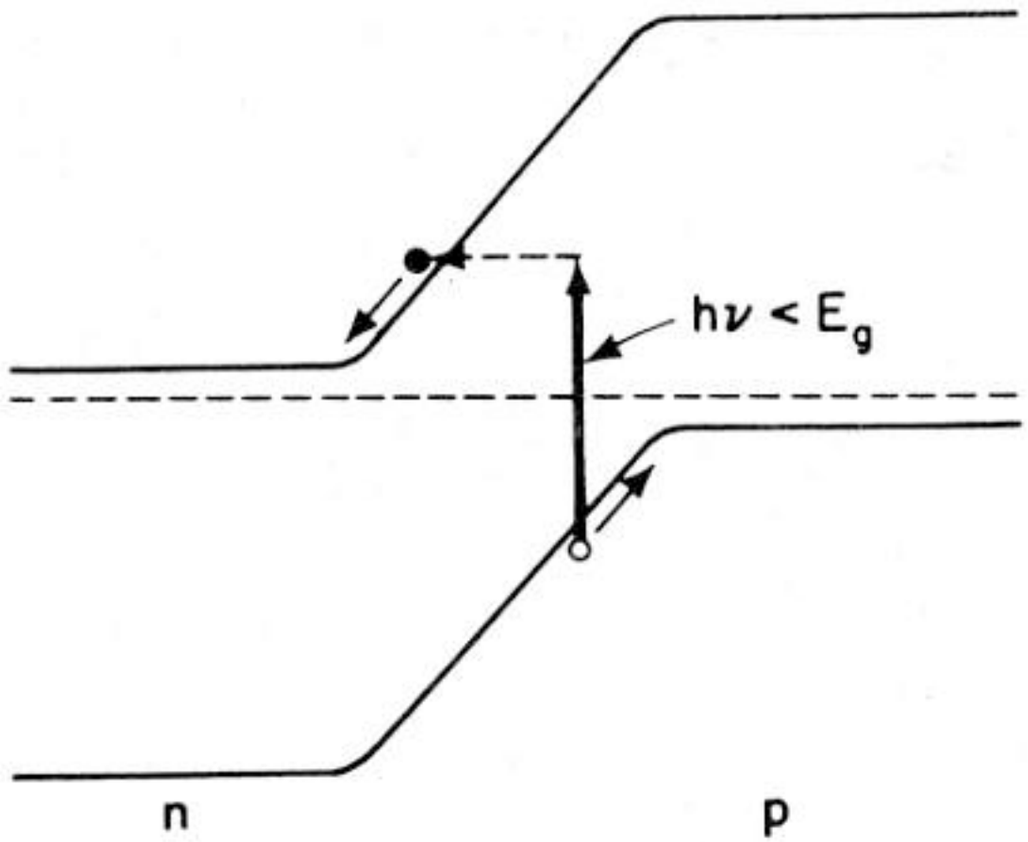


Fig. 14-3 Junction photocurrent and photovoltage as a function of light intensity.[2]


hν < E_g
n
p

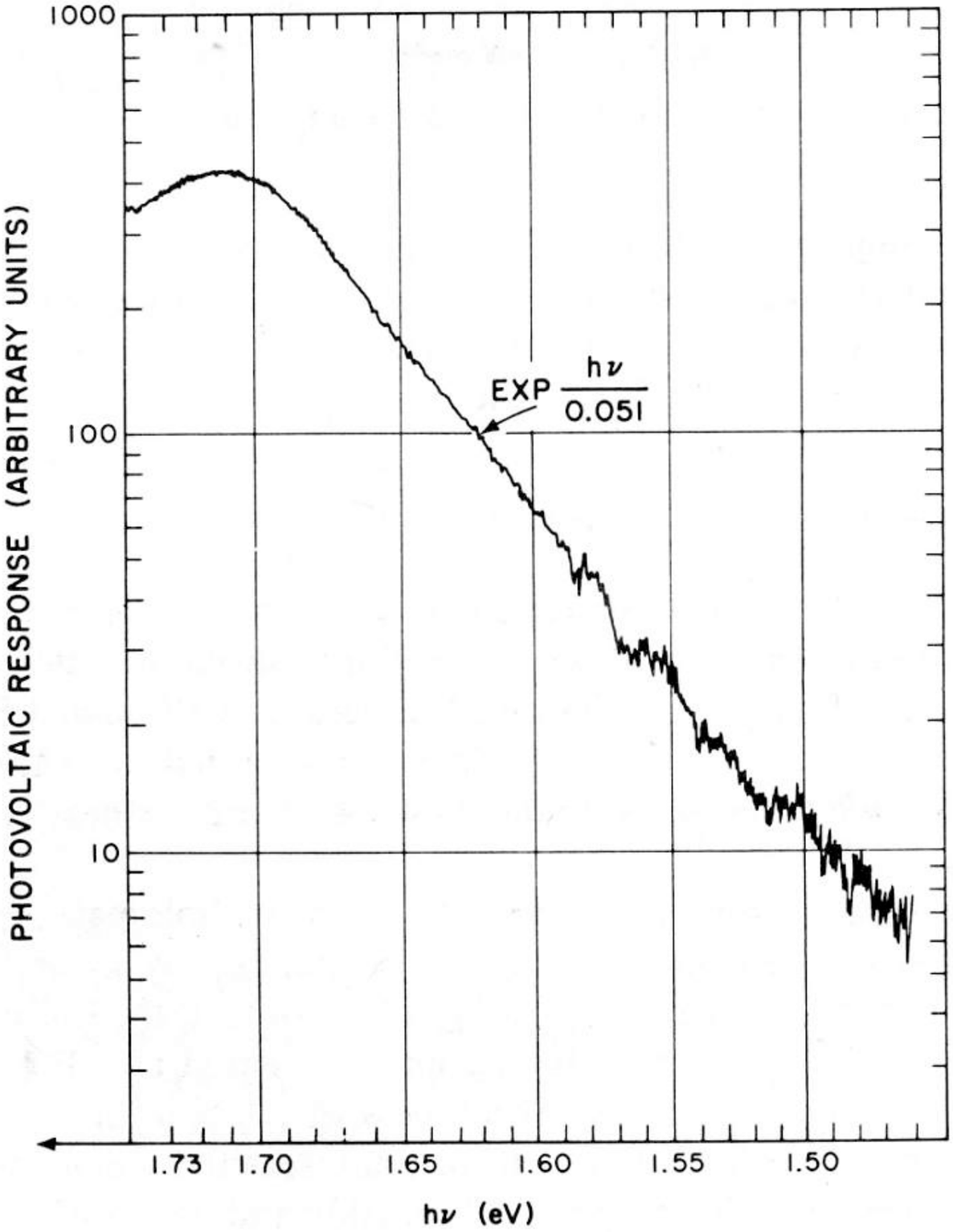
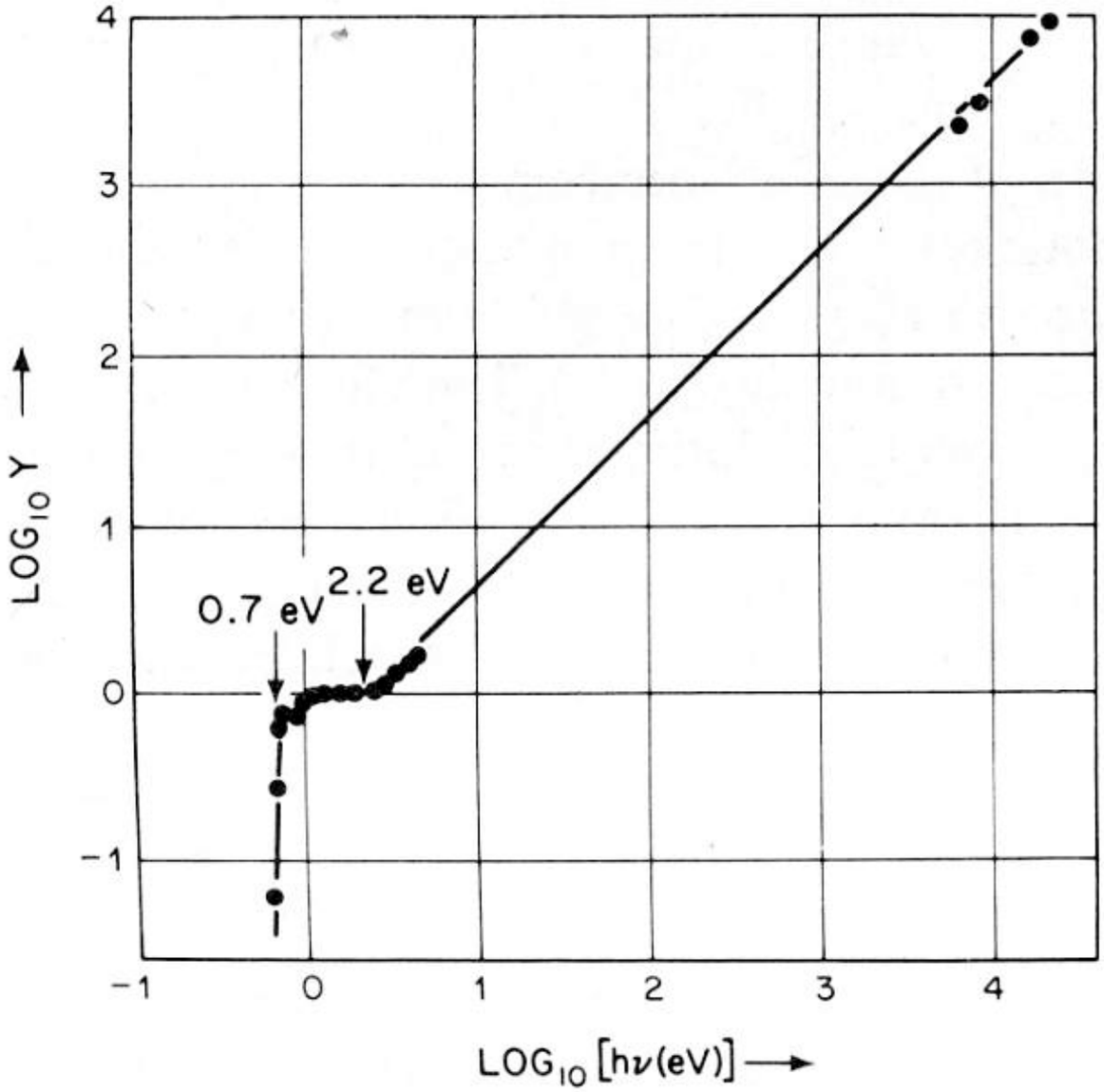


Fig. 14-5 The photovoltaic spectrum of a p–n junction in $GaAs_{0.85}P_{0.15}$.[4]

Quantum yield versus energy



Y = # pares generados/fotón

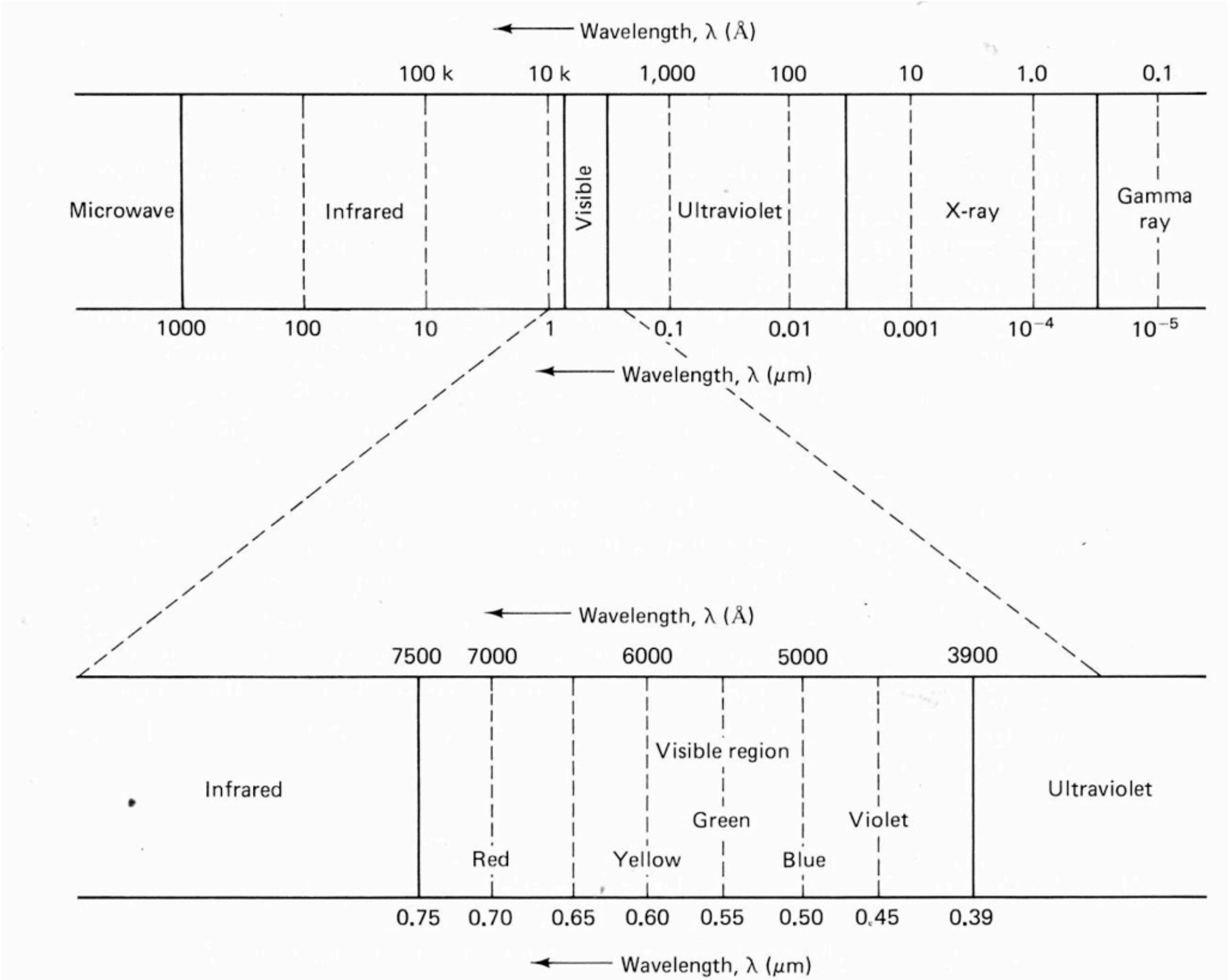
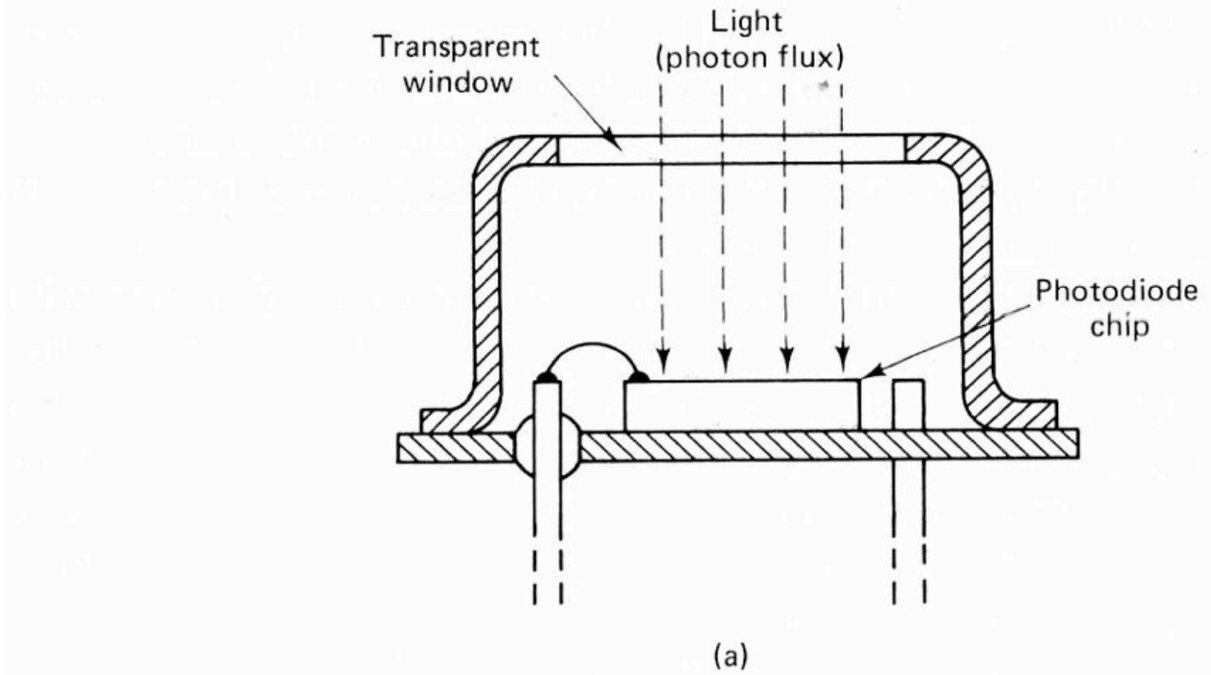
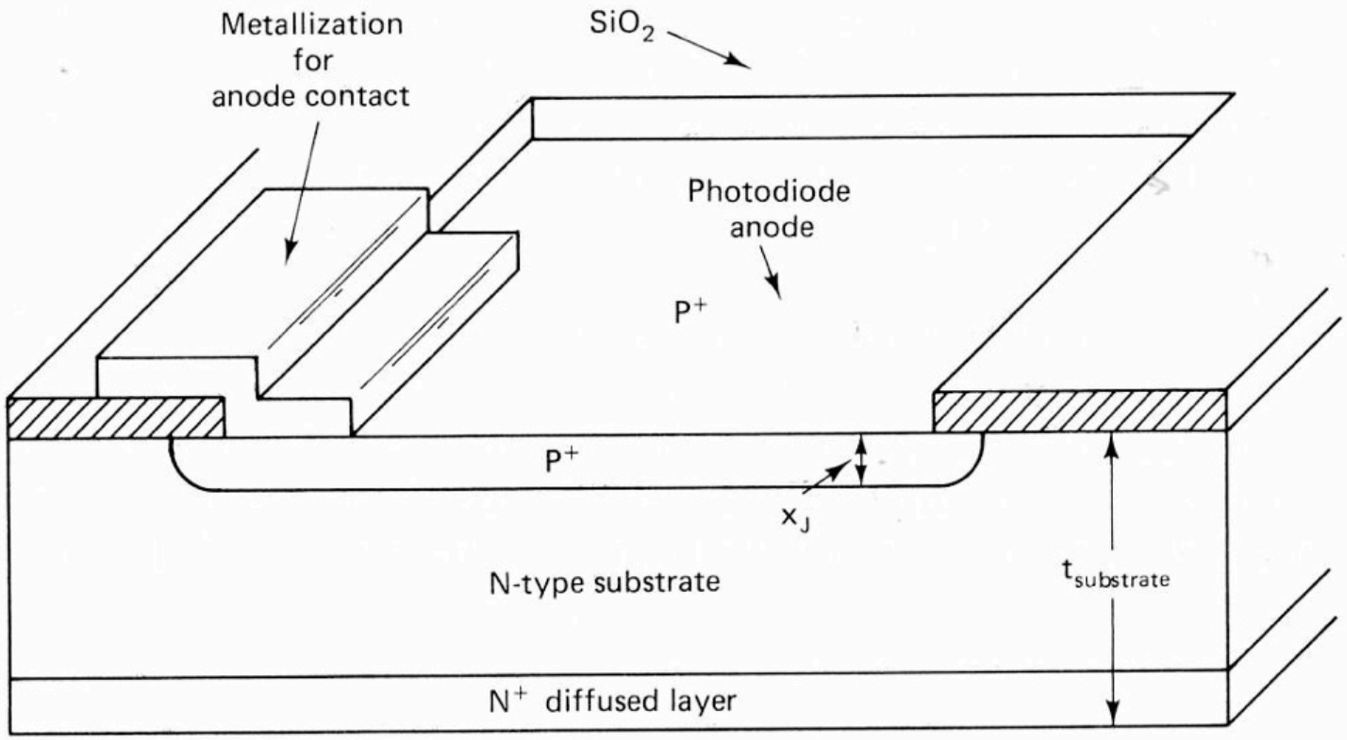


Figure 15.1 Electromagnetic spectrum.



(a)



(b)

Figure 15.2 Photodiode: (a) photodiode package with transparent window; (b) photodiode chip (cross-sectional perspective view).

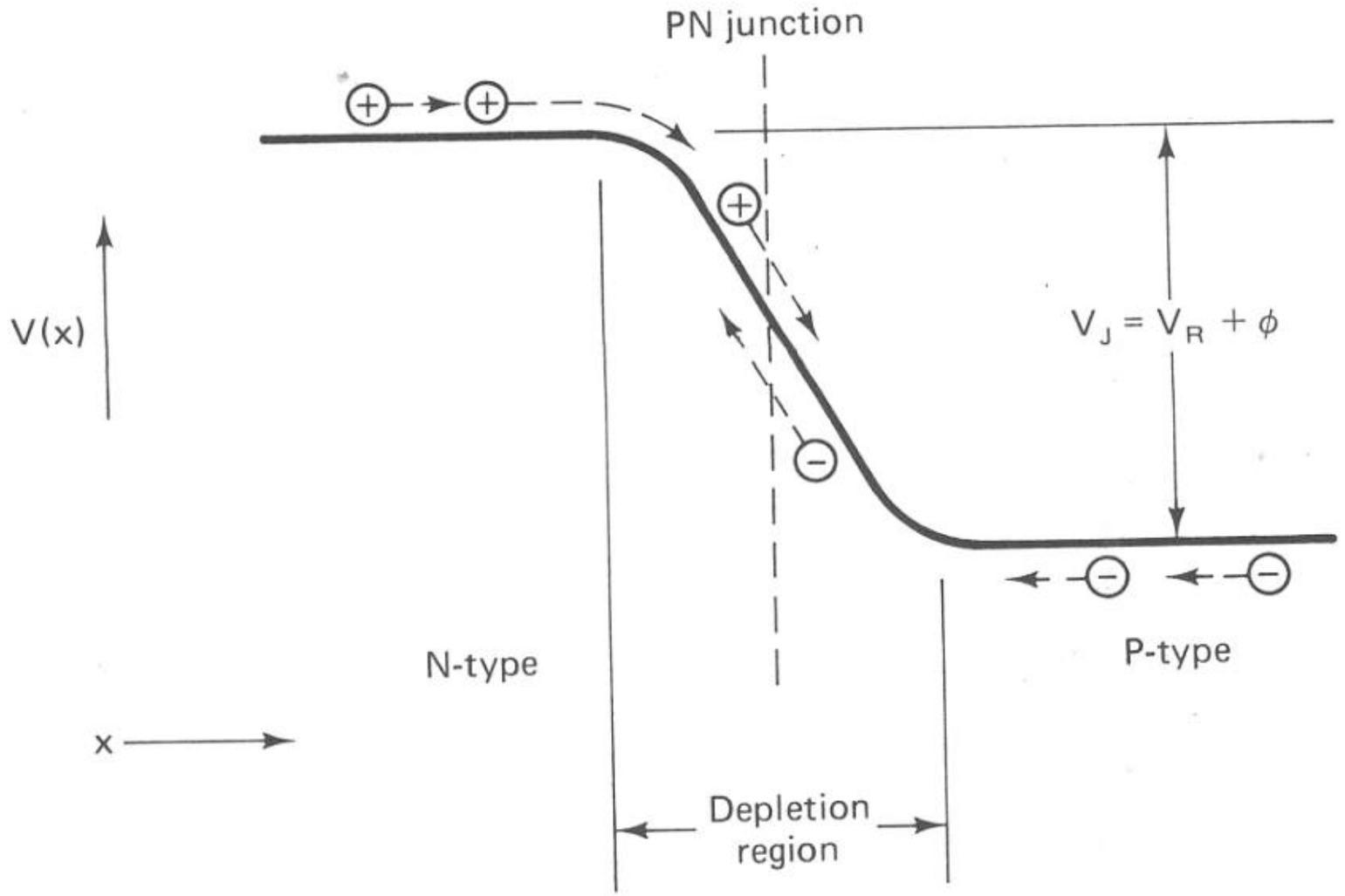
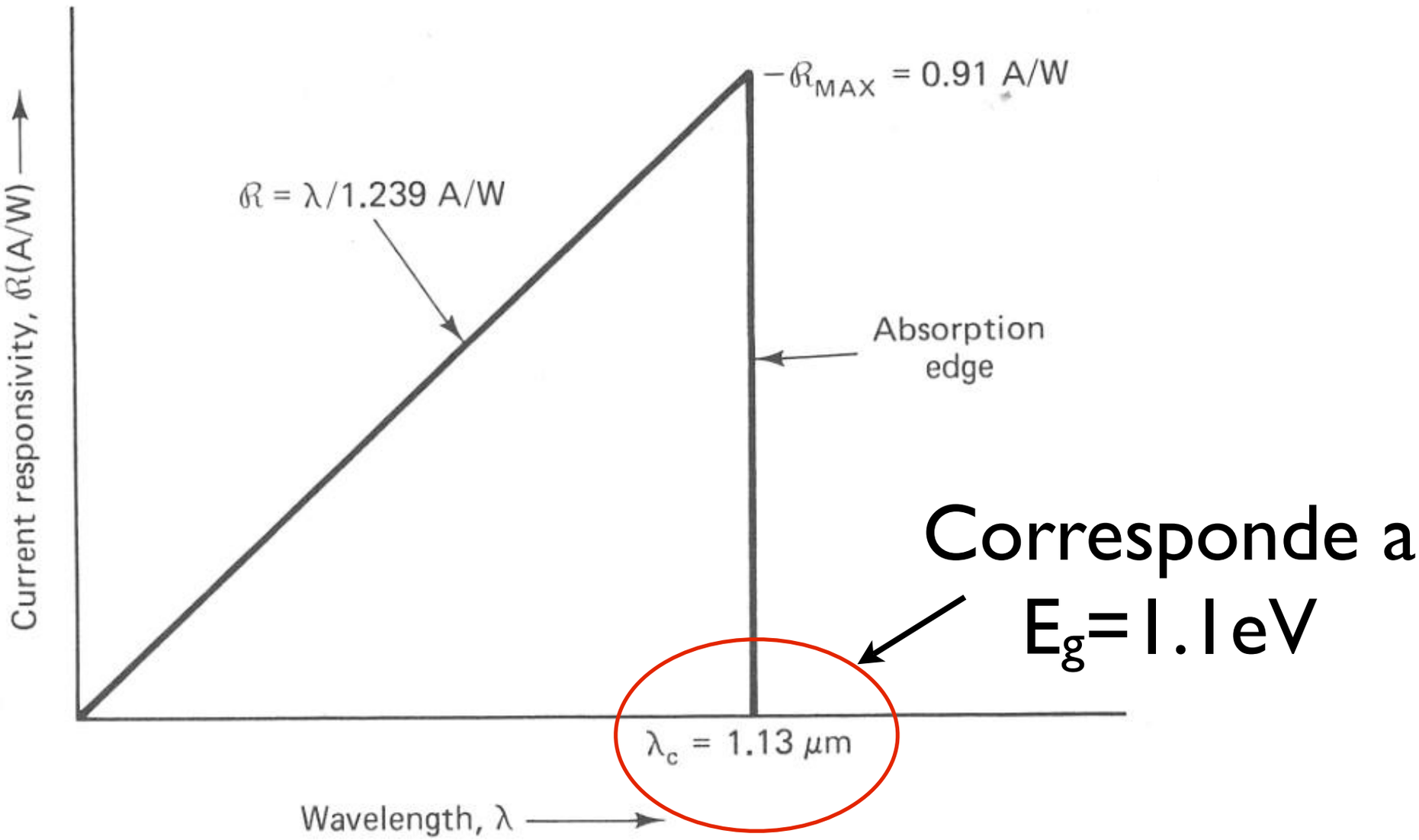


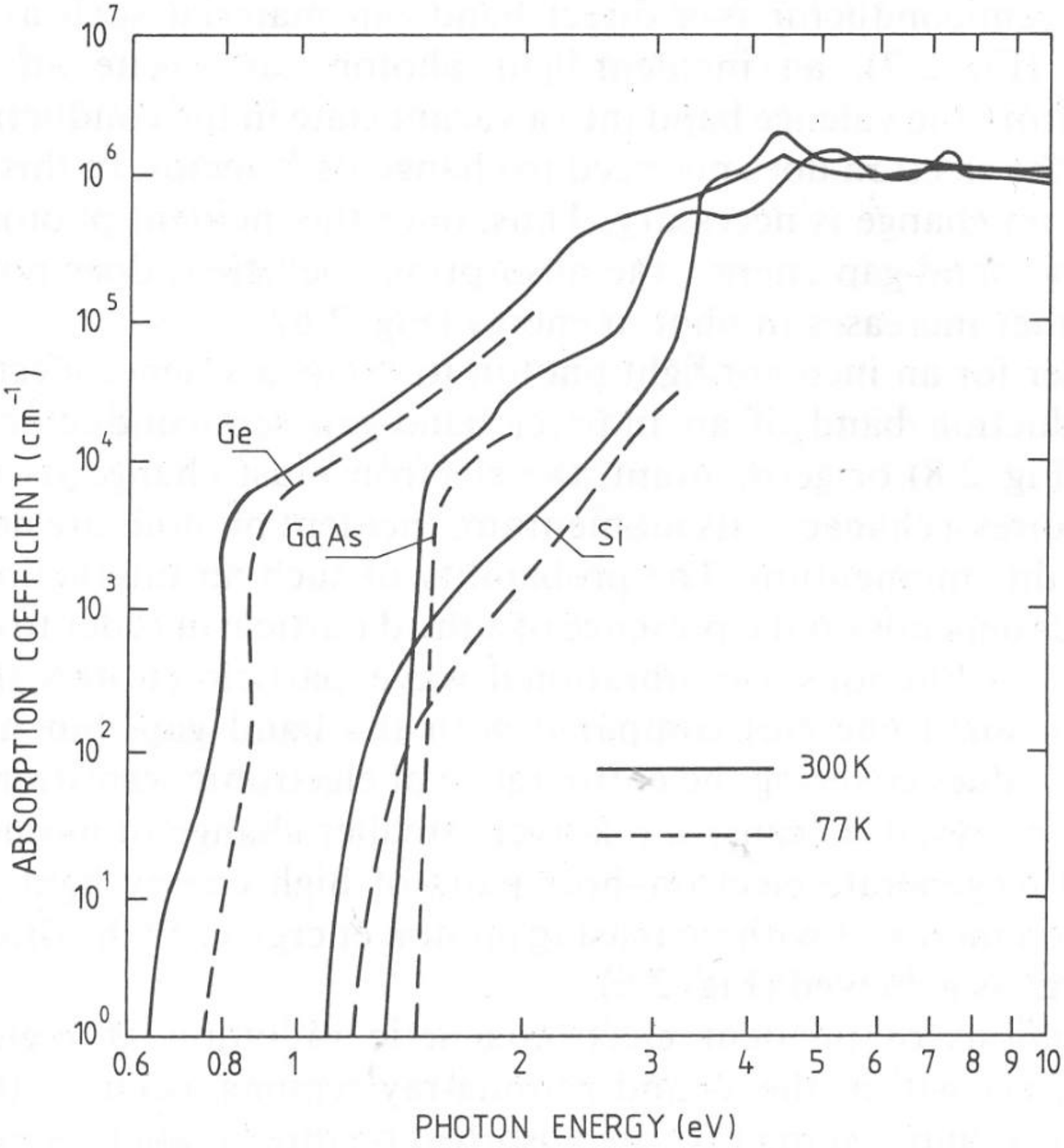
Figure 15.3 Flow of minority carriers across a reverse-biased PN junction.

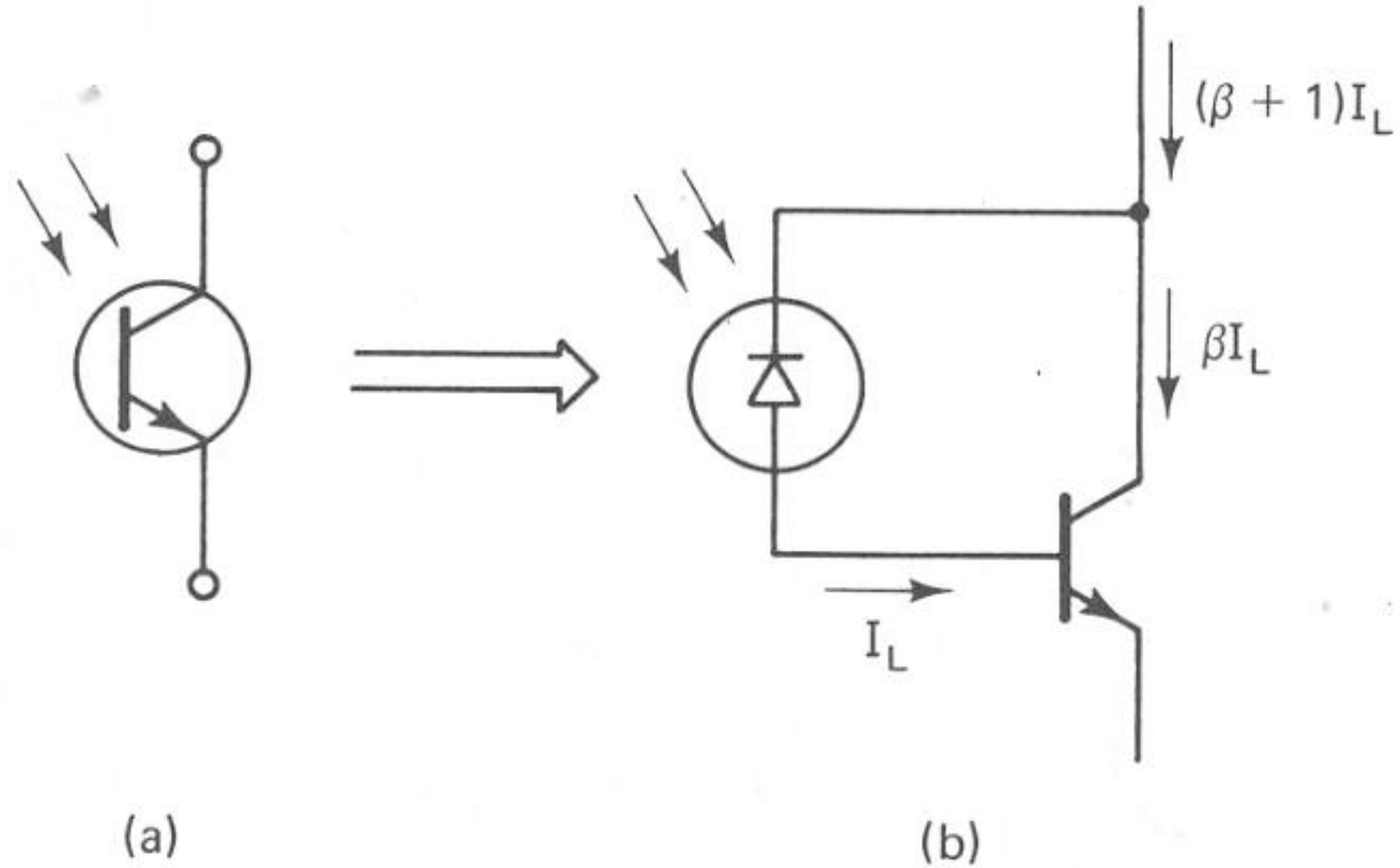
$$\mathcal{R} = \frac{I_L}{P} = \frac{q}{\text{energy/photon}} = \frac{q}{hc/\lambda}$$

$$= \frac{\lambda}{hc/q} = \frac{\lambda}{1.239\ \text{V}\mu\text{m}} = \frac{\lambda\ (\mu\text{m})}{1.239}\ \text{A/W}$$



Corresponde a E_g=1.1eV


ABSORPTION COEFFICIENT (cm^{-1})
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
Ge
GaAs
Si
300 K
77 K
0.6
0.8
1
2
3
4
5
6
7
8
9
10
PHOTON ENERGY (eV)



(a) (b)

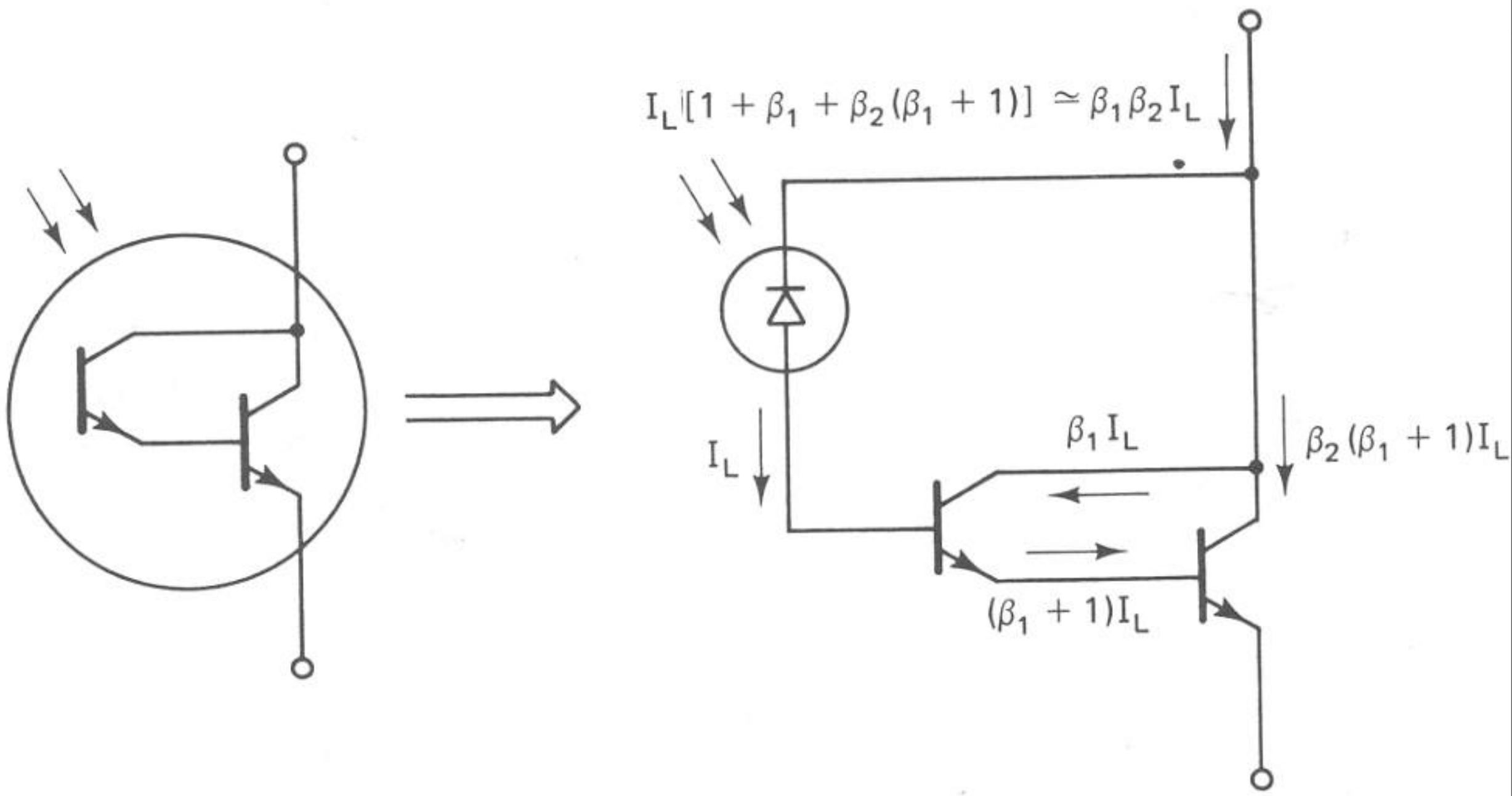


Figure 15.7 Photodarlington transistor.

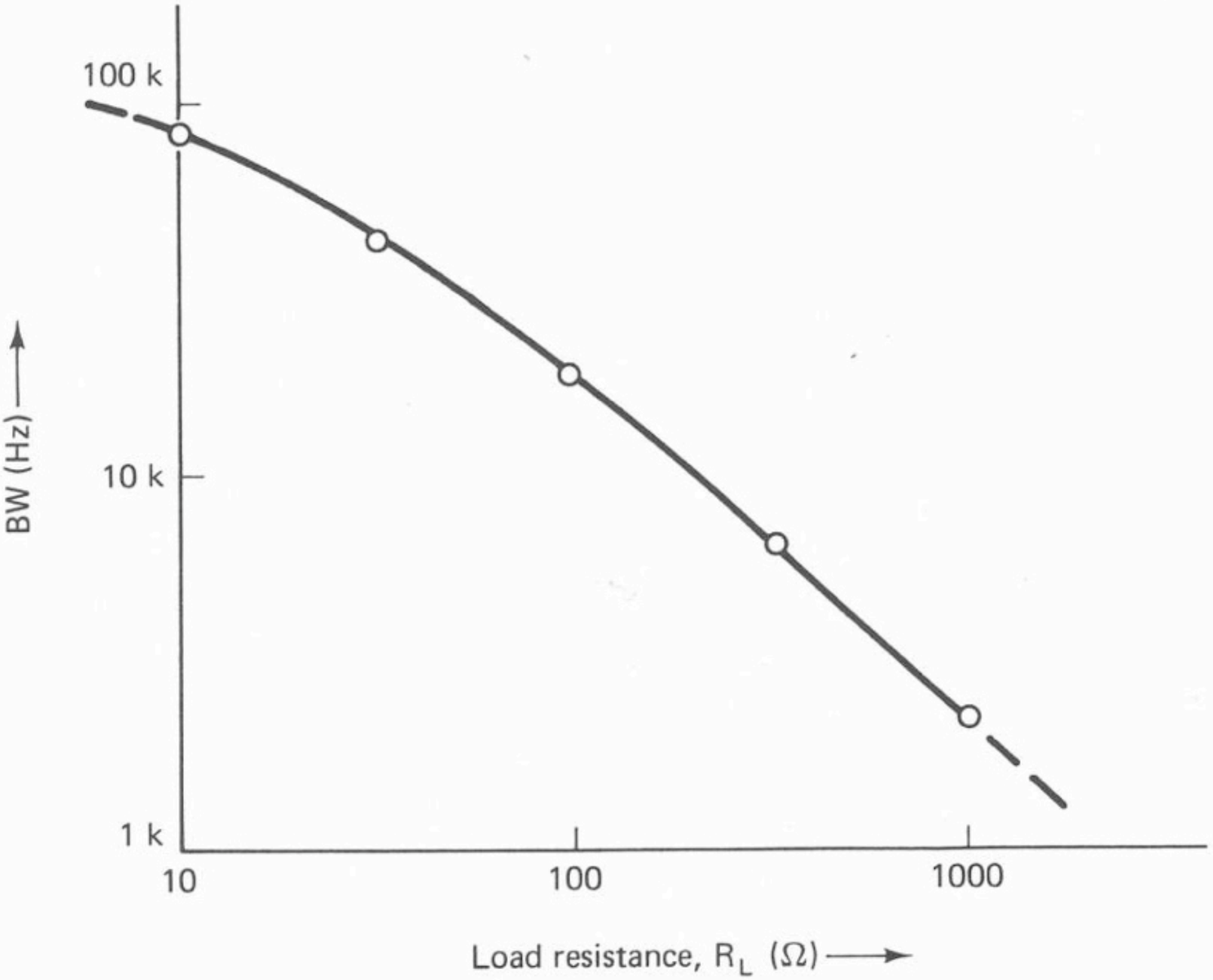
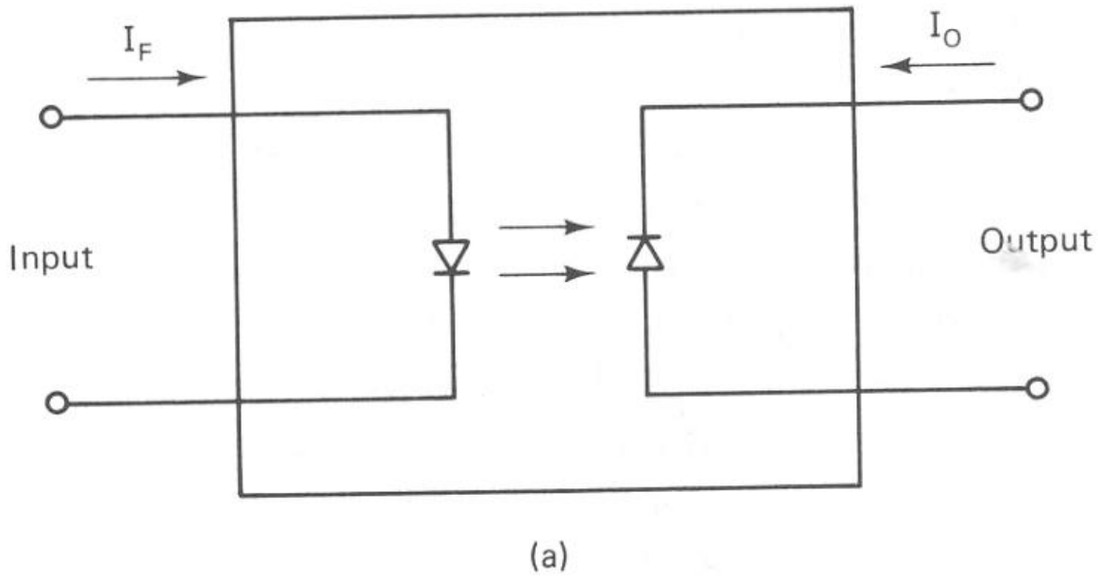
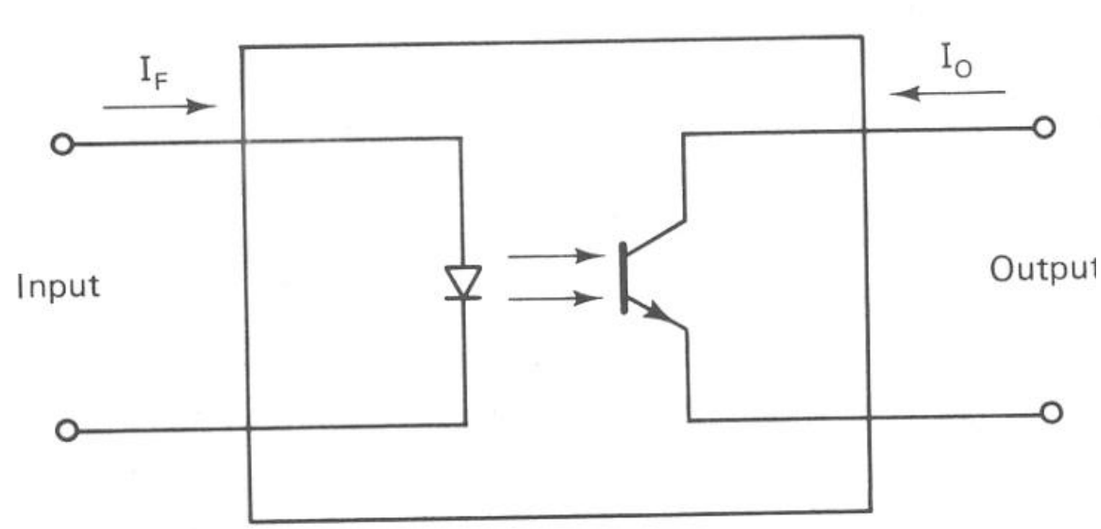


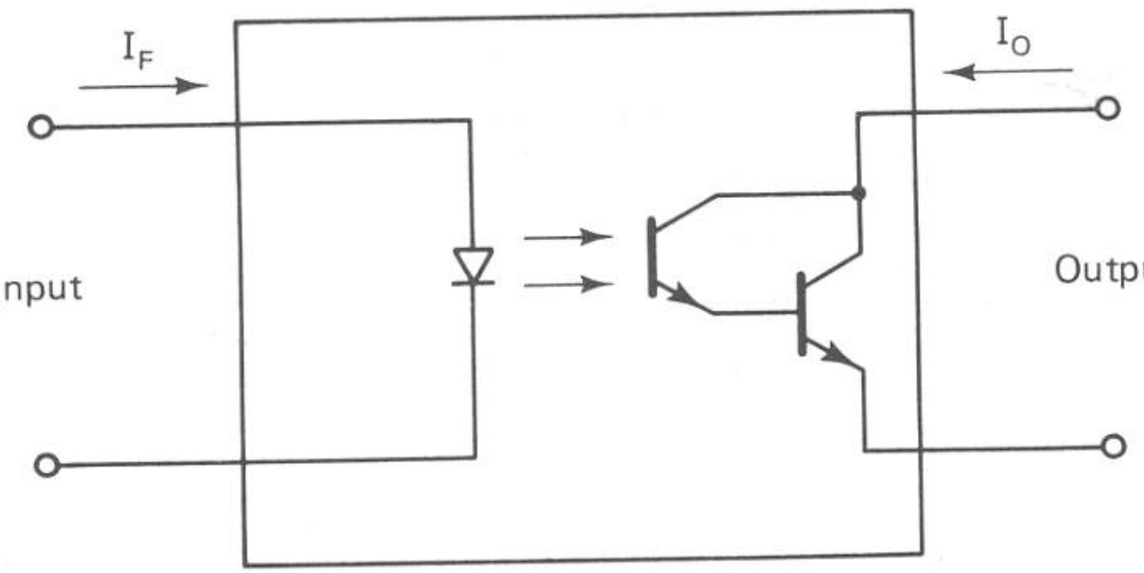
Figure 15.9 Photodarlington transistor (ZN5777) bandwidth versus load resistance



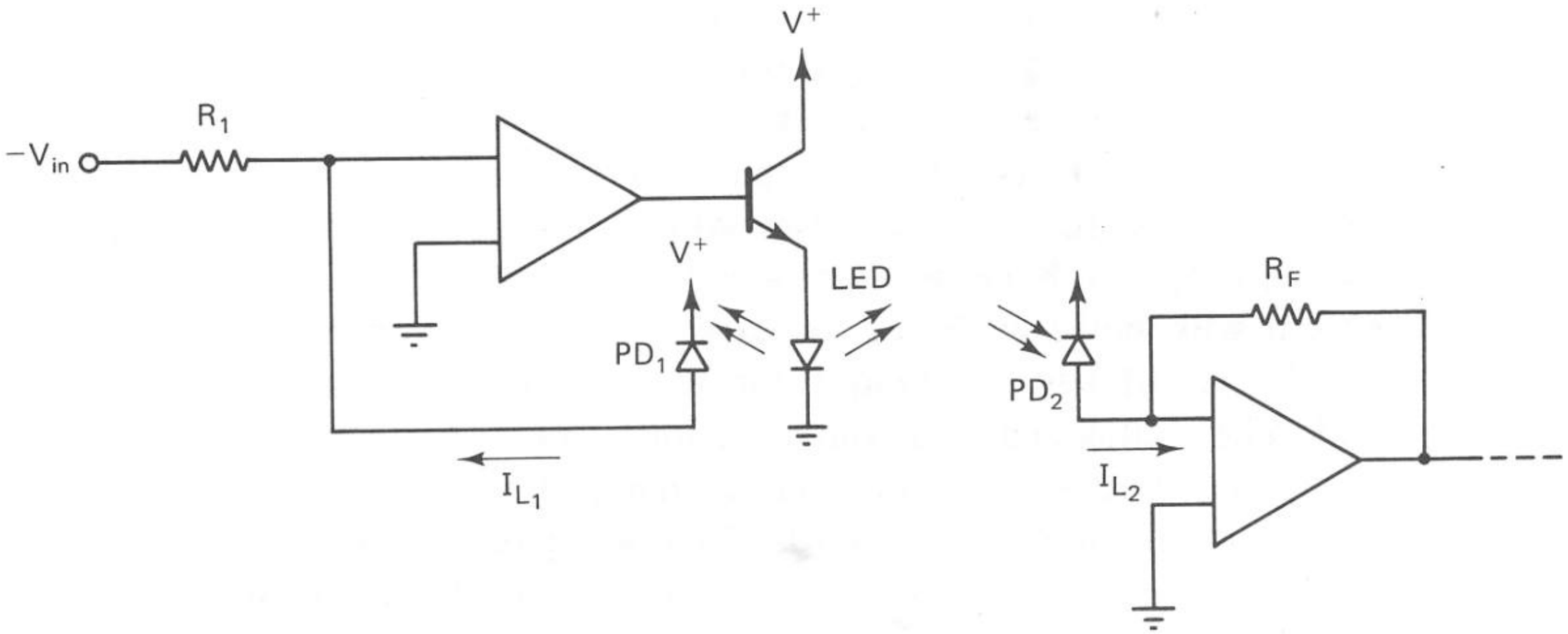
(a)



(b)



(c)


$-V_{in}$
R_1
V^+
V^+
LED
PD_1
I_{L_1}
R_F
PD_2
I_{L_2}