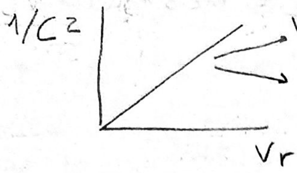
NANO - ALPUIM   P2 ; P4 ; P5 ; P9 ; P10 ; P11

$\frac{4}{20}$ $\frac{13}{20}$

P4 → polarização inversa | pg 570 | Ex. 6.7

A : secção transversal : 500 μm × 500 μm



→ V_o = ? potencial intrínseco

→ N_d = ? concentração de dadores

N_a = ?

→ p^+n abrupta => dizer que e⁻ $\boxed{N_a >> N_d}$

Equation 6.27 : $C_{dep} = A\left[\frac{e\varepsilon}{2N_d(V_o - V)}\right]^{1/2}$

substituindo $V = -V_r$

$$C_{dep} = A\left[\frac{e\varepsilon}{2N_d(V_o + V_r)}\right]^{1/2} \Rightarrow C_{dep}^2 = A^2\left[\frac{e\varepsilon}{2N_d(V_o + V_r)}\right]$$

$$\Leftrightarrow \frac{1}{C_{dep}^2} = \frac{2N_d}{A^2 e\varepsilon}(V_o + V_r) \qquad \frac{1}{C^2} = \underbrace{\alpha V_o}_{\text{ordenada na origem}} + \alpha V_r$$

$$= \underbrace{\frac{2N_d}{A^2 e\varepsilon}}_{\alpha} V_o + \underbrace{\frac{2N_d}{A^2 e\varepsilon}}_{\alpha} V_r$$

$y = 0.0004x + 0.0003$

$\alpha = 0.0004 \Leftrightarrow \frac{2N_d}{A^2 e\varepsilon} = 0.0004\ V\,pF^{-2}$

$\Leftrightarrow N_d = \alpha V_o = 0.0003 \Leftrightarrow \frac{V_o}{2} = \frac{0.0003}{0.0004} = 0.75\,V$ // 1.6×10^{-19} 1.06×10^{-10} F/m

voltar aqui

$\frac{\alpha}{2}$ $N_d = 4 \times 10^{-4} \times 10^{-12}$ V/F

→ $A = 500 \times 500\ \mu m^2$
$= 25 \times 10^4 \times 10^{-12}\ m^2$
$= 25 \times 10^{-8}\ m^2$

→ $e = 1.6 \times 10^{-19}$ C

→ $\varepsilon = \varepsilon_0 \varepsilon_r$
$= 8.854 \cdot 10^{-12}\ \frac{F}{m} \cdot 11.9$
$= 1.053626 \times 10^{-10}$ F/m

P5 Exemplo 6.8 (pg 570)

→ B atoms from the gas enter and diffuse into the Si-Crystal

→ The boron (acceptor) concentration N_a decays with x

a) Mostrar que : → $E_{max} = -\frac{eBw^2}{8\varepsilon}$ e → $V_o - V = \frac{eBw^3}{12\varepsilon}$

P9 → $I_{sc} = 50\,mA$ → $I/2 \Rightarrow V_{oc}$ e I_{sc} ?

→ $V_{oc} = 0.65V$

→ $\eta = 1 \Rightarrow \frac{P_{out}}{P_{in}} = 1 \Leftrightarrow P_{out} = P_{in}$

Exemplo 6.17 (pg 606) — comparar com as relações] dos PP

- Open-circuit $\Rightarrow I = 0$: $I = -I_{ph} + I_o\left[\exp\left(\frac{eV_{oc}}{\eta kT}\right) - 1\right] = 0$ (6.52)

assumindo que $V_{oc} \gg \eta kT/e$: $V_{oc} = \frac{\eta kT}{e}\ln\left(\frac{I_{ph}}{I_o}\right)$ — photocurrent depends on the intensity $\boxed{I_{ph} = KI}$

$N.$ se $I \to I/2 \to V_{oc}\downarrow$

Logo, $\underbrace{V_{oc1} - V_{oc2}} = \frac{\eta kT}{e}\left[\ln\left(\frac{I_{ph1}}{I_o}\right) - \ln\left(\frac{I_{ph2}}{I_o}\right)\right]$

$= \frac{\eta kT}{e}\ln\left(\frac{I_{ph1}}{I_{ph2}}\right) = \frac{\eta kT}{e}\ln\left(\frac{I}{I/2}\right)\Bigg] = \frac{\eta kT}{e}\ln 2$

por ser circuito aberto (?) $\Rightarrow I_{sc2} = I_{sc1}\left(\frac{I_2}{I_1}\right) = 50 \cdot \frac{1}{2} = 25\,mA$

$\boxed{I_{sc} = -I_{ph}}$

P10 → tensão no díodo : $V - IR_s$

célula de solar de Si $\Rightarrow \eta = 1.5 \to I_o = 3\times10^{-6}\,mA \to I_{ph} = 10\,mA$

$\to R_s = 0/20/50$

(p.595) The series resistance broadens the I/V curve and reduces the maximum available power and hence the overall efficiency of the solar cell.

→ R_s: effective series resistance in the photovoltaic circuit (electron paths in the n-layer surface region to finger electrodes) (p.594)

There is also a series resistance related to neutral p-region but this is generally small compared to

NOTA: I_{ph} and $I_d \Rightarrow$ opposite directions; in open-circuity they cancel each other

$\boxed{\text{eq } 6.52}$ (p.604)

$I = -I_{ph} + I_o\left[\exp\left(\frac{eV}{\eta kT}\right) - 1\right] \Leftrightarrow I = -10\,mA + 3\times10^{-6}\,mA\left[\exp\left(\frac{eV}{1.5(kT)}\right) - 1\right]$

se $T = 300$: $\frac{1.6\times10^{-19}\,C}{300\,K \cdot 1.38\times10^{-23}\,J/K} = \frac{1}{0.0259}\,eV^{-1}$

$\Leftrightarrow I = -10\,mA + 3\times10^{-6}\,mA\left[\exp\left(\frac{V - IR_s}{0.025\,eV}\right) - 1\right]$

$\Leftrightarrow \frac{I + 10\,mA + 3\times10^{-6}\,mA}{3\times10^{-6}\,mA} = \exp\left(\frac{V - IR_s}{0.025\,eV}\right)$

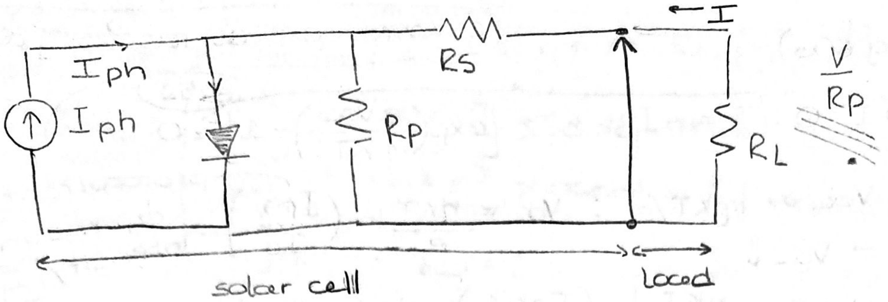
$\Leftrightarrow \frac{I + 10}{3\times10^{-6}} + \exp(0.025) = \exp(V - IR_s)$

$\Leftrightarrow \ln\left(\frac{I + 10}{3\times10^{-6}} + \exp(0.025)\right) = V - IR_s$

$\Leftrightarrow \ln\left(\frac{I + 10}{3\times10^{-6}} + \exp(0.025)\right) IR_s = \underline{\underline{V}}$

FAZER EM PYTHON ?

P11 → Rp: effects that prevent photogenerated carriers from flowing in the external circuit can be represented by effective internal shunt or parallel resistance Rp



FAZER PLOT PYTHON

Ver FSR
SNR