CONDUTTORI $\rho \approx 10^{-9}\ \Omega \cdot m$
(Al, Cu..)

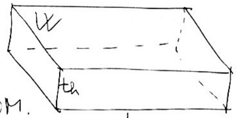
SEMI - CONDUTTORI $\rho_{PURO} \approx 1\ \Omega \cdot m$
Si,

ISOLANTI $\rho \approx 10^{9}\ \Omega \cdot m$
SiO_2
→ $\sigma \approx \emptyset$ (10^{-9}) → $n \cong \emptyset$

$V = RI$ ↓

$R = \rho \cdot \frac{L}{S}$

PAR. GEOM.



$S = W \cdot th$

$\sigma = \frac{1}{\rho}$

$\sigma = q \mu_n n$ $[n] = \frac{1}{cm^3} \left(\frac{1}{m^3}\right)$

$q = 1.6 \times 10^{-19} C$ $[\mu_n] = m^2/Vs$

$n(Al) = 6 \times 10^{22} cm^{-3}$ $v_{media} = -\mu_n \mathcal{E}$

$\mu_n(Al) = 0.0035\ m^2/Vs$

SEMICONDUTTORI

Si (IV gruppo)

Sed COMPOSTI (LED) GaAs III - V In... Al...

GaN DISP. P...

miconduttori Si (IV Gr.) | PURO

$n(T=300\ K) \simeq 1.5 \times 10^{10}\ cm^{-3}$

P, As (V Gruppo) DROGAGGIO (n, elettroni)

$\leq [P] \leq 10^{19}\ cm^{-3}$

n° atomi impurezze / cm^3

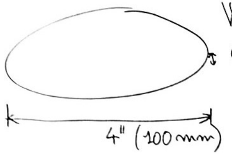
10^{16} atomi P / cm^3

$\ll n \leq 10^{19}\ cm^{-3}$

1 cm^3 Si 10^{22} atomi +

10^{16} atomi di P

$10^{-5} \leq \rho_{Si}(n) < 1\ \Omega \cdot m$



$\sigma = q\,\mu_n\,n$ $[n] = \frac{1}{cm^3}\left(\frac{1}{m^3}\right)$

$q = 1.6 \times 10^{-19}\ C$ $[\mu_n] = m^2/Vs$

$n(Al) = 6 \times 10^{22}\ cm^{-3}$ $v_{media} = -\mu_n \mathcal{E}$

$\mu_n(Al) = 0.0035\ m^2/Vs$

B (III Gruppo)

$10^{14} \leq [B] \leq 10^{19}\ cm$

BUCA HOLE
LACUNA

Carica +q

Massa $\simeq$ elettrone

$p = [B]\ cm$

(h)

$[B] = 10^{16}\ cm^{-}$

$$J = \sigma_n \mathcal{E}$$

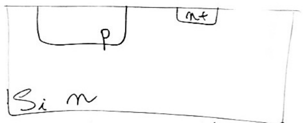
SCD n $\quad \sigma_n = q \mu_n n$

(P, As, Sb)

$$J = \sigma_p \mathcal{E}$$

SCD p $\quad \sigma_p = q \mu_p p$

DROGAGGIO SELETTIVO



$\mathcal{E} \neq 0$ e $dn/dx \neq \emptyset$ $\left(\frac{dp}{dx} \neq 0\right)$

$$J_n = \underbrace{q \mu_n n}_{\sigma_n} \mathcal{E} + q D_n \frac{dn(x)}{dx}$$

$$J_p = q \mu_p p \mathcal{E} - q D_p \frac{dp(x)}{dx}$$

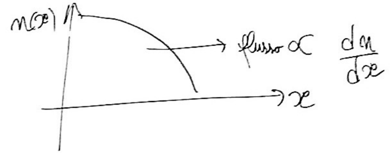
EQUAZIONI di DRIFT – DIFFUSION

TRASCINAMENTO (campo elettrico)

DIFFUSIONE (Gradiente conc.)

D_p, D_n: COEFFICIENTI di DIFFUSIONE

$$D_n = \frac{KT}{q} \cdot \mu_n$$



$n(x)$, $p(x)$

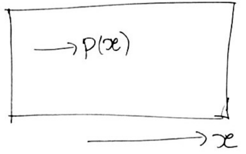
$\hookrightarrow \frac{dn}{dx} \neq 0$ o $\frac{dp}{dx} \neq 0$

$\longrightarrow$ CORRENTE di DIFFUSIONE

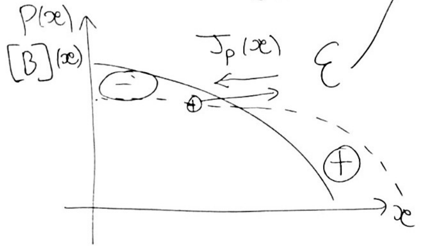
$$J_p = -q D_p \frac{dp(x)}{dx}$$

$$J_n = +q D_n \frac{dn(x)}{dx}$$

con $\mathcal{E} = \emptyset$



$$J_p = -q D_p \frac{d p(x)}{dx}$$



$\mathcal{E}$

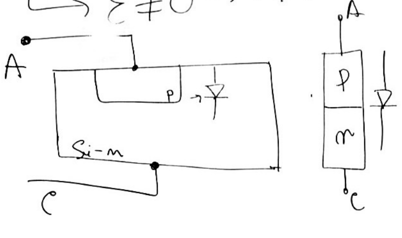
$B^{(III)}$ (−)

$$J_p = q \mu_p p(x) \mathcal{E} - q D_p \frac{dp}{dx}$$

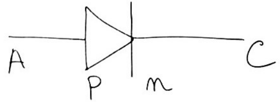
EQUILIBRIO → $J_p = \emptyset$

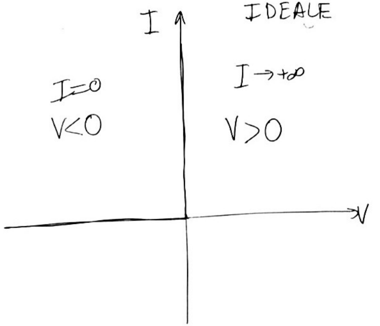
$$q \mu_p p \mathcal{E} - q D_p \frac{dp}{dx} = 0$$

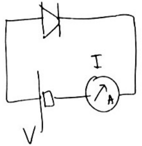
→ $\mathcal{E} \neq 0 \rightarrow V \neq \emptyset$



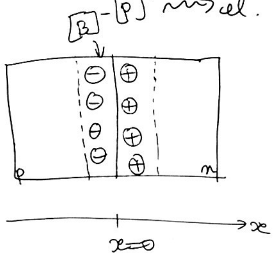
GIUNZIONE pn o DIODO



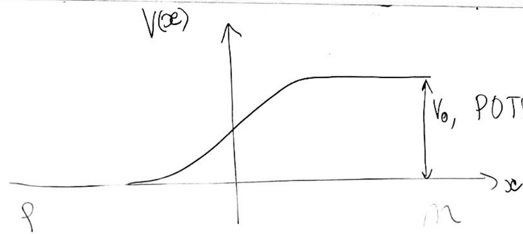




GIUNZIONE pn o DIODO

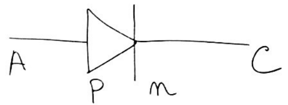


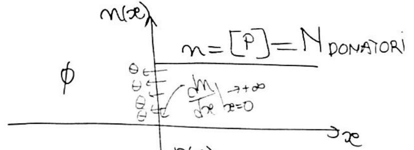
$J = \Phi$

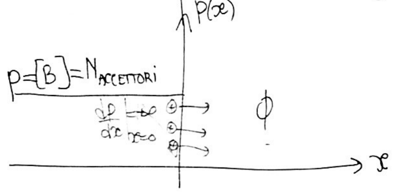


V_0, POTENZIALE di CONTATTO (POTENZIALE di BUILT-IN)

V_0 o V_{Bi}



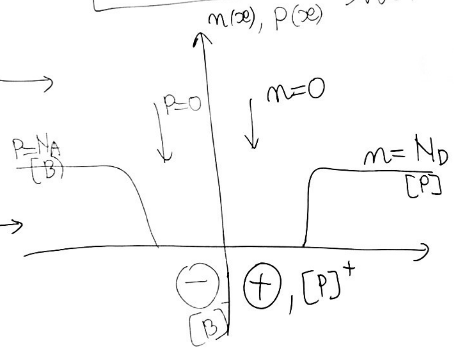


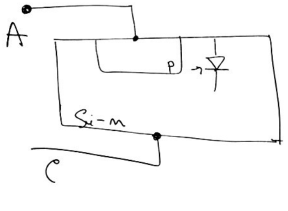


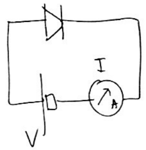
EQUILIBRIO

REGIONE di SVUOTAMENTO (DEPLETION REGION)

$n = N_D$, $p = N_A$, $V_0 = \frac{KT}{q} \ln\left(\frac{N_A N_D}{n_i^2}\right)$







$n = N_{Donat.} = [P]$ o $[As]$, $x > 0$

$p = N_{Accettori} = [B]$, $x < 0$

$n_i = 1.5 \times 10^{10}\ cm^{-3}$

CONC. di ELETTRONI nel Si PURO, INTRINSECO

n intrinseco