Metoodele de izolare a elementelor CI și fișa tehnologică a circuitului

CIM - toate elementele se fac în interiorul cristalului, și doar contactele se fac în exterior.

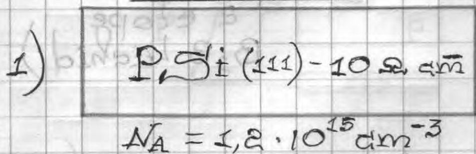
Metodele de izolare

1) Izolarea cu ajutorul PN joncțiunii.
(tehnologia standart, izolarea cu ajutorul bazei, izolarea cu ajutorul colectorului, a 3 fotomăști).
2) Izolarea cu dielectrici (procesul epic)

3) Izolarea recombinată (procesul viol și izoplanar).

- Fișa tehnologică a metodei standart. (această tehnologie este una dintre cele mai întrebuințate)

Plachetă

1) 

$N_A = 1,2 \cdot 10^{15} cm^{-3}$

Purificarea plachetei

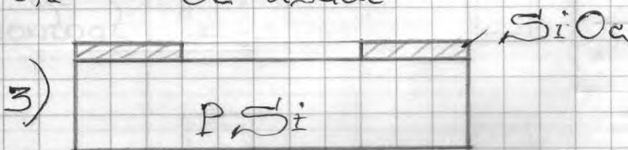
2)

$X_{SiO_2} = 1\ \mu m$

0,1 μm – O_2 uscat

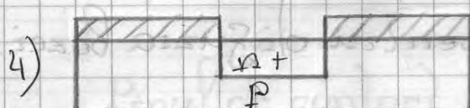
0,8 – O_2 umed

0,1 – O_2 uscat

3) 

fotolitografie

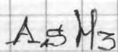
Masca Nr. 1

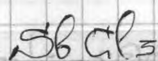
4) 

Dif. n^+

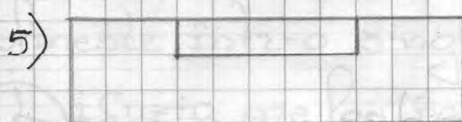
str. îngh.

$AsCl_3$


AsH_3


$SbCl_3$

24.05.2014.

5) 

Corodare SiO_2 în HF pentru ca în viitor să fie crescut un strat epitaxial.

6)

$6 \div 10 \mu m$

$n = 10^{16}\ cm^{-3}$

7)

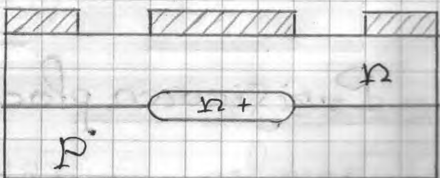
SiO_2

Oxidarea termică

$X_{SiO_2} \approx 1\ \mu m$

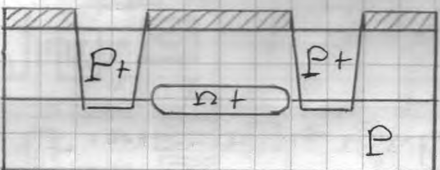
în 3 etape.

8) Litografia pe SiO_2 pentru difuzia de izolare



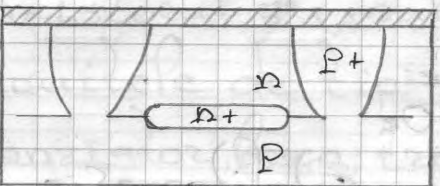
masca nr.2 (Izolare în 2 etape B_3B lichid)

9)

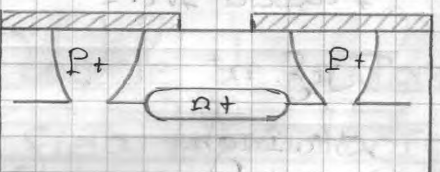


10)

SiO_2



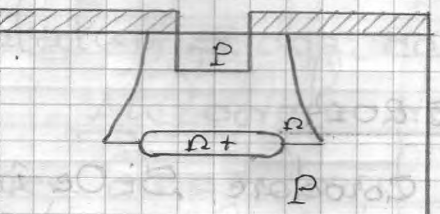
11)



masca nr. 3

pentru difuzia bazei.

12)

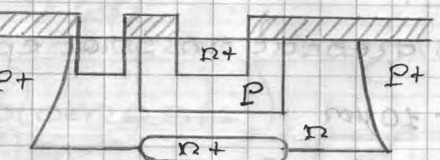


în 2 etape

difuzia în BBr_3-lichid

BN- solid.

13)



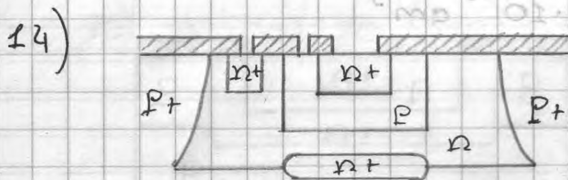
Oxidare +

Fotolitografie cu masca 4

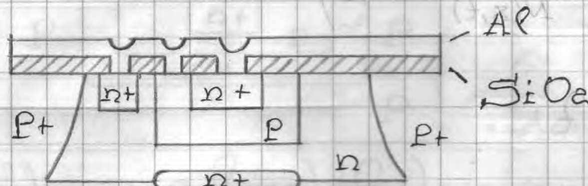
difuzia pentru emitor și contact la colector.

(PCl_2, PH_3, etc).

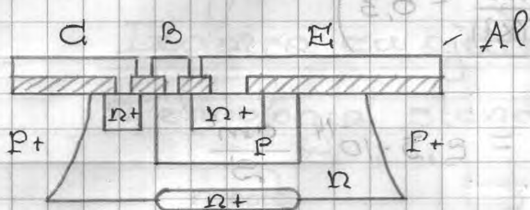
14)



15) Depunem materialul de contact (Al)



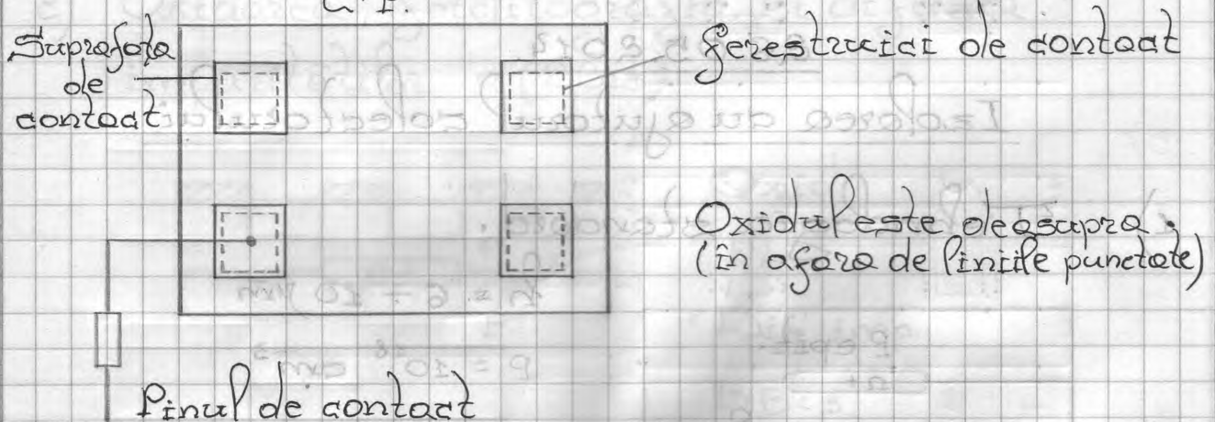
16)



Litografie, masca nr.6 pentru a crea traseele de contact.

18) Fotolitografia nr 7. (deschiderea fer. de contact)

C'P.



Procesul tehnologic s-a terminat.

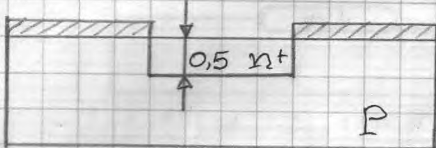
Practica

① Determinați temp. de difuzie care se îndeplinește într-o singură etapă cu constantă la supr.

Difuzia are loc în p Si cu 1 Ω cm

$X_{p-n} = 0{,}5\ \mu m$, $N_0 = 1{,}5 \cdot 10^{21}\ cm^{-3}$, $t = 1\ h$

$$N_0 = 1,5 \cdot 10^{+16}\ cm^{-3}$$



$$X_{p-n} = 2\sqrt{Dt}\left(\sqrt{\ln\frac{N_0}{N(x,t)}} - 0,3\right)$$

$$D = \left(\frac{2X_{pn}}{\sqrt{\ln\frac{N_0}{N(x,t)}} - 0,3}\right)^2 t$$

$$X_{p-n}^2 = 4Dt + \left(\sqrt{\ln\frac{N_0}{N(x,t)}} - 0,3\right)^2$$

$$D = \frac{X_{pn}^2}{\left(\sqrt{\ln\frac{N_0}{N(x,t)}} - 0,3\right)^2 4t} = 2,3 \cdot 10^{-14}\ \frac{cm^2}{s}$$

$T = 1050\,°C$ - luăm această valoare din tabel.

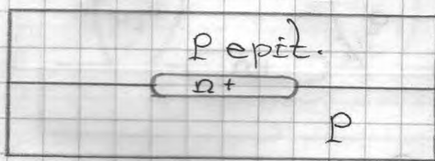
26.05.2014.

Izolarea cu ajutorul colectorului

1) Tehnologia standard.

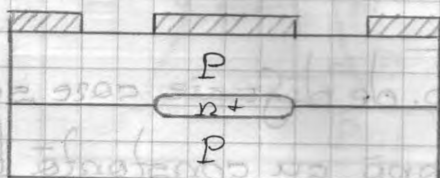
$h = 6 \div 10\ \mu m$

$p = 10^{18}\ cm^{-3}$



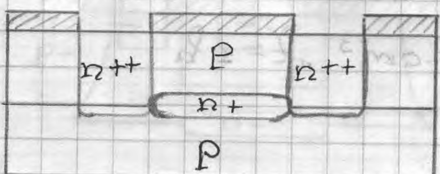
Oxidarea & litografia

2)



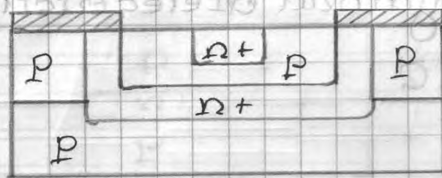
Oxid

F.L.

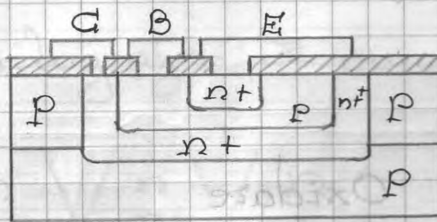


Dif

n + +



Oxid
FL.
Dif.

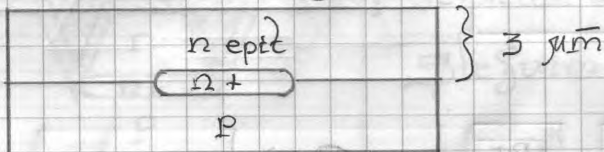


Regiunea de izolare este şi colectorul tranzistorului.

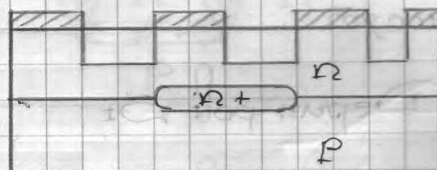
- Acest tip de tranzistor nu poate fi folosit la tensiuni mari.

Izolarea cu ajutorul bazei

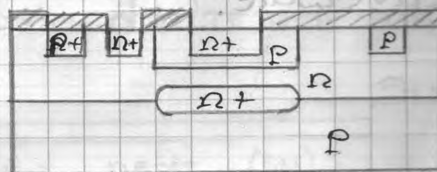
1) Tehnologia standard.



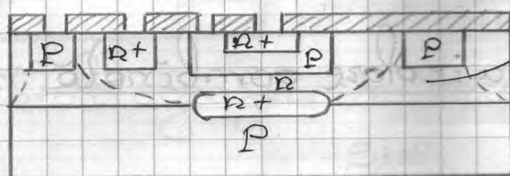
2) Oxidarea, fotolitografia şi difuzia impurităţilor p (BBr_3)



Oxid
FL
Dif imp.
BBr_3



Oxid
FL
Dif n^+ (E)
(PCl_3)



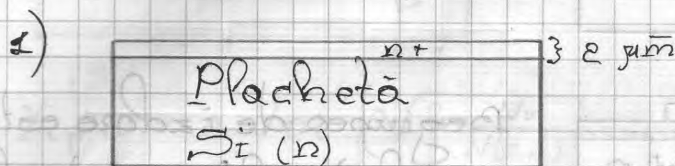
Regiunea sărăcită se măreşte.

Neajunsul este necesitatea a 2 surse de alimentare.

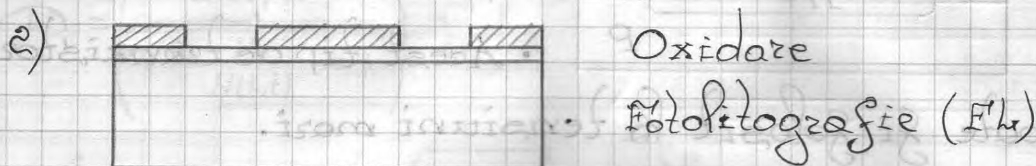
Izolarea cu ajutorul dielectricilor

Procesul EPIC

1)

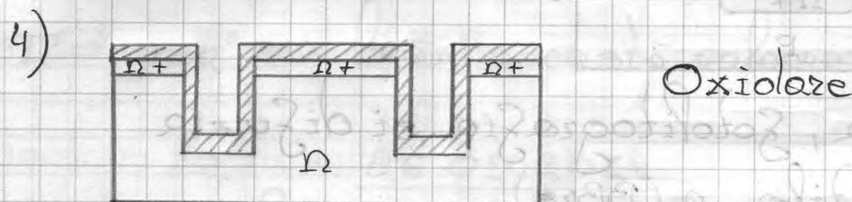


2)

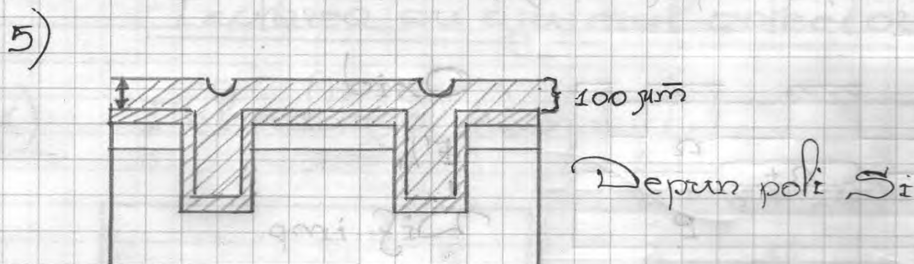


3)

4)



5)

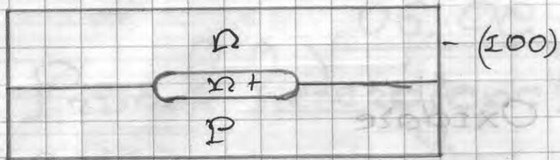


6) Slefuire, poleire, inversare.

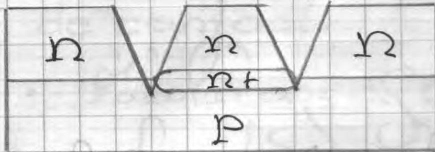
Tehnologie cu izolare combinată

1) Procesul VIP.
2) Procesul izoplanar.

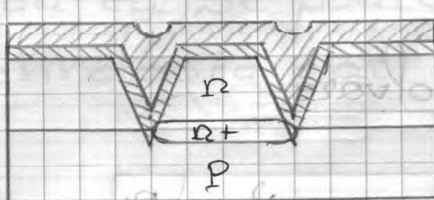
1) VIP - constă în formarea a niște șanțuri sub forma literei V.



2) Litografia & corodarea



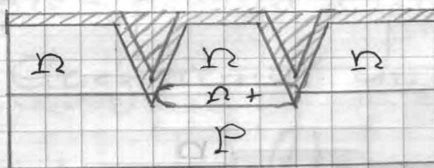
3) Oxidarea



} Umplerea cu poli Si

Şlefuim 10 μm

4) După şlefuire obţinem:

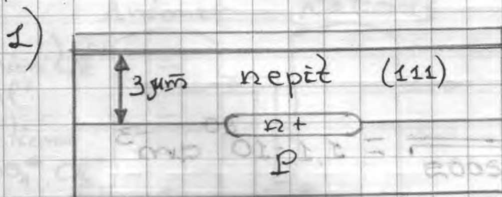


Tehnologia izoplanară

este una dintre cele mai întrebuinţate tehnologii.

Tehnologia standard.

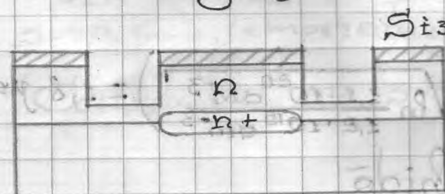
1)



Depunerea Si_3N_4 (netrună de Si)

(nu se oxidează)

2) Fotolitografia & corodarea.

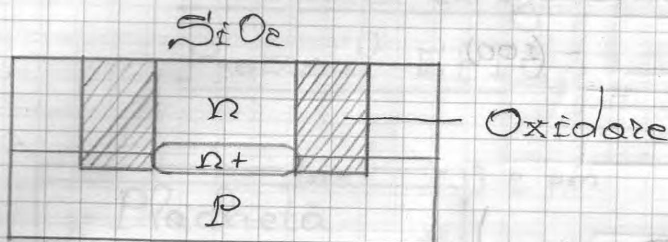


Corodare

Si_3N_4

Si Inf. F.R.

3) Oxidarea.



28.05.2014

Problemă

La formarea regiunii bazei tr. se utilizează difuzia în 2 etape a Borului în pelicola de tipul n, cu concentrația:

Se dă:

$N_D = 1{,}2 \cdot 10^{15}\ cm^{-3}$

$T_1 = 1050°C$

$t = 10\ min.$

$D_1 = 2{,}5 \cdot 10^{-14}\ cm^2/s$

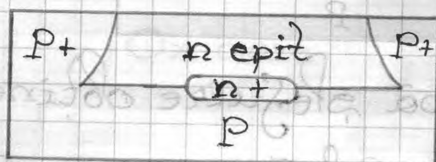
$T_2 = 1100°C$

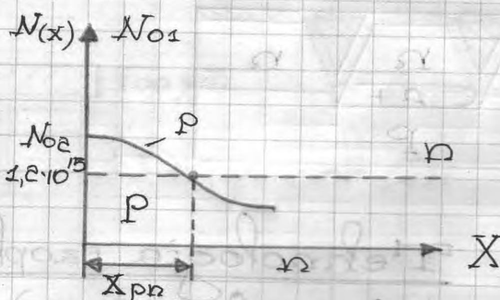
$t_2 = 2\ h$

$D_2 = 10^{-13}\ cm^2/s$

$N_{01} = 1{,}2 \cdot 10^{21}\ cm^{-3}$

Rezolvare





$$X_{p\text{-}n} = 2\sqrt{D_2 t_2}\left(\sqrt{\ln \frac{N_{02}}{N(xt)}}\right)$$

$$N_{02} = \frac{Q}{\sqrt{\pi D t}} = \frac{5{,}24 \cdot 10^{15}\ cm^{-2}}{\sqrt{3{,}14 \cdot 10^{-13}\ cm^2/s \cdot 7200 s}} = 1{,}1 \cdot 10^{20}\ cm^{-3}$$

$$Q = 2 N_{01}\sqrt{D_1 t_1/\pi} = 2 \cdot 1{,}2 \cdot 10^{21}\ cm^{-3}\sqrt{2{,}5 \cdot 10^{-14}\ cm/s \cdot 600/3{,}14} = 5{,}24 \cdot 10^{15}\ cm^{-2}$$

$$X_{p\text{-}n} = 2\sqrt{10^{-13}\ cm^2/s \cdot 7200} \cdot \left(\sqrt{\ln \frac{1{,}1 \cdot 10^{20}\ cm^{-3}}{1{,}2 \cdot 10^{15}\ cm^{-3}}}\right) = 1{,}8\ \mu m$$

Epitaxia din faza lichidă