

[86.03/66.25] Dispositivos Semiconductores
1er Cuatrimestre 2020

Juntura MOS

1. Identificación de materiales y valor de parámetros eléctricos
- 2. Distribución de carga para distintos regímenes**
3. Curva Capacidad-Tensión

Enunciado

Para una estructura MOS con poly-silicio tipo N, $N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$, $V_T = 0.547 \text{ V}$, $\gamma^2 = 0.545 \text{ V}$ y $C'_{\text{ox}} = 2.46 \cdot 10^{-7} \text{ F/cm}^2$, considerando que está polarizado con:

$$V_{\text{GB}} \in \{-2\text{V}, V_{\text{FB}}, 0, V_T, 2\text{V}\}$$

hallar

1. Las caídas de potencial en el óxido y en el SC, ΔV_{OX} , ΔV_{Bulk}
2. La carga por unidad de superficie en la interfaz poly-óxido $Q'_{\text{Poly-Ox}}$
3. La capacidad por unidad de área C'_{GB}

Enunciado

Del ejercicio anterior sabemos que el sustrato es tipo P y los valores de V_{FB} y ϕ_B

Para una estructura MOS con poly-silicio tipo N, $N_{Bulk} = 10^{17} \text{ cm}^{-3}$, $V_T = 0.547 \text{ V}$, $\gamma^2 = 0.545 \text{ V}$ y $C'_{ox} = 2.46 \cdot 10^{-7} \text{ F/cm}^2$, considerando que está polarizado con:

$$V_{GB} \in \{-2V, V_{FB}, 0, V_T, 2V\}$$

hallar

1. Las caídas de potencial en el óxido y en el SC, ΔV_{OX} , ΔV_{Bulk}
2. La carga por unidad de superficie en la interfaz poly-óxido $Q'_{Poly-Ox}$
3. La capacidad por unidad de área C'_{GB}

Datos
Poly-N y Subs. P
$N_{Bulk} = 10^{17} \text{ cm}^{-3}$
$V_T = 0.547 \text{ V}$
$\gamma^2 = 0.545 \text{ V}$
$C'_{OX} = 246 \text{ nF/cm}^2$
$V_{FB} = -\phi_B = -0.97 \text{ V}$

Se resuelve en el siguiente video

Enunciado

<u>Resultados</u>					
V_{GB}	-2	V_{FB}	0	V_T	2
Q'_{p-o}					
ΔV_{ox}					
ΔV_{Bu}					

Para resolver el enunciado debemos completar una tabla de este estilo

Enunciado

<u>Resultados</u>					
V_{GB}	-2	V_{FB}	0	V_T	2
Q'_{p-o}					
ΔV_{ox}	3	2	1	4	5
ΔV_{Bu}					

Para resolver el enunciado debemos completar una tabla de este estilo

Vaciamiento (en este caso Eq. Térmico)

<u>Resultados</u>					
V_{GB}	-2	V_{FB}	0	V_T	2
Q'_{p-o}					
ΔV_{ox}					
ΔV_{Bu}					

1

$$V_{GB} = 0$$

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

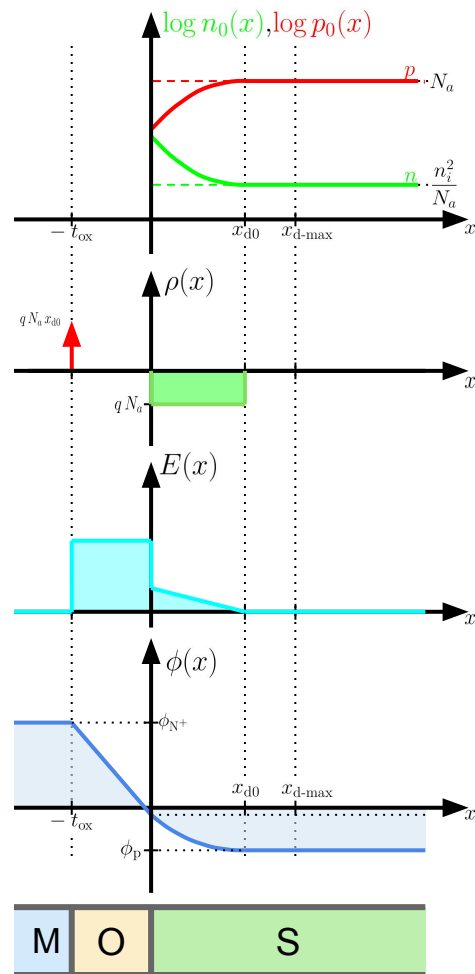
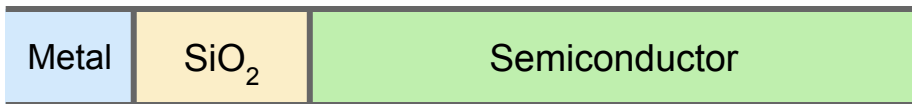
Resultados

$$V_{GB} = 0 \text{ V}$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = 0$$

Diagrama de portadores en vaciamiento

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

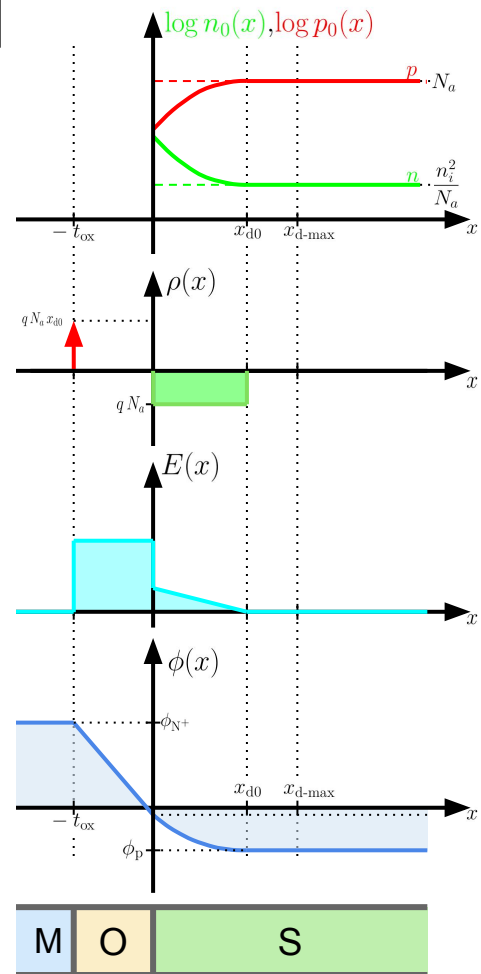
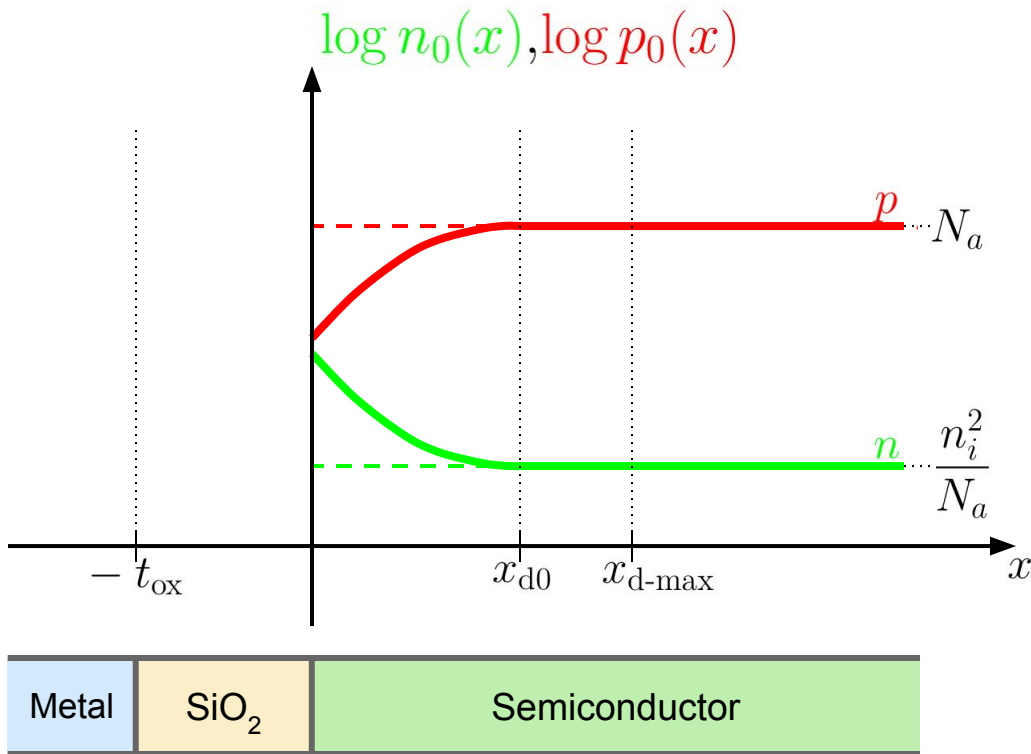
Resultados

$$V_{GB} = 0 \text{ V}$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = 0$$

Diagrama de portadores en vaciamiento

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

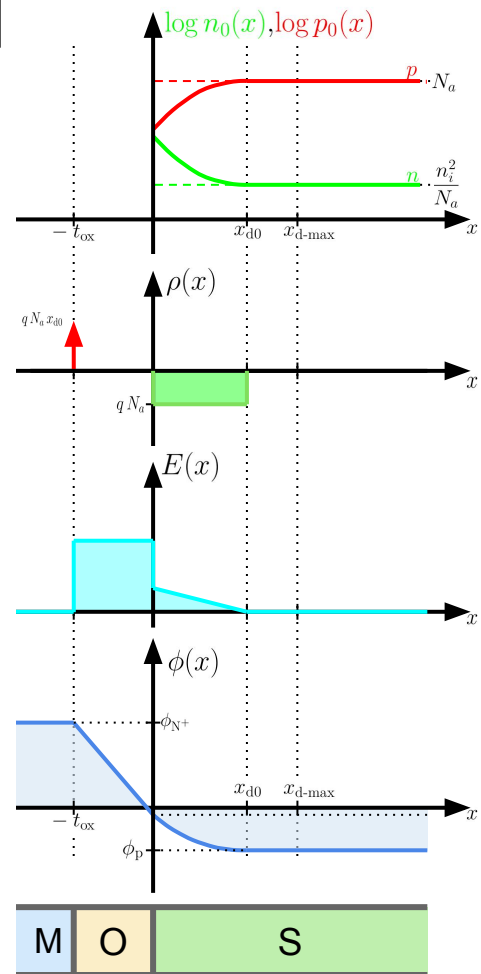
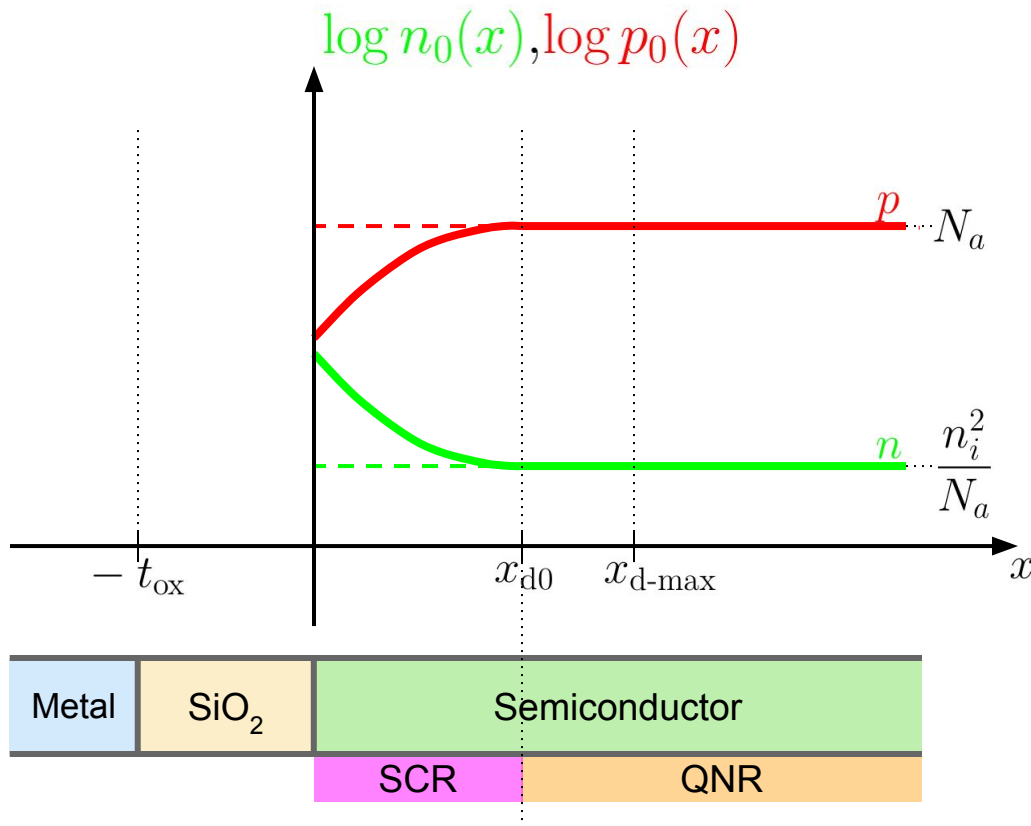
Resultados

$$V_{GB} = 0 \text{ V}$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = 0$$

Diagrama de densidad de carga en vaciamiento

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

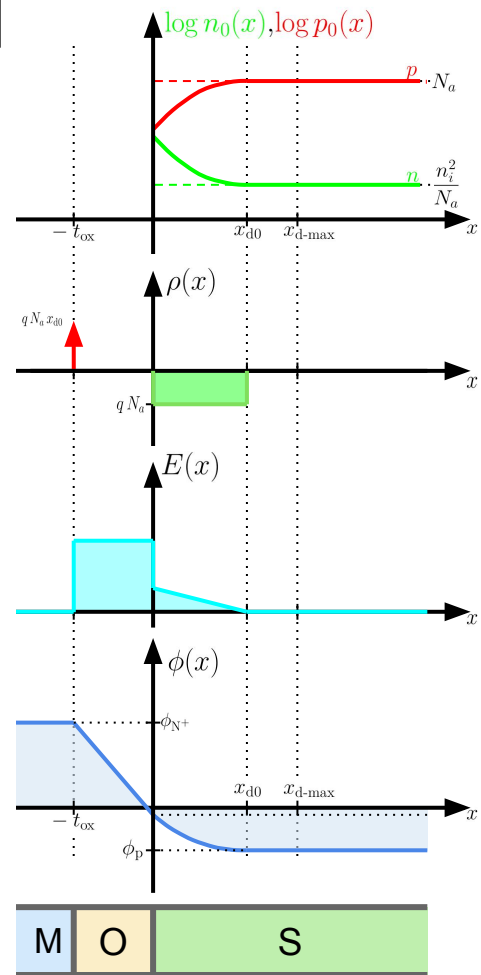
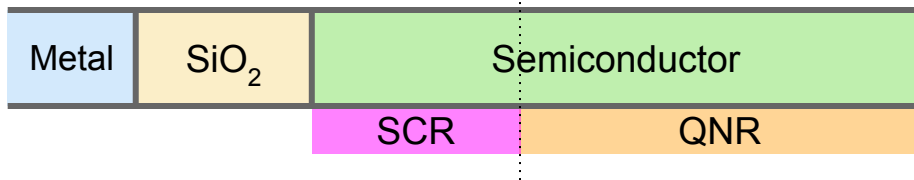
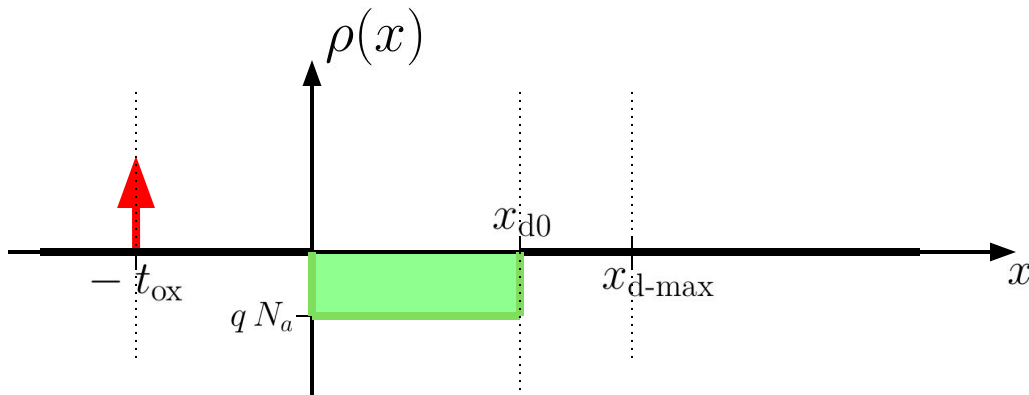
Resultados

$$V_{\text{GB}} = 0 \text{ V}$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = 0$$

Diagrama de densidad de carga en vaciamiento

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

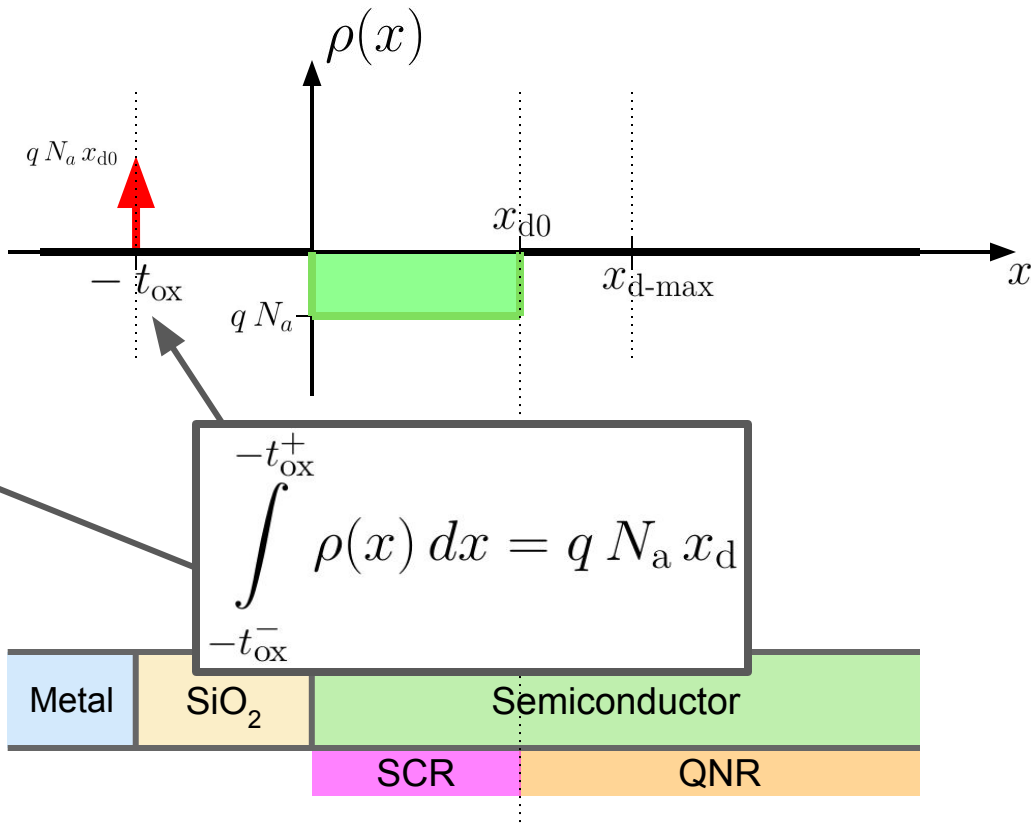
Resultados

$$V_{\text{GB}} = 0 \text{ V}$$

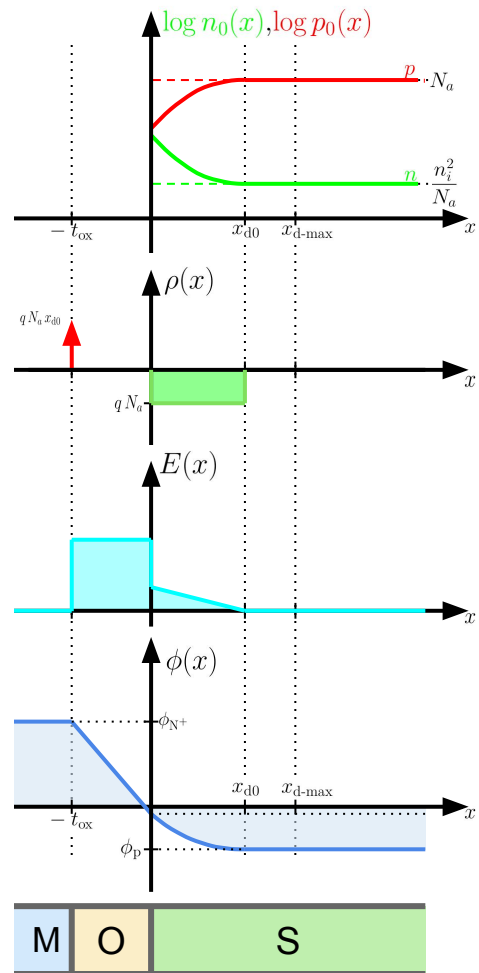
$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$\int_{-t_{\text{OX}}^-}^{-t_{\text{OX}}^+} \rho(x) dx = q N_a x_{\text{d}}$$



$$V_{GB} = 0$$

Diagrama de densidad de carga en vaciamiento

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

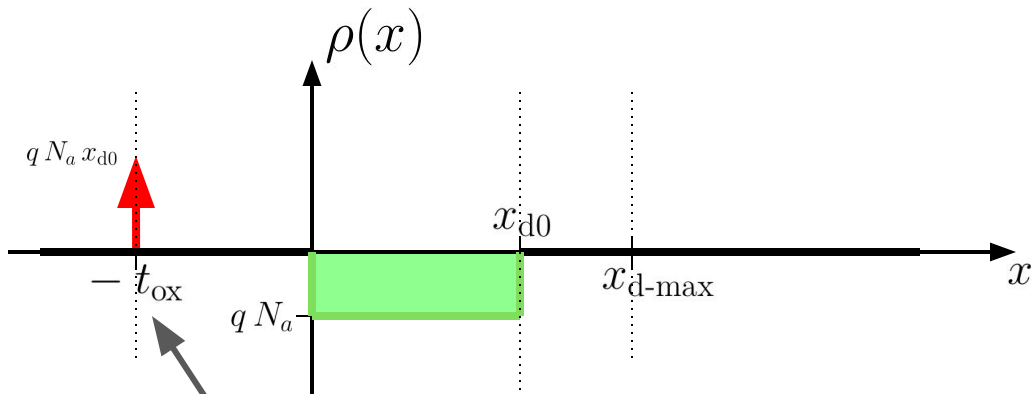
Resultados

$$V_{\text{GB}} = 0 \text{ V}$$

$$Q'_{\text{p-o}} =$$

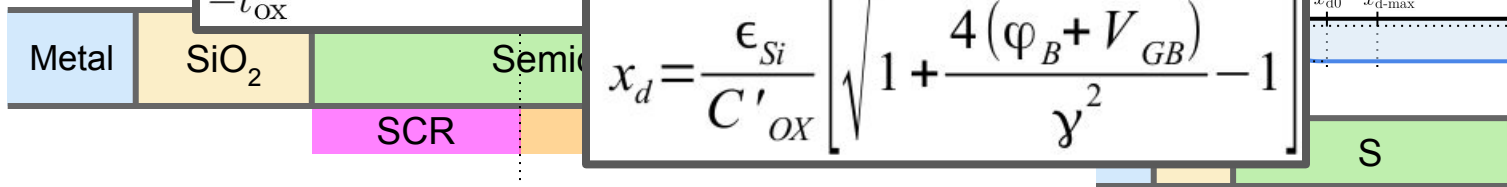
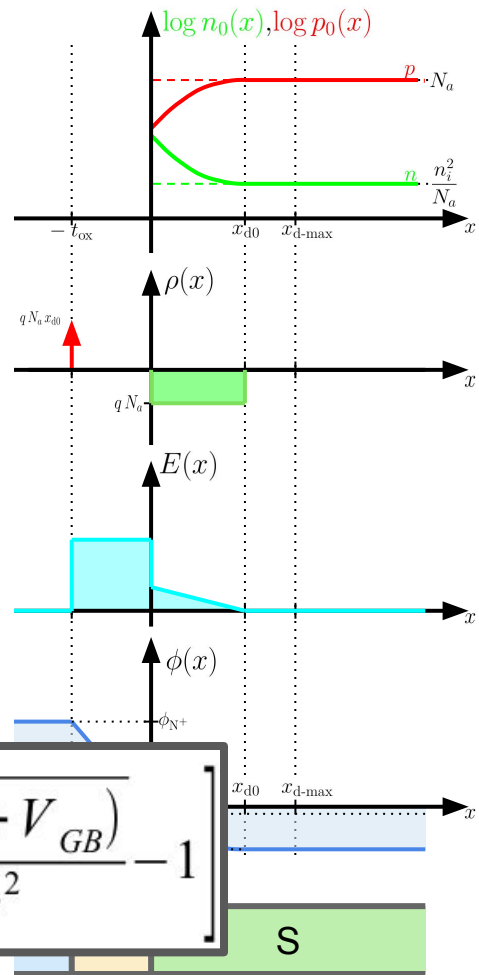
$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$\int_{-t_{\text{OX}}^-}^{-t_{\text{OX}}^+} \rho(x) dx = q N_a x_d$$

$$x_d = \frac{\epsilon_{\text{Si}}}{C'_{\text{OX}}} \left[\sqrt{1 + \frac{4(\phi_B + V_{\text{GB}})}{\gamma^2}} - 1 \right]$$



$$V_{GB} = 0$$

Diagrama de densidad de carga en vaciamiento

Datos

Poly-N y Subs. P

$$N_{Bulk} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{OX} = 246 \text{ nF/cm}^2$$

$$V_{FB} = -\phi_B = -0.97 \text{ V}$$

```

7 Na = 1e17;
6 vt = 0.547;
5 Cosp = 246e-9
4 gamma = sqrt(0.545);
3 phib = 0.97;
2 vfb = -phib;
1 vgb = 0;
17 █
1 xd = esi/Cosp*(sqrt(1+4*(phib+vgb)/gamma^2)-1)
2 xd0 = xd;
3 Q_poly_ox_p = q*Na*xd0
4
5
6
N... script.m 70% ≡ 17/24 ln : 1
"script.m" 24L, 279C written
    
```

Resultados

$$V_{GB} = 0 \text{ V}$$

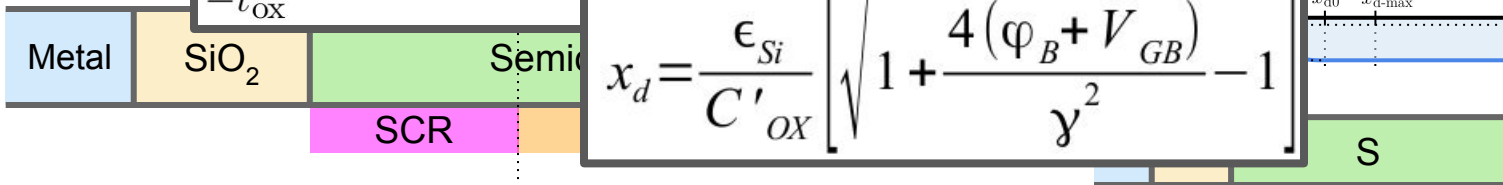
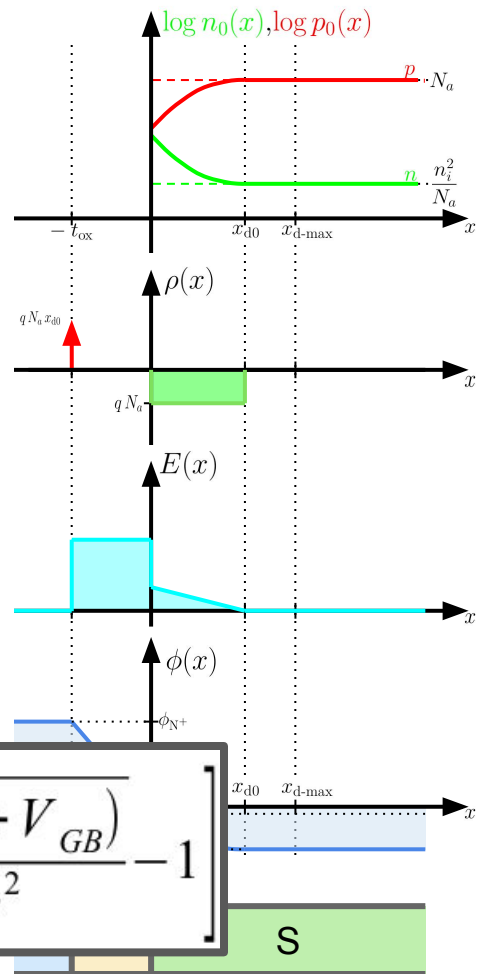
$$Q'_{p-o} =$$

$$\Delta V_{ox} =$$

$$\Delta V_{Bu} =$$

$$\int_{-t_{ox}^-}^{-t_{ox}^+} \rho(x) dx = q N_a x_d$$

$$x_d = \frac{\epsilon_{Si}}{C'_{OX}} \left[\sqrt{1 + \frac{4(\phi_B + V_{GB})}{\gamma^2}} - 1 \right]$$



$$V_{GB} = 0$$

Diagrama de densidad de carga en vaciamiento

Datos

Poly-N y Subs. P

$$N_{Bulk} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{OX} = 246 \text{ nF/cm}^2$$

$$V_{FB} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{GB} = 0 \text{ V}$$

$$Q'_{p-o} = 125 \text{ nC/cm}^2$$

$$\Delta V_{ox} =$$

$$\Delta V_{Bu} =$$

```

7 Na = 1e17;
6 vt = 0.547;
5 Coxp = 246e-9
4 gamma = sqrt(0.545);
3 phib = 0.97;
2 vfb = -phib;
1 vgb = 0;
17 █
1 xd = esi/Coxp*(sqrt(1+4*(phib+vgb)/gamma^2)-1)
2 xd0 = xd;
3 Q_poly_ox_p = q*Na*xd0
4
5
6
█ script.m 70%
"script.m" 24L, 279C written

```

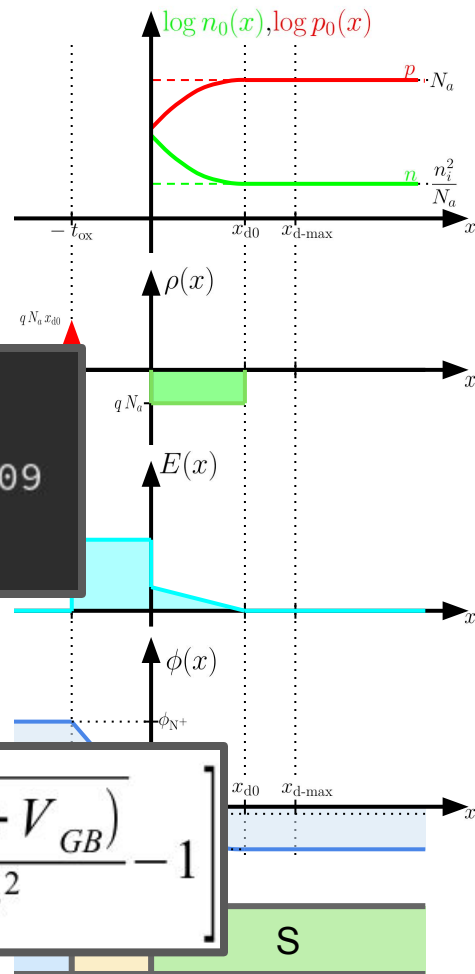
```

Coxp = 246.0000e-009
xd = 7.7845e-006
Q_poly_ox_p = 124.5525e-009
octave:21> █

```

$$\int_{-t_{ox}^-}^{-t_{ox}^+} \rho(x) dx = q N_a x_d$$

$$x_d = \frac{\epsilon_{Si}}{C'_{OX}} \left[\sqrt{1 + \frac{4(\phi_B + V_{GB})}{\gamma^2}} - 1 \right]$$



$$V_{GB} = 0$$

Diagrama de campo eléctrico en vaciamiento

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$Y^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

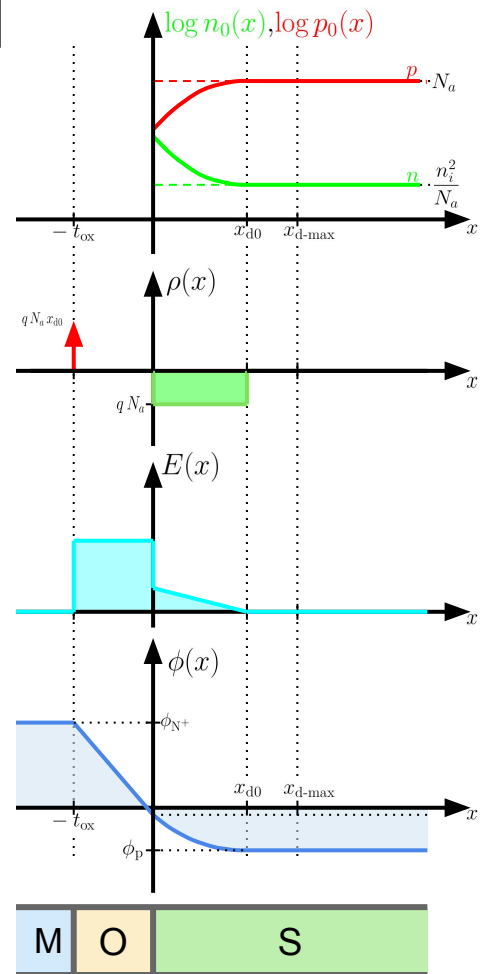
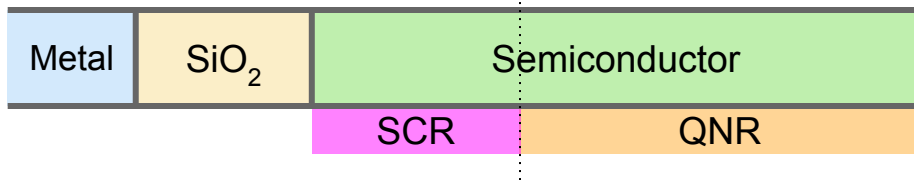
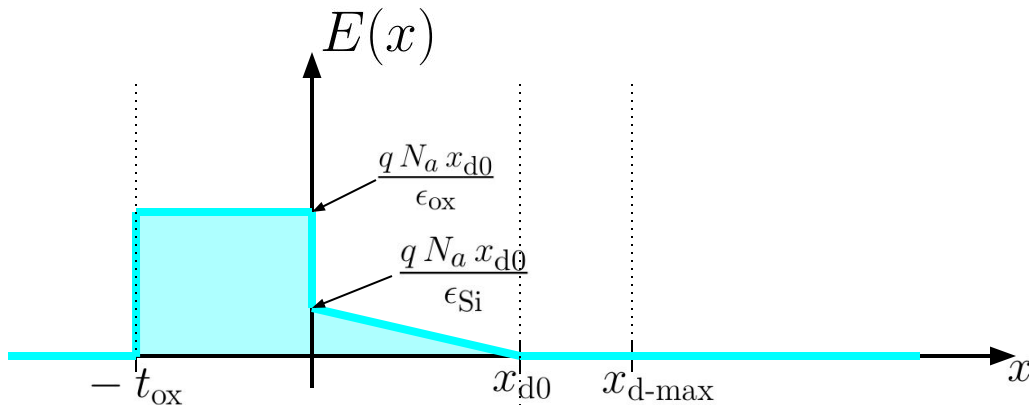
Resultados

$$V_{GB} = 0 \text{ V}$$

$$Q'_{\text{p-o}} = 125 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = 0$$

Diagrama de potencial en vaciamiento

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

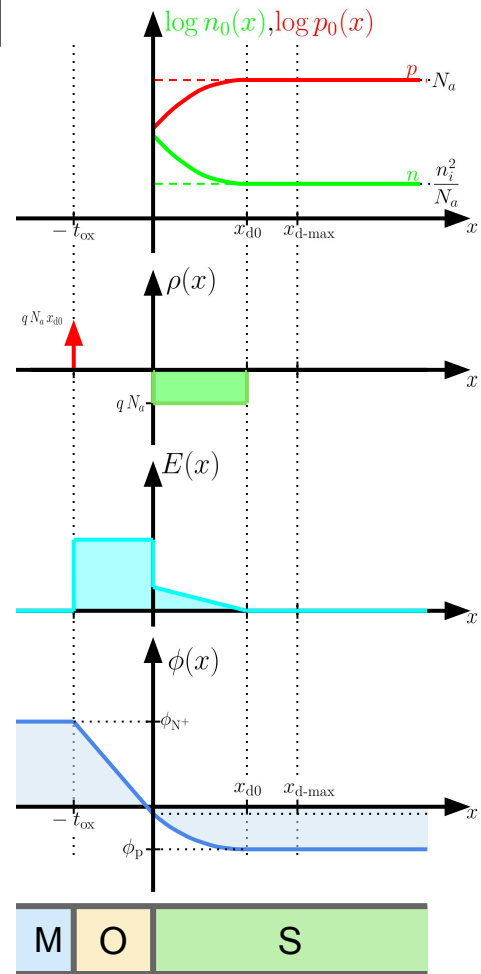
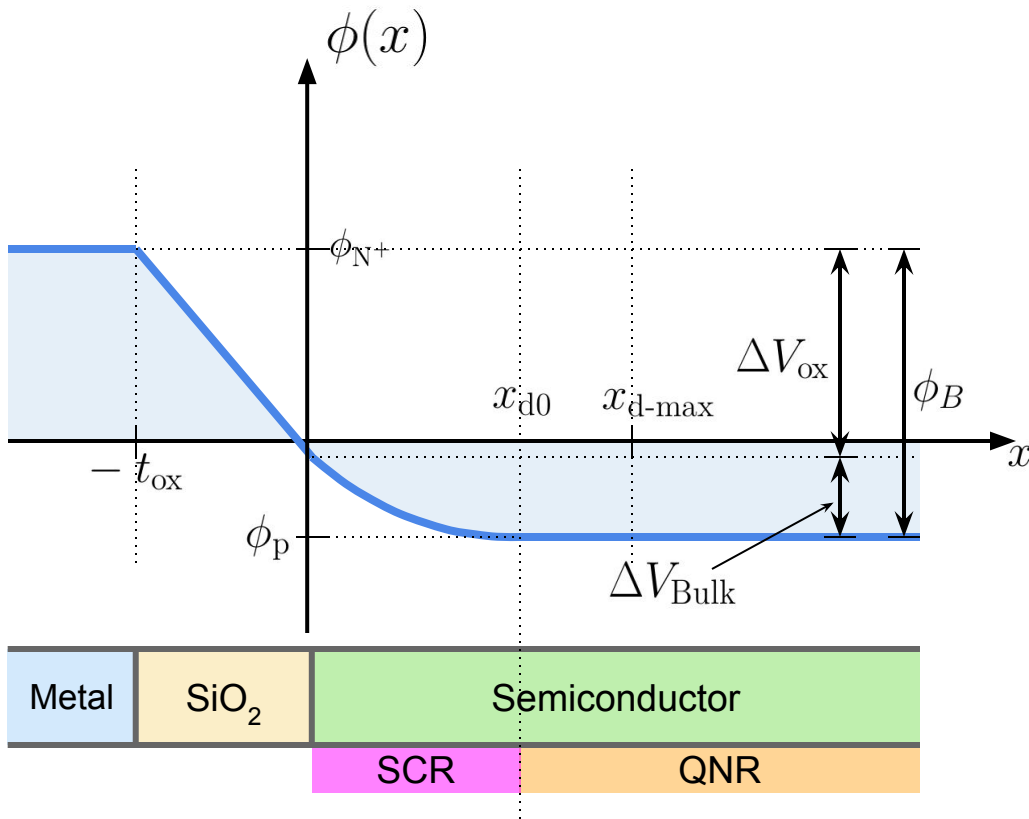
Resultados

$$V_{\text{GB}} = 0 \text{ V}$$

$$Q'_{\text{p-o}} = 125 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = 0$$

Diagrama de potencial en vaciamiento

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

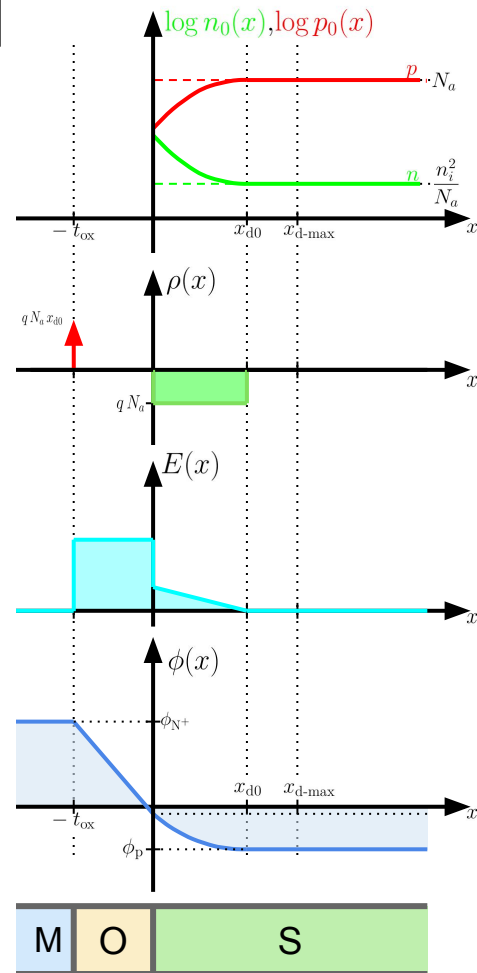
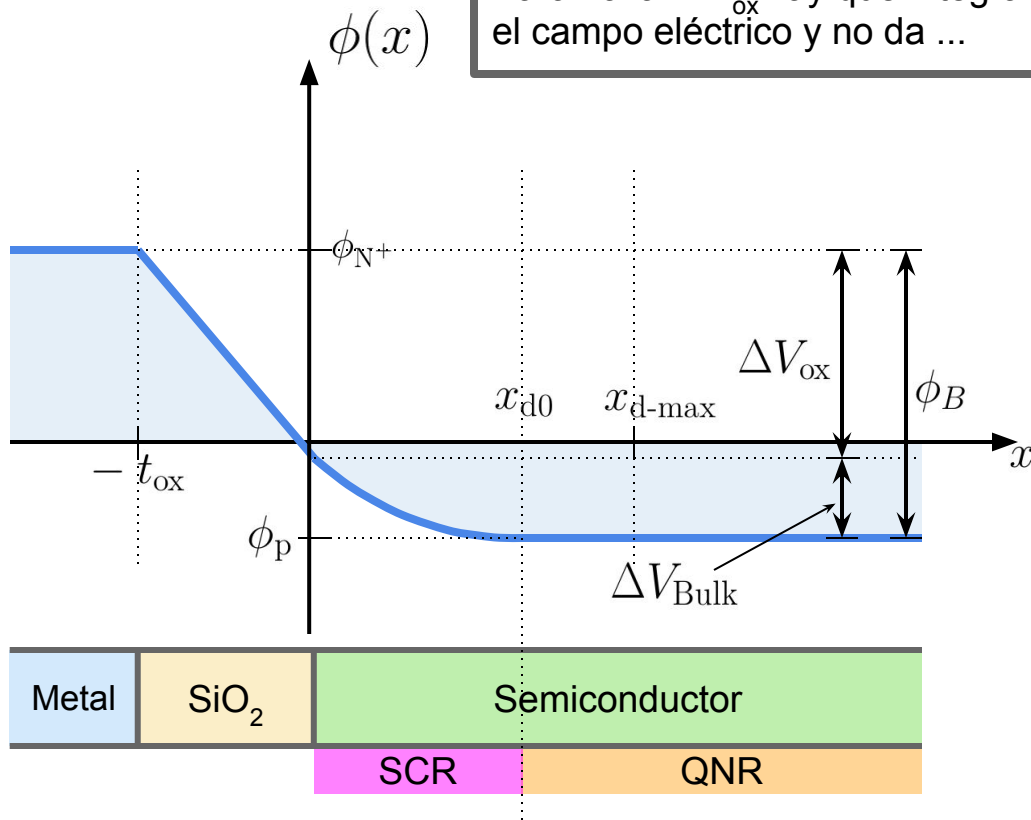
$$V_{\text{GB}} = 0 \text{ V}$$

$$Q'_{\text{p-o}} = 125 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$

Para hallar ΔV_{ox} hay que integrar el campo eléctrico y no da ...



$$V_{GB} = 0$$

Diagrama de potencial en vaciamiento

Datos

Poly-N y Subs. P

$$N_{Bulk} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$Y^2 = 0.545 \text{ V}$$

$$C'_{OX} = 246 \text{ nF/cm}^2$$

$$V_{FB} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{GB} = 0 \text{ V}$$

$$Q'_{p-o} = 125 \text{ nC/cm}^2$$

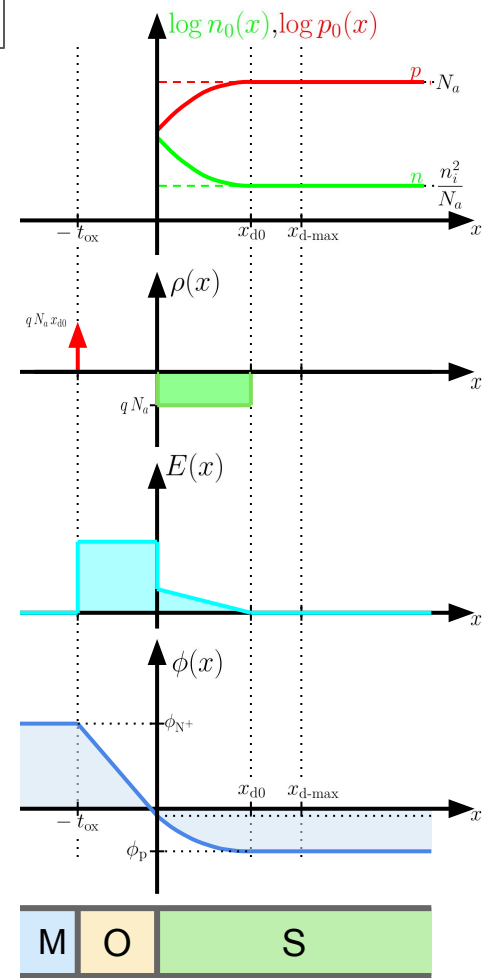
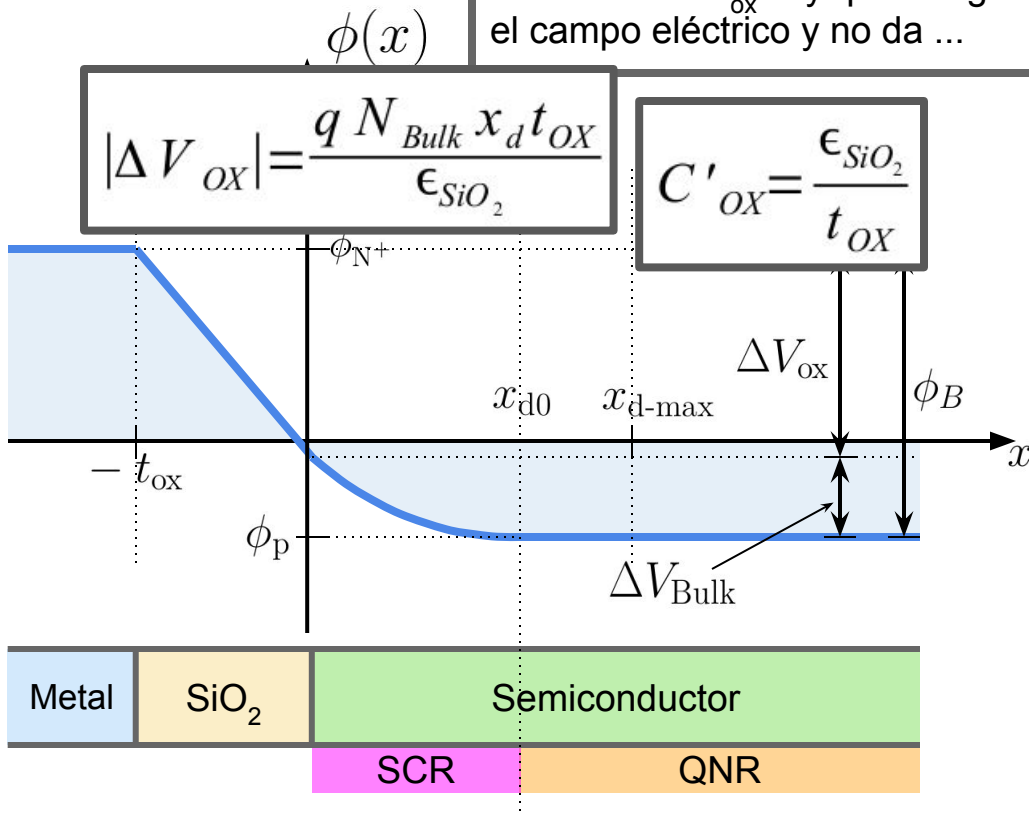
$$\Delta V_{ox} =$$

$$\Delta V_{Bu} =$$

Para hallar ΔV_{ox} hay que integrar el campo eléctrico y no da ...

$$|\Delta V_{ox}| = \frac{q N_{Bulk} x_d t_{OX}}{\epsilon_{SiO_2}}$$

$$C'_{OX} = \frac{\epsilon_{SiO_2}}{t_{OX}}$$



$$V_{GB} = 0$$

Diagrama de potencial en vaciamiento

Datos

Poly-N y Subs. P

$$N_{Bulk} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{OX} = 246 \text{ nF/cm}^2$$

$$V_{FB} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{GB} = 0 \text{ V}$$

$$Q'_{p-0} = 125 \text{ nC/cm}^2$$

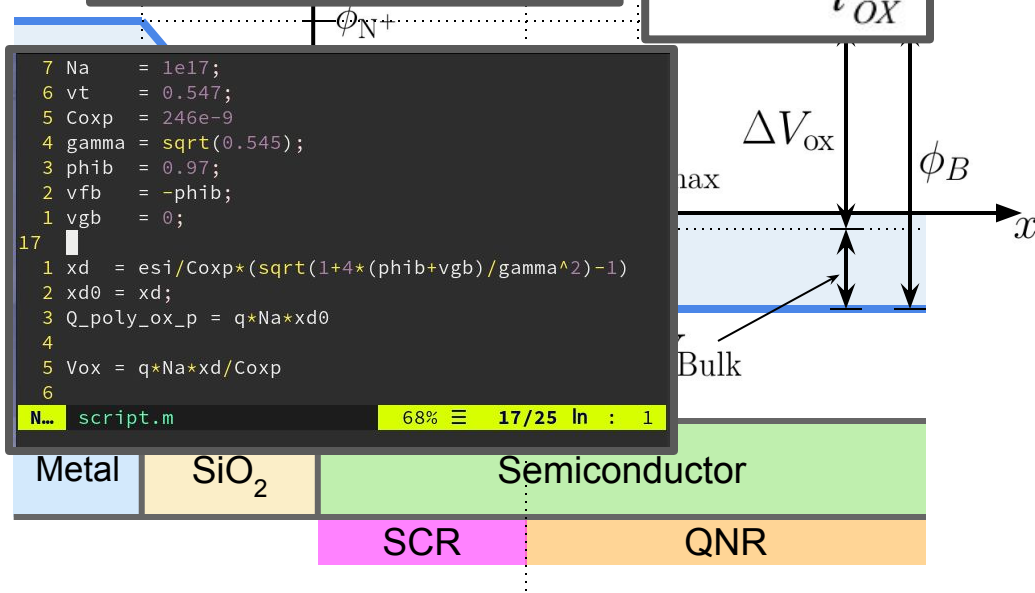
$$\Delta V_{ox} =$$

$$\Delta V_{Bu} =$$

Para hallar ΔV_{ox} hay que integrar el campo eléctrico y no da ...

$$|\Delta V_{ox}| = \frac{q N_{Bulk} x_d t_{OX}}{\epsilon_{SiO_2}}$$

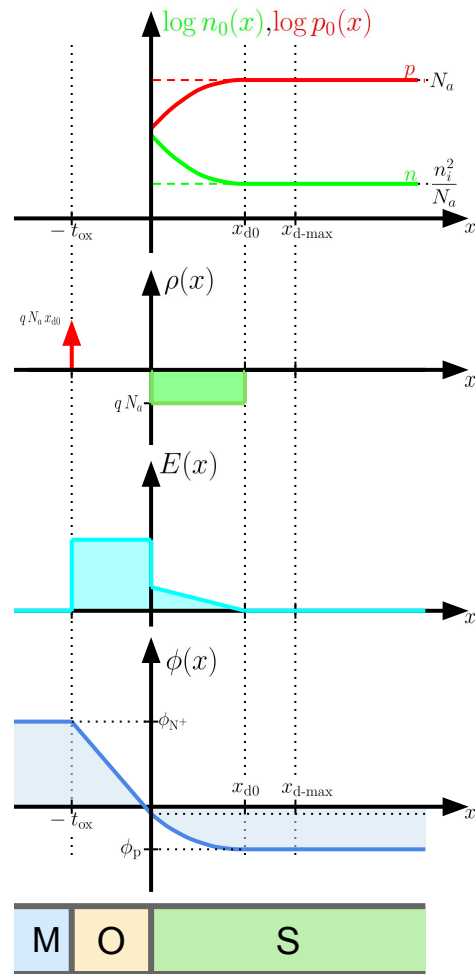
$$C'_{OX} = \frac{\epsilon_{SiO_2}}{t_{OX}}$$



```

7 Na = 1e17;
6 vt = 0.547;
5 Cexp = 246e-9;
4 gamma = sqrt(0.545);
3 phib = 0.97;
2 vfb = -phib;
1 vgb = 0;
17
1 xd = esi/Cexp*(sqrt(1+4*(phib+vgb)/gamma^2)-1)
2 xd0 = xd;
3 Q_poly_ox_p = q*Na*xd0
4
5 Vox = q*Na*xd/Cexp
6
N... script.m 68% 17/25 ln : 1

```



$$V_{GB} = 0$$

Diagrama de potencial en vaciamiento

Datos

Poly-N y Subs. P

$$N_{Bulk} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{OX} = 246 \text{ nF/cm}^2$$

$$V_{FB} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{GB} = 0 \text{ V}$$

$$Q'_{p-o} = 125 \text{ nC/cm}^2$$

$$\Delta V_{ox} = 505 \text{ mV}$$

$$\Delta V_{Bu} =$$

Para hallar ΔV_{ox} hay que integrar el campo eléctrico y no da ...

$$|\Delta V_{ox}| = \frac{q N_{Bulk} x_d t_{OX}}{\epsilon_{SiO_2}}$$

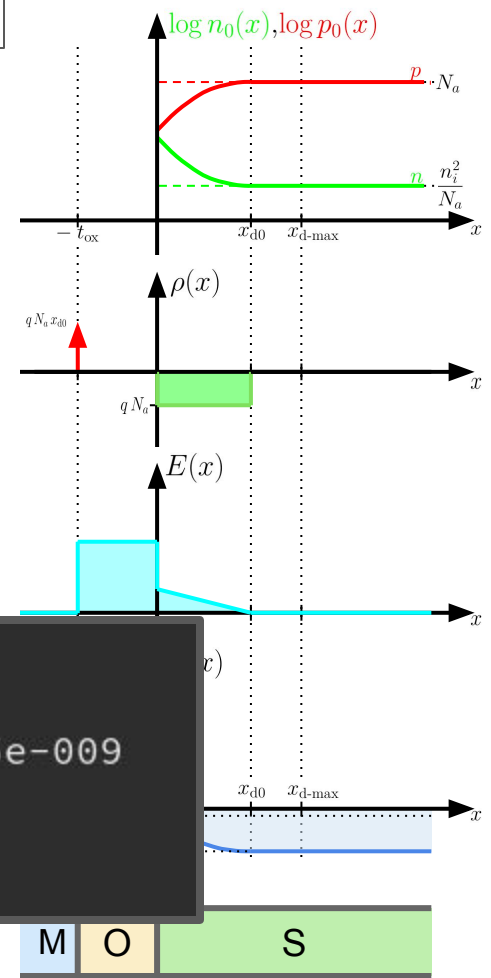
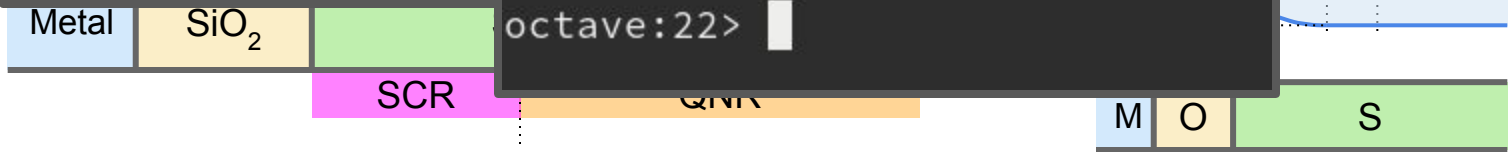
$$C'_{OX} = \frac{\epsilon_{SiO_2}}{t_{OX}}$$

```

7 Na = 1e17;
6 vt = 0.547;
5 Cosp = 246e-9
4 gamma = sqrt(0.545);
3 phib = 0.97;
2 vfb = -phib;
1 vgb = 0;
17
1 xd = esi/Cosp*(sqrt(1+4*(phib+vgb)/...
2 xd0 = xd;
3 Q_poly_ox_p = q*Na*xd0
4
5 Vox = q*Na*xd/Cosp
6
N... script.m 68%
  
```

```

Cosp = 246.0000e-009
xd = 7.7845e-006
Q_poly_ox_p = 124.5525e-009
Vox = 506.3111e-003
octave:22>
  
```



$$V_{GB} = 0$$

Diagrama de potencial en vaciamiento

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

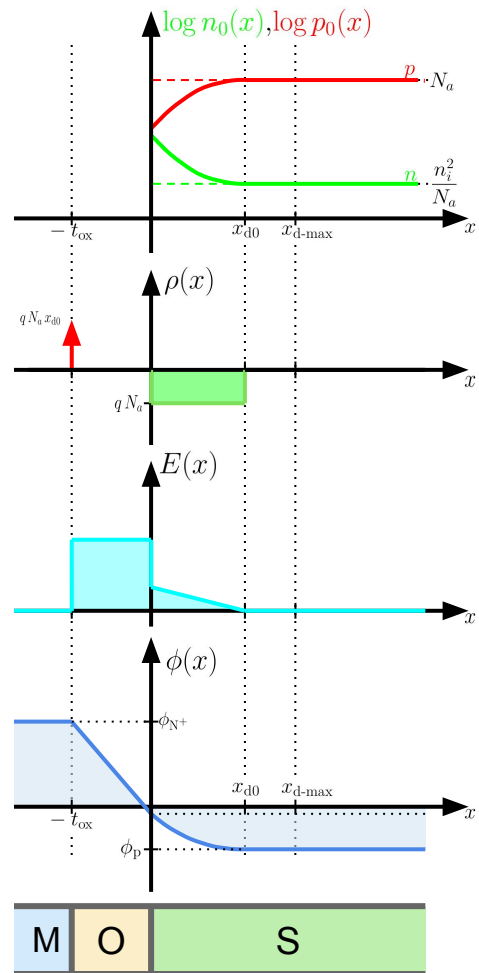
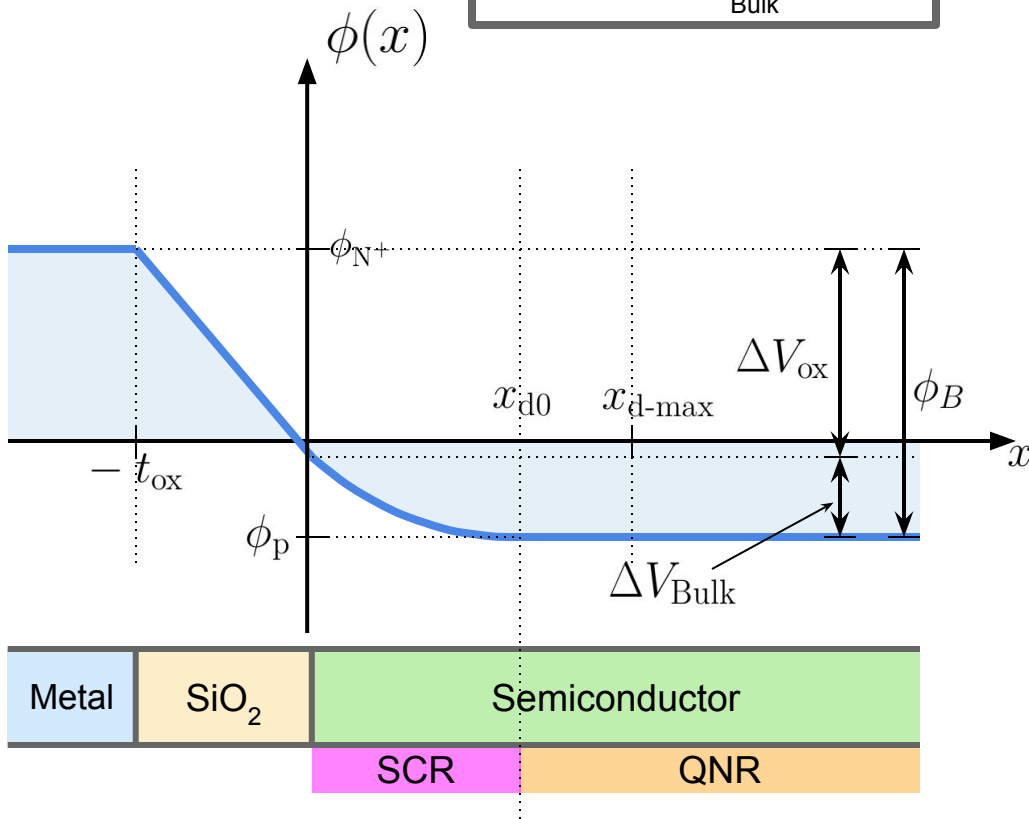
$$V_{\text{GB}} = 0 \text{ V}$$

$$Q'_{\text{p-o}} = 125 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} = 505 \text{ mV}$$

$$\Delta V_{\text{Bu}} =$$

Para hallar ΔV_{Bulk} ...



$$V_{GB} = 0$$

Diagrama de potencial en vaciamiento

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{\text{GB}} = 0 \text{ V}$$

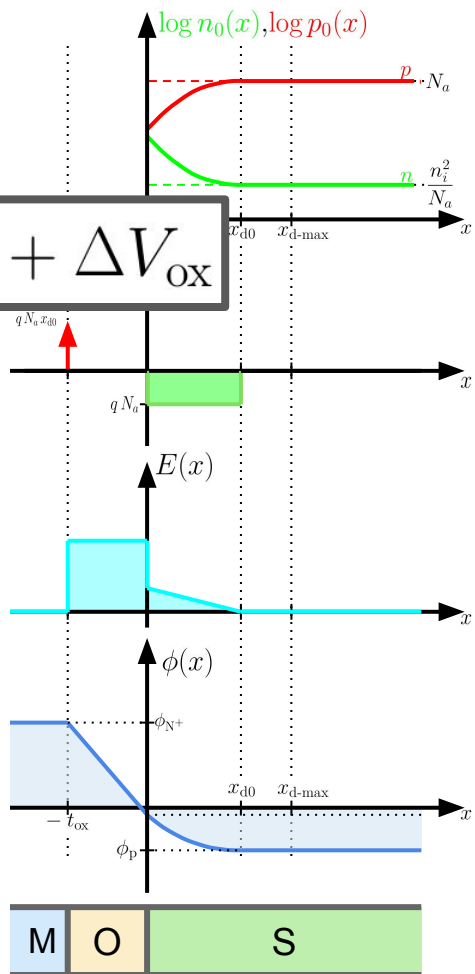
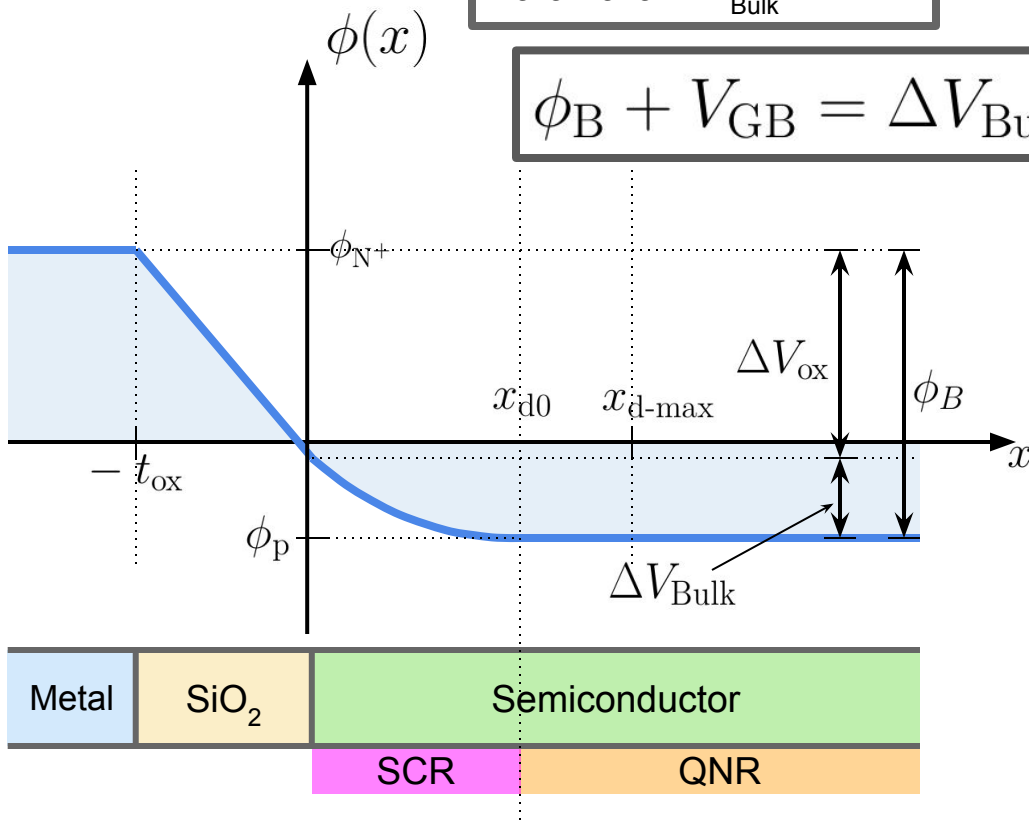
$$Q'_{\text{p-o}} = 125 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} = 505 \text{ mV}$$

$$\Delta V_{\text{Bu}} =$$

Para hallar ΔV_{Bulk} ...

$$\phi_B + V_{\text{GB}} = \Delta V_{\text{Bulk}} + \Delta V_{\text{OX}}$$



$$V_{GB} = 0$$

Diagrama de potencial en vaciamiento

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{\text{GB}} = 0 \text{ V}$$

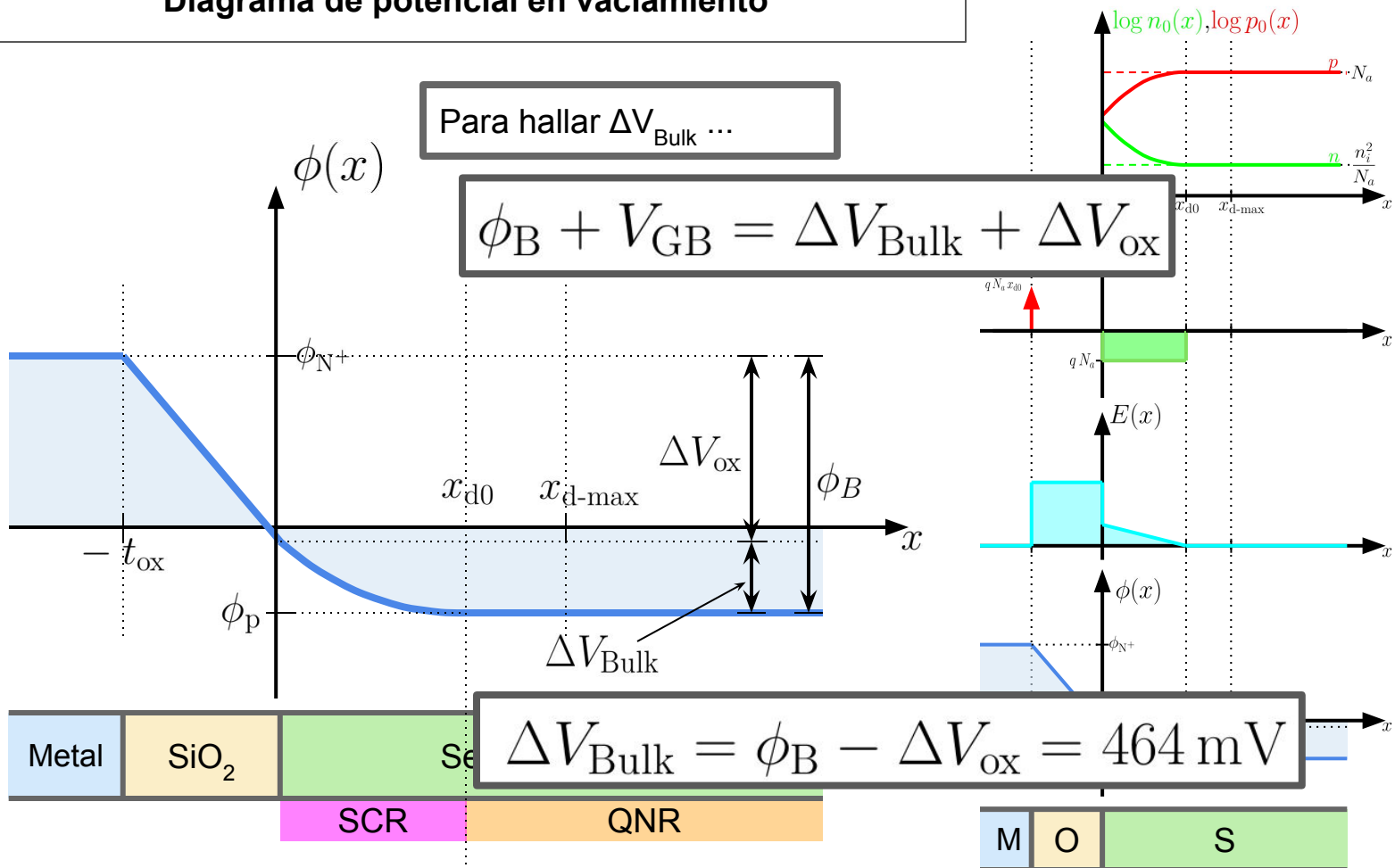
$$Q'_{\text{p-o}} = 125 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} = 506 \text{ mV}$$

$$\Delta V_{\text{Bu}} = 464 \text{ mV}$$

Para hallar ΔV_{Bulk} ...

$$\phi_B + V_{\text{GB}} = \Delta V_{\text{Bulk}} + \Delta V_{\text{OX}}$$



$$\Delta V_{\text{Bulk}} = \phi_B - \Delta V_{\text{ox}} = 464 \text{ mV}$$

Vaciamiento (en este caso Eq. Térmico)

<u>Resultados</u>					
V_{GB}	-2	V_{FB}	0	V_T	2
Q'_{o-s}			125 nC/cm ²		
ΔV_{ox}			506 mV		
ΔV_{Bu}			464 mV		

Banda Plana

<u>Resultados</u>					
V_{GB}	-2	V_{FB}	0	V_T	2
Q'_{o-s}			125 nC/cm ²		
ΔV_{ox}			506 mV		
ΔV_{Bu}			464 mV		

2

$$V_{GB} = V_{FB}$$

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

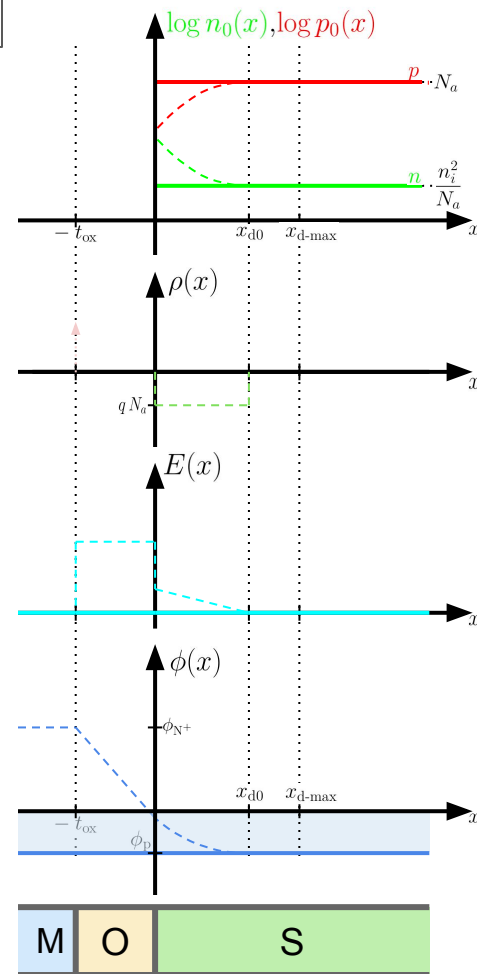
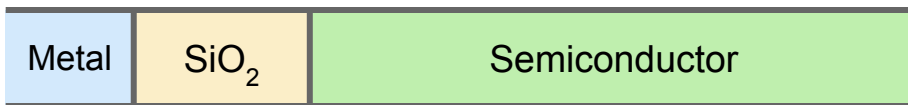
Resultados

$$V_{\text{GB}} = -0.97 \text{ V}$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = V_{FB}$$

Diagrama de portadores en banda plana

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

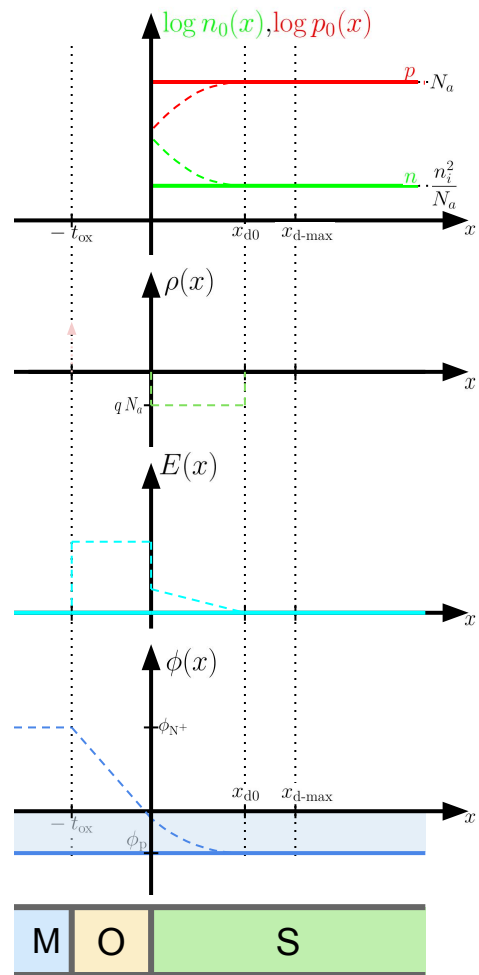
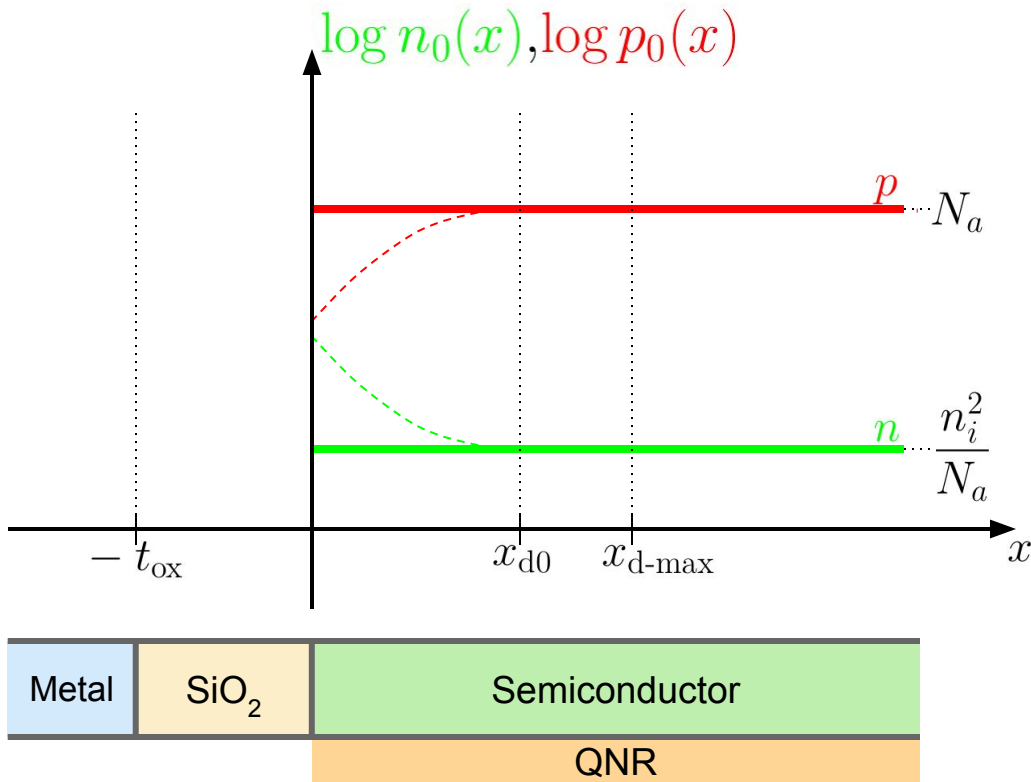
Resultados

$$V_{\text{GB}} = -0.97 \text{ V}$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = V_{FB}$$

Diagrama de densidad de carga en banda plana

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

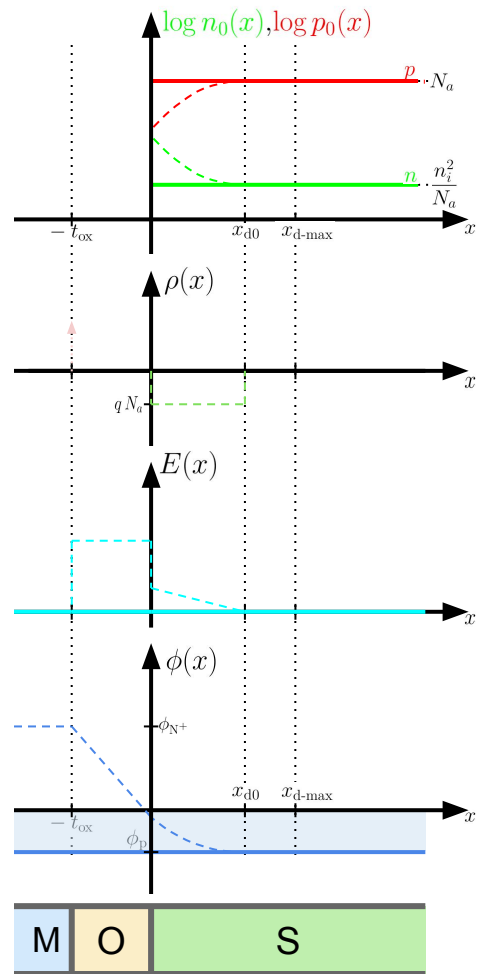
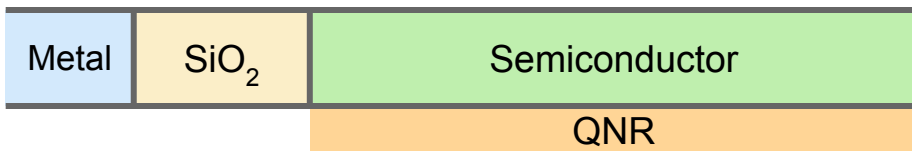
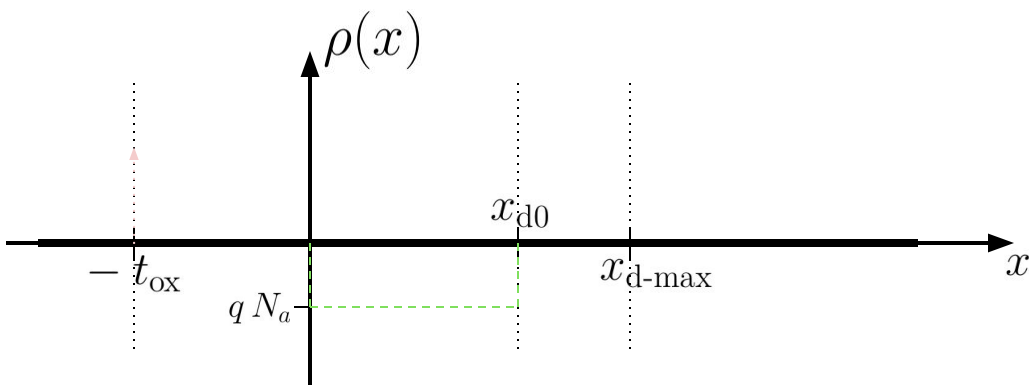
Resultados

$$V_{\text{GB}} = -0.97 \text{ V}$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = V_{FB}$$

Diagrama de campo eléctrico en banda plana

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{FB} = -\phi_B = -0.97 \text{ V}$$

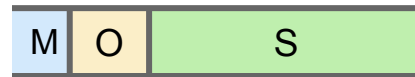
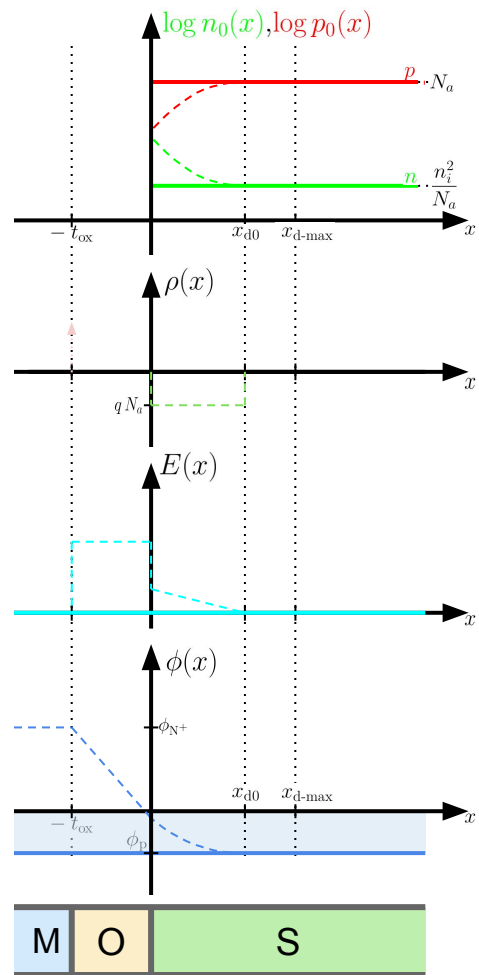
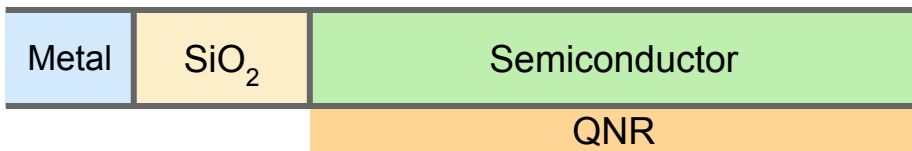
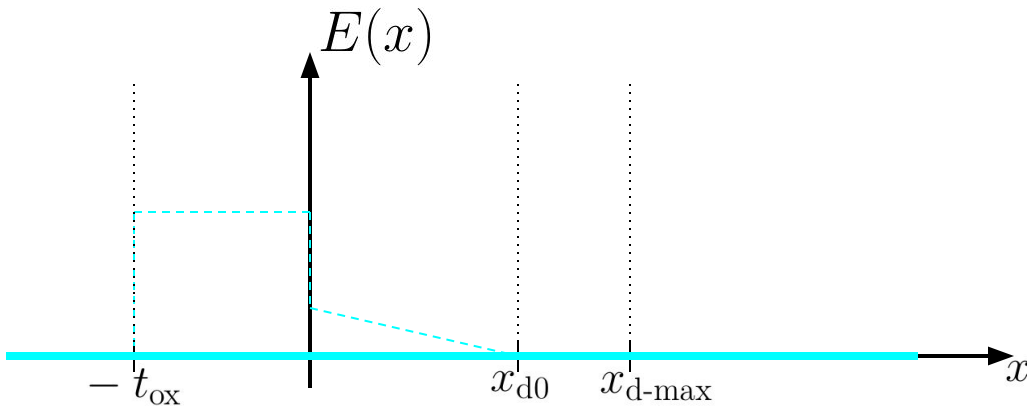
Resultados

$$V_{GB} = -0.97 \text{ V}$$

$$Q'_{p-o} = 0$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = V_{FB}$$

Diagrama de potencial en banda plana

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

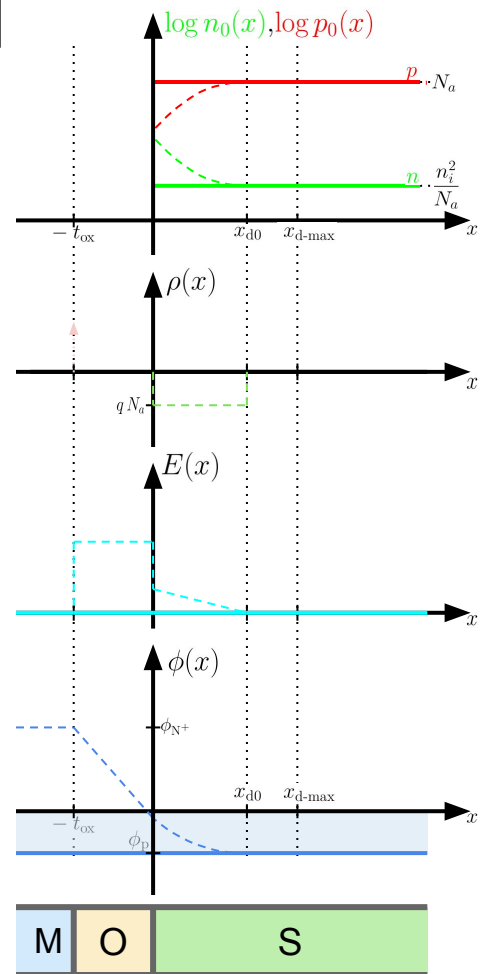
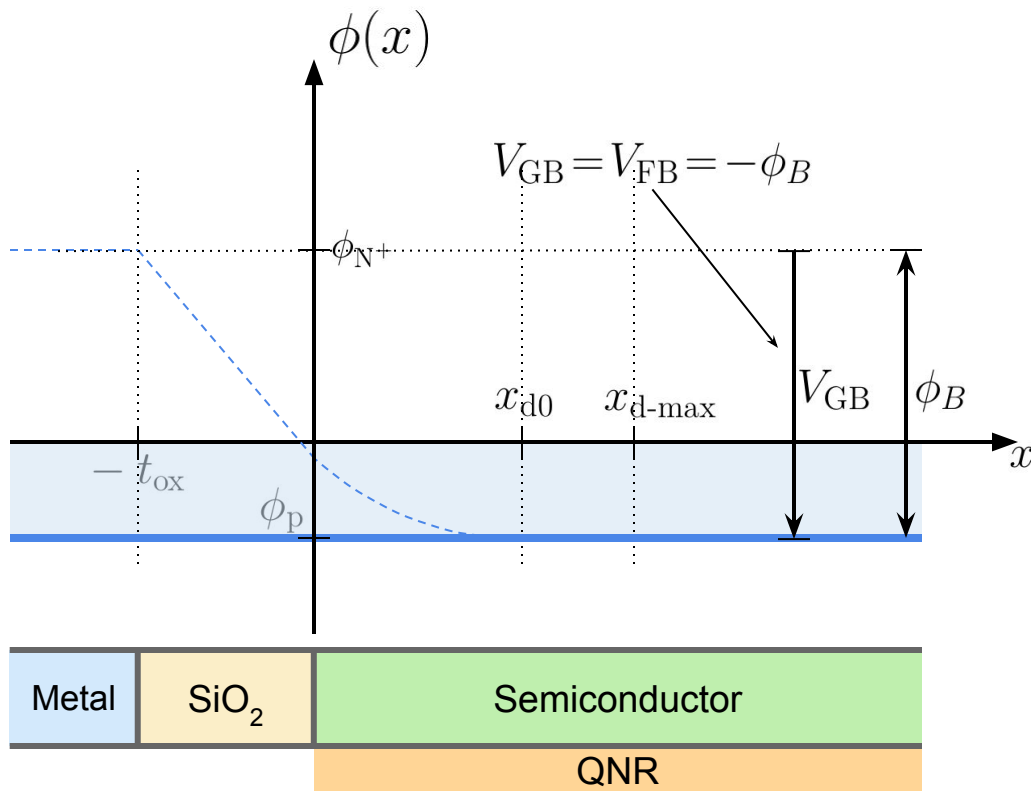
Resultados

$$V_{\text{GB}} = -0.97 \text{ V}$$

$$Q'_{\text{p-o}} = 0$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = V_{FB}$$

Diagrama de potencial en banda plana

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

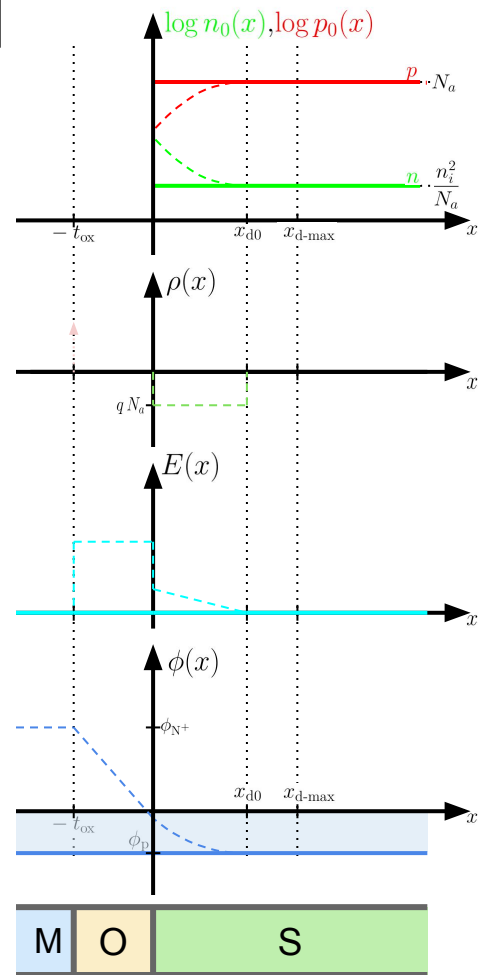
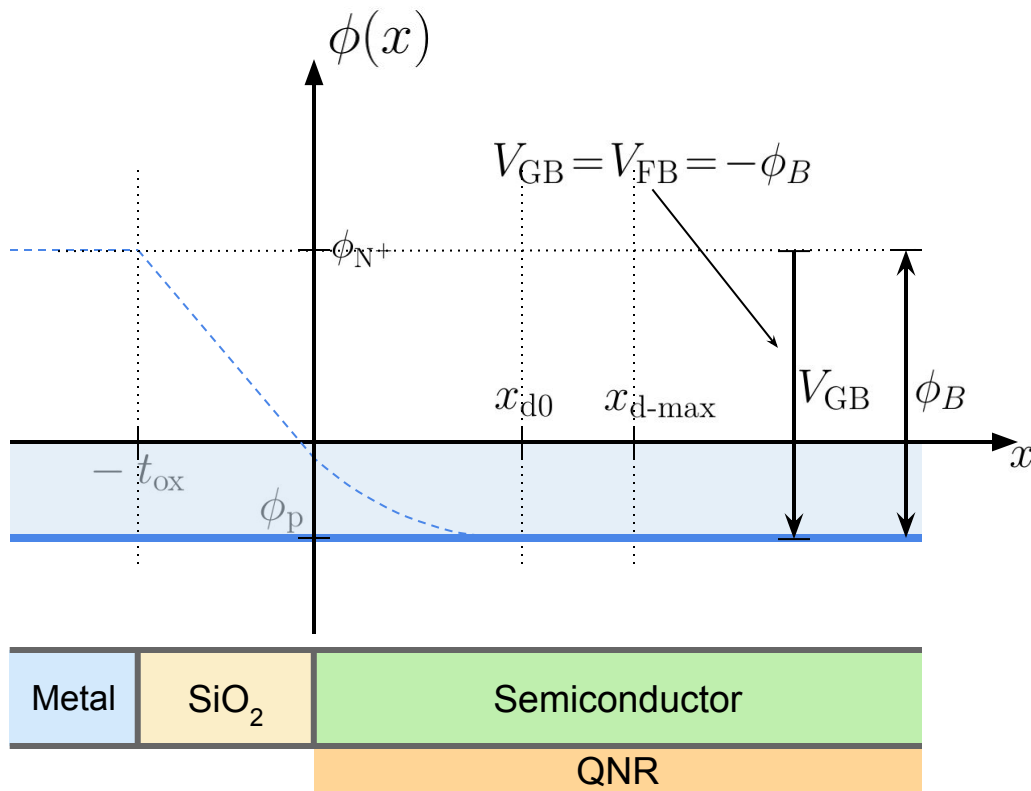
Resultados

$$V_{\text{GB}} = -0.97 \text{ V}$$

$$Q'_{\text{p-o}} = 0$$

$$\Delta V_{\text{ox}} = 0$$

$$\Delta V_{\text{Bu}} = 0$$



Banda Plana

<u>Resultados</u>					
V_{GB}	-2	V_{FB}	0	V_T	2
Q'_{p-o}		0	125 nC/cm ²		
ΔV_{ox}		0	506 mV		
ΔV_{Bu}		0	464 mV		

Acumulación

<u>Resultados</u>					
V_{GB}	-2	V_{FB}	0	V_T	2
Q'_{p-o}		0	125 nC/cm ²		
ΔV_{ox}		0	506 mV		
ΔV_{Bu}		0	464 mV		

3

$$V_{GB} = -2$$

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

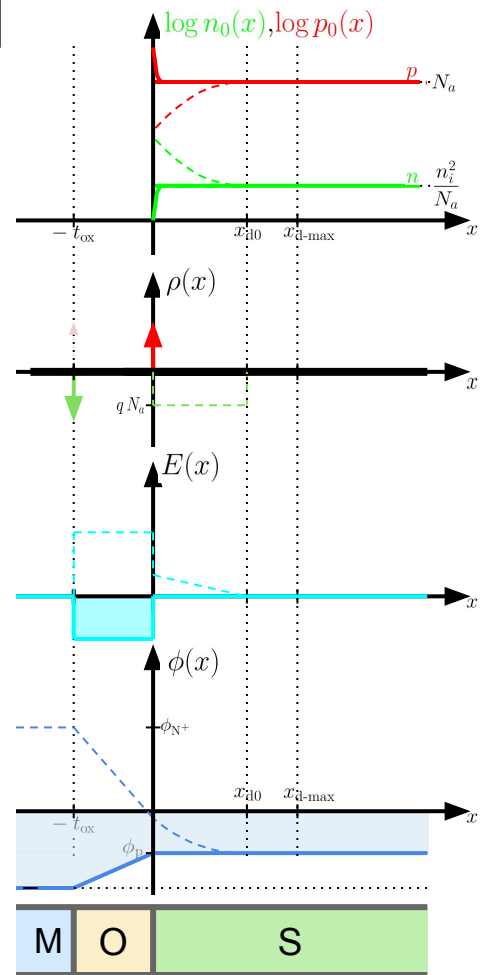
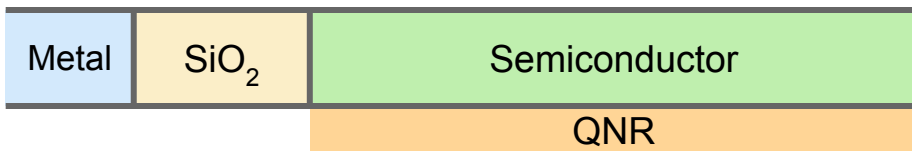
Resultados

$$V_{GB} = -2$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = -2$$

Diagrama de portadores en acumulación

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

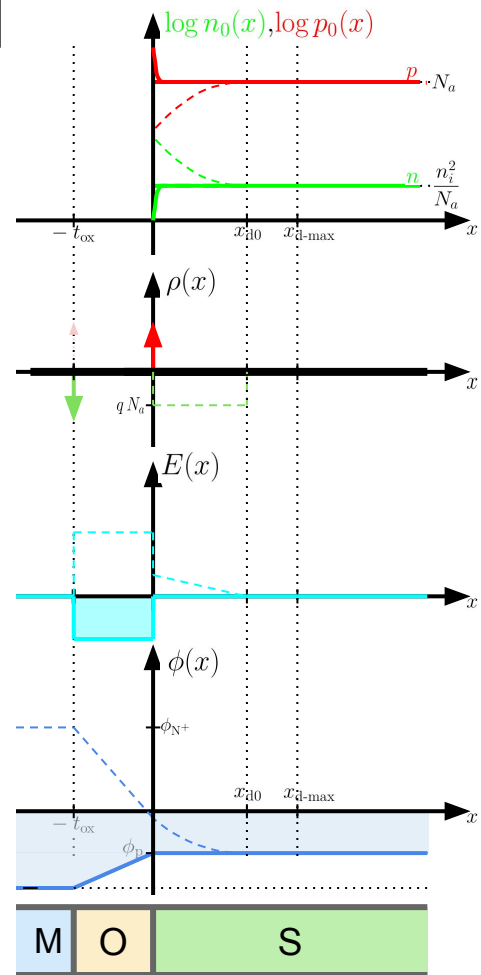
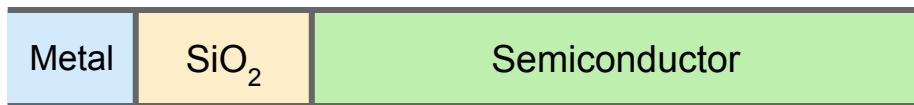
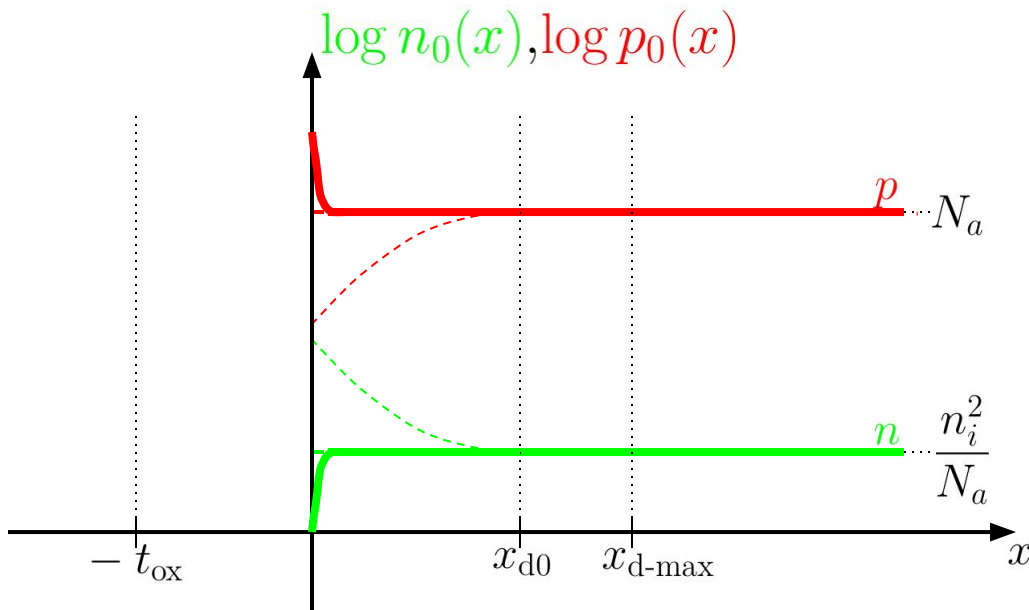
Resultados

$$V_{GB} = -2$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = -2$$

Diagrama de portadores en acumulación

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

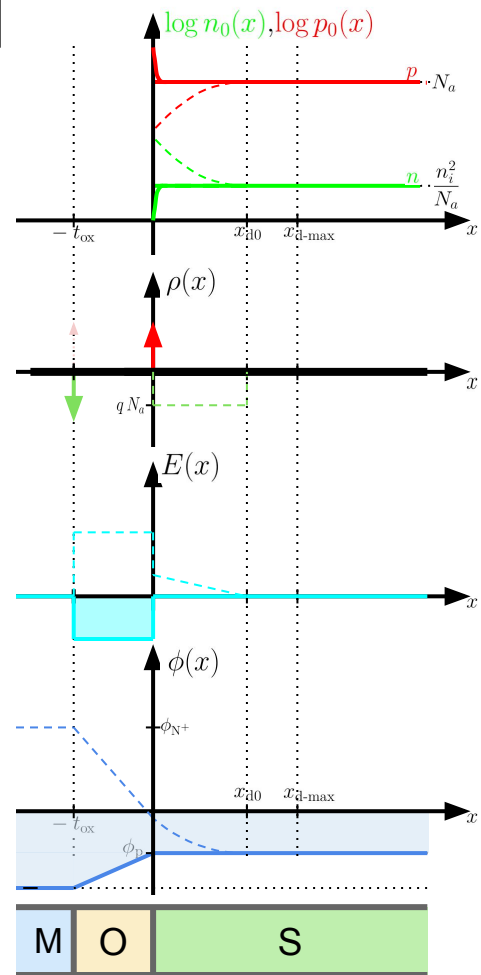
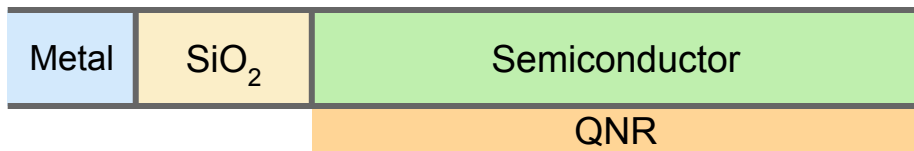
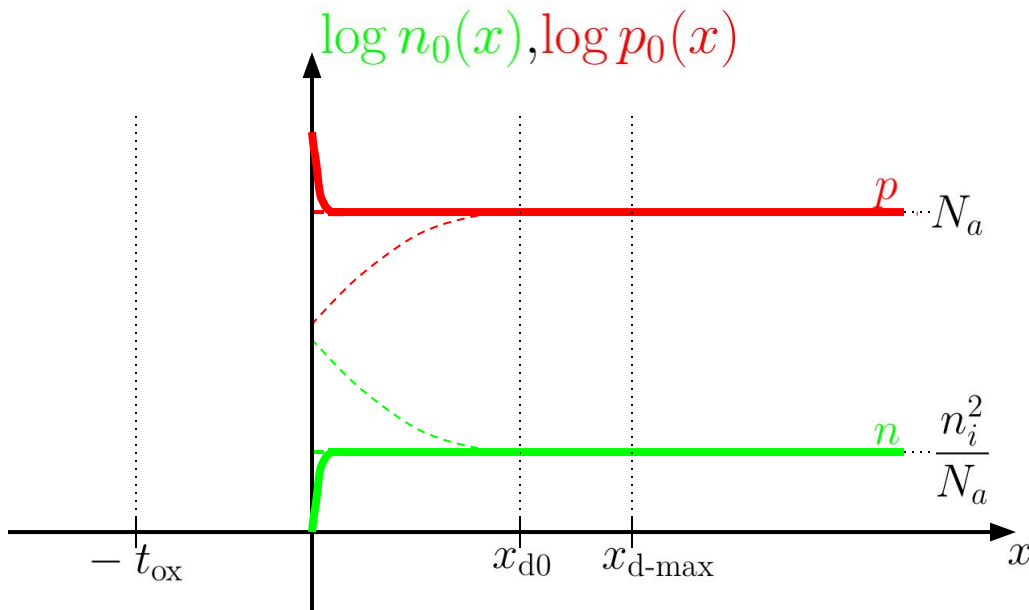
Resultados

$$V_{GB} = -2$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = -2$$

Diagrama de densidad de carga en acumulación

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

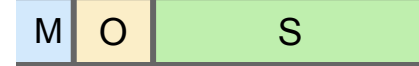
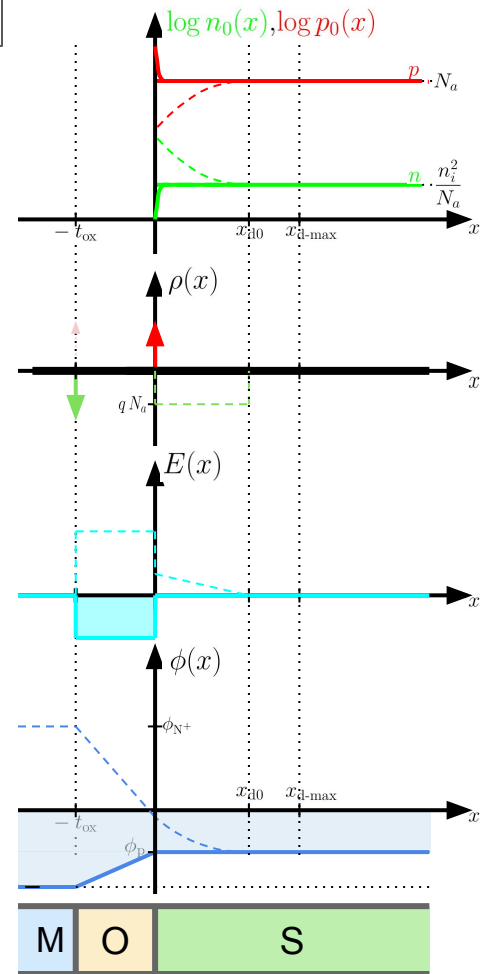
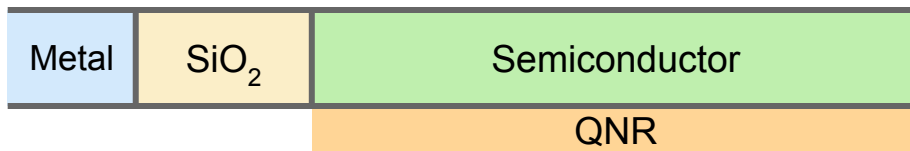
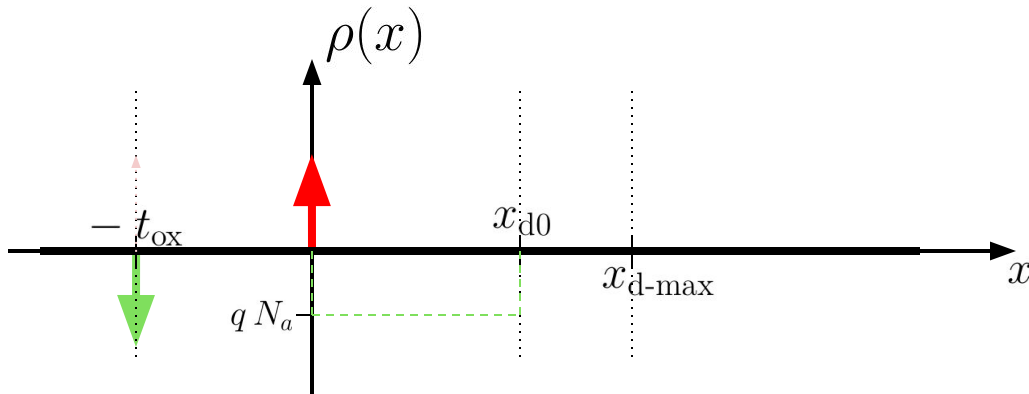
Resultados

$$V_{\text{GB}} = -2$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = -2$$

Diagrama de densidad de carga en acumulación

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{\text{GB}} = -2$$

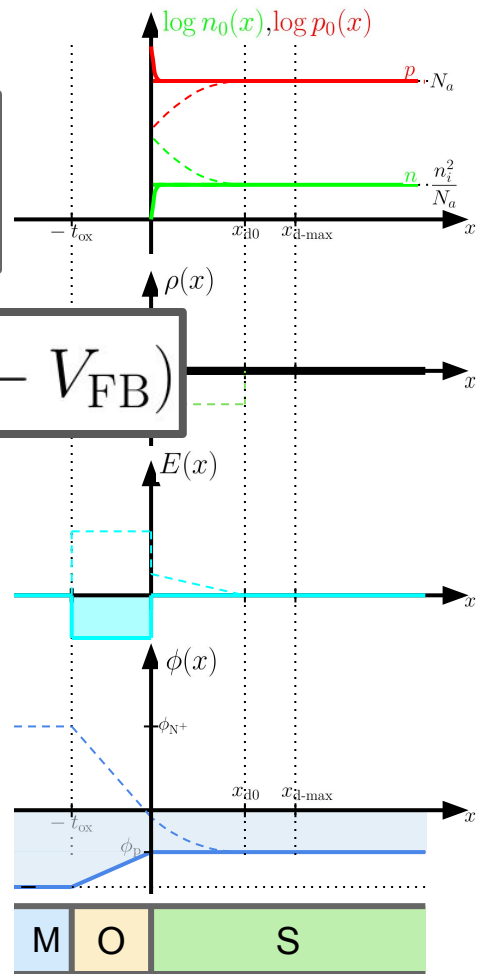
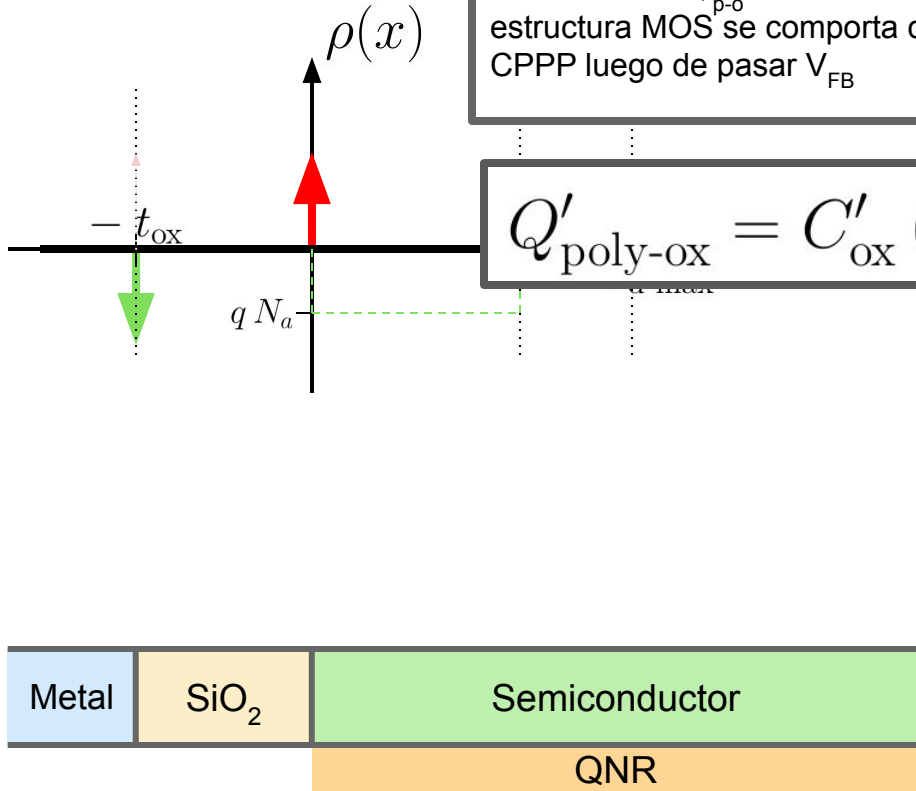
$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$

Para hallar $Q'_{\text{p-o}}$ consideramos que la estructura MOS se comporta como un CPPP luego de pasar V_{FB}

$$Q'_{\text{poly-ox}} = C'_{\text{OX}} (V_{\text{GB}} - V_{\text{FB}})$$



$$V_{GB} = -2$$

Diagrama de densidad de carga en acumulación

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{GB} = -2$$

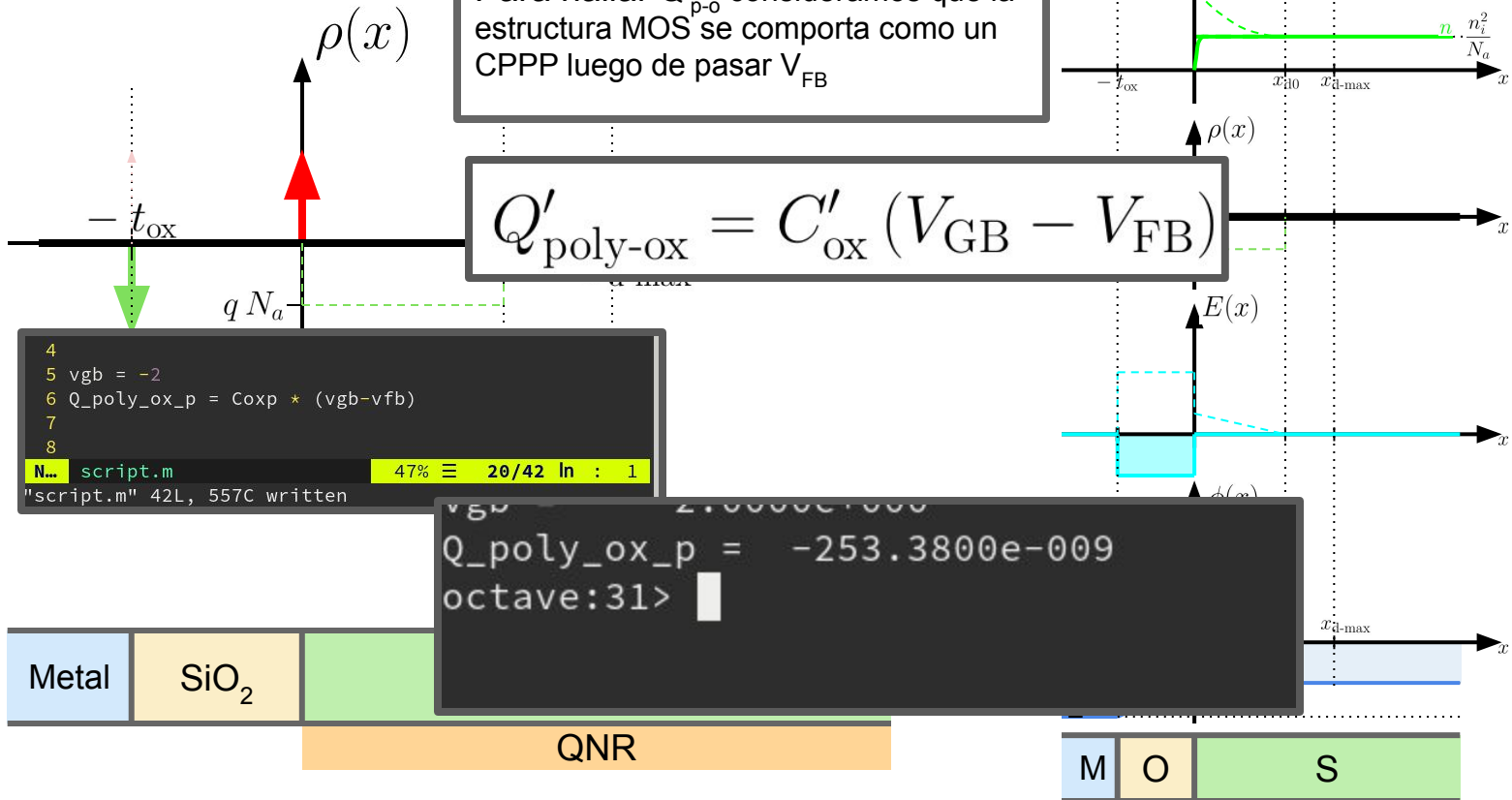
$$Q'_{\text{p-o}} = -253 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$

Para hallar $Q'_{\text{p-o}}$ consideramos que la estructura MOS se comporta como un CPPP luego de pasar V_{FB}

$$Q'_{\text{poly-ox}} = C'_{\text{OX}} (V_{\text{GB}} - V_{\text{FB}})$$



```

4
5 vgb = -2
6 Q_poly_ox_p = C_ox * (vgb-vfb)
7
8
N... script.m 47% 20/42 ln : 1
"script.m" 42L, 557C written

```

```

vgb = -2.000000000
Q_poly_ox_p = -253.3800e-009
octave:31>

```

$$V_{GB} = -2$$

Diagrama de campo eléctrico en acumulación

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

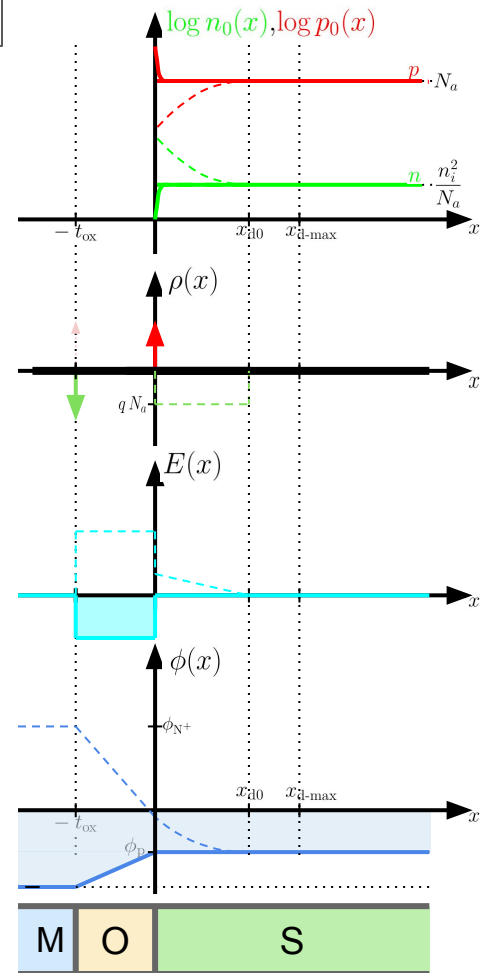
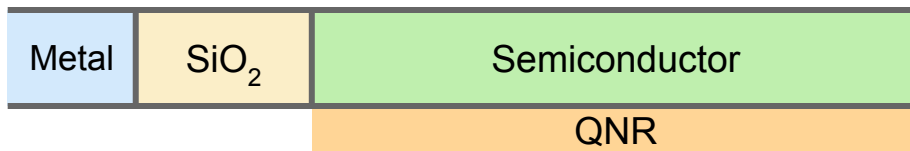
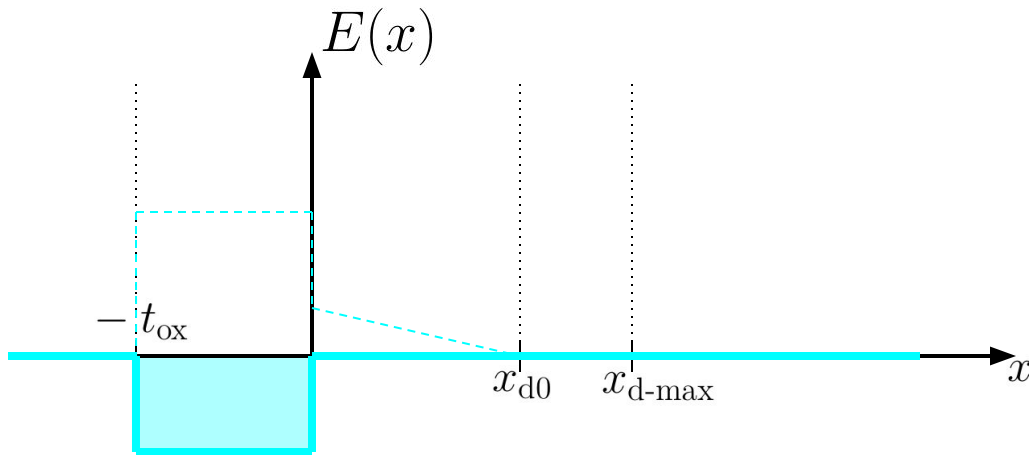
Resultados

$$V_{GB} = -2$$

$$Q'_{p-o} = -253 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = -2$$

Diagrama de potencial en acumulación

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

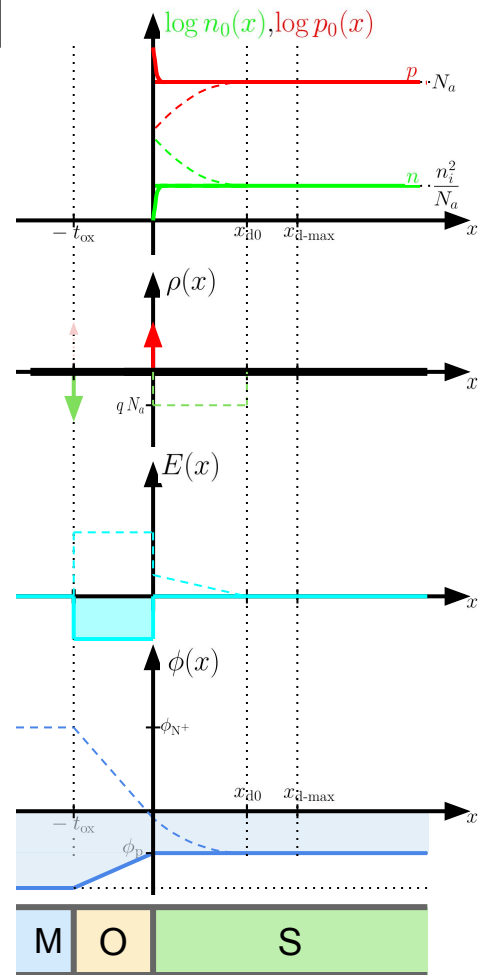
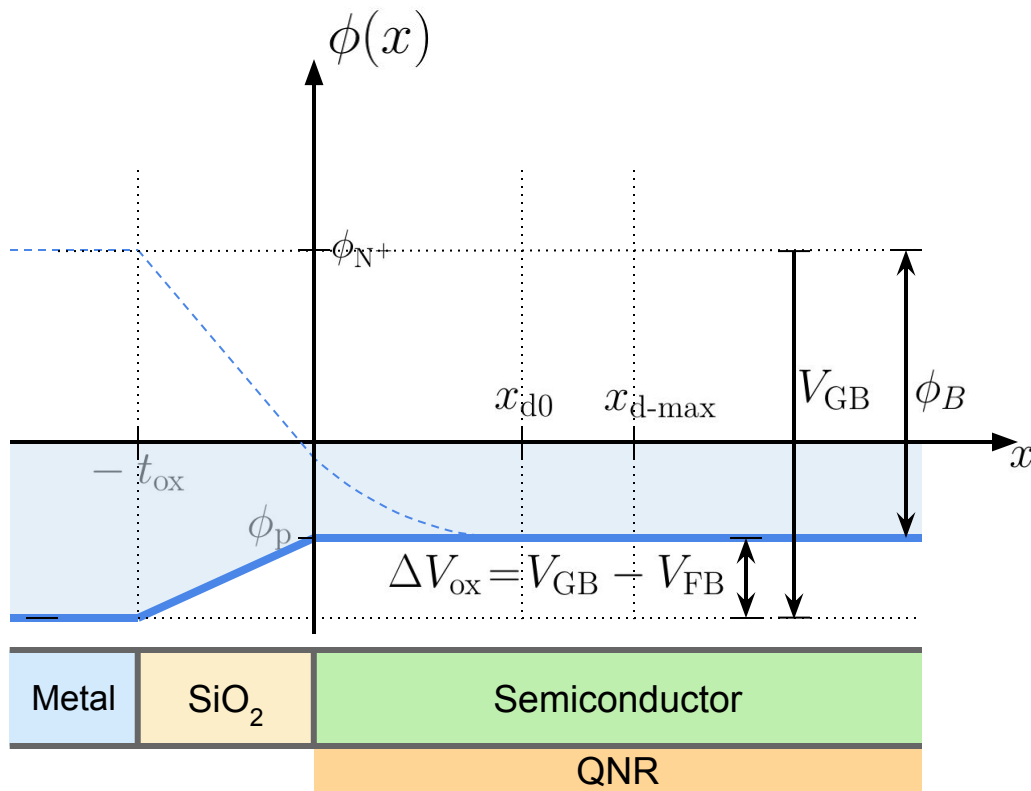
Resultados

$$V_{GB} = -2$$

$$Q'_{p-o} = -253 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = -2$$

Diagrama de potencial en acumulación

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

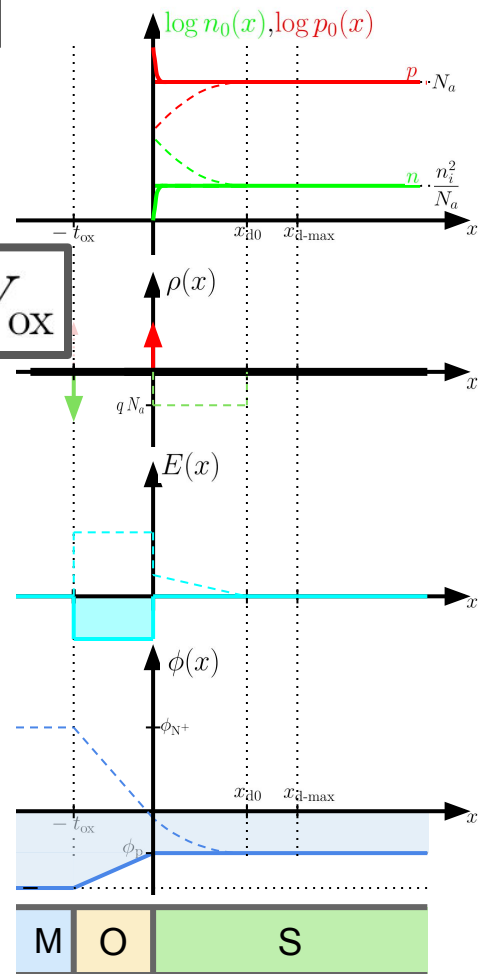
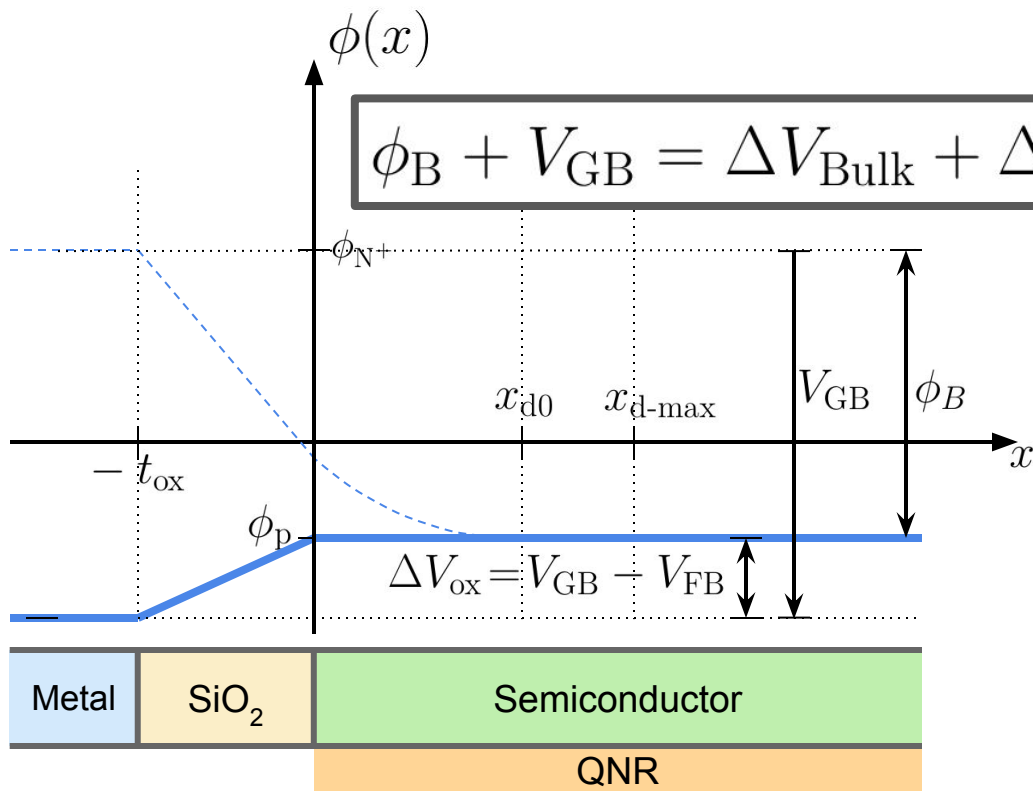
Resultados

$$V_{GB} = -2$$

$$Q'_{p-o} = -253 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = -2$$

Diagrama de potencial en acumulación

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

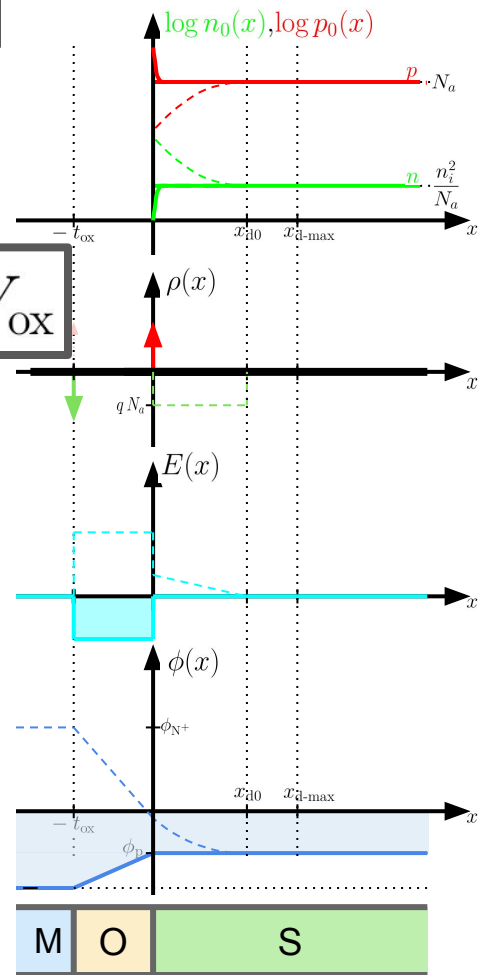
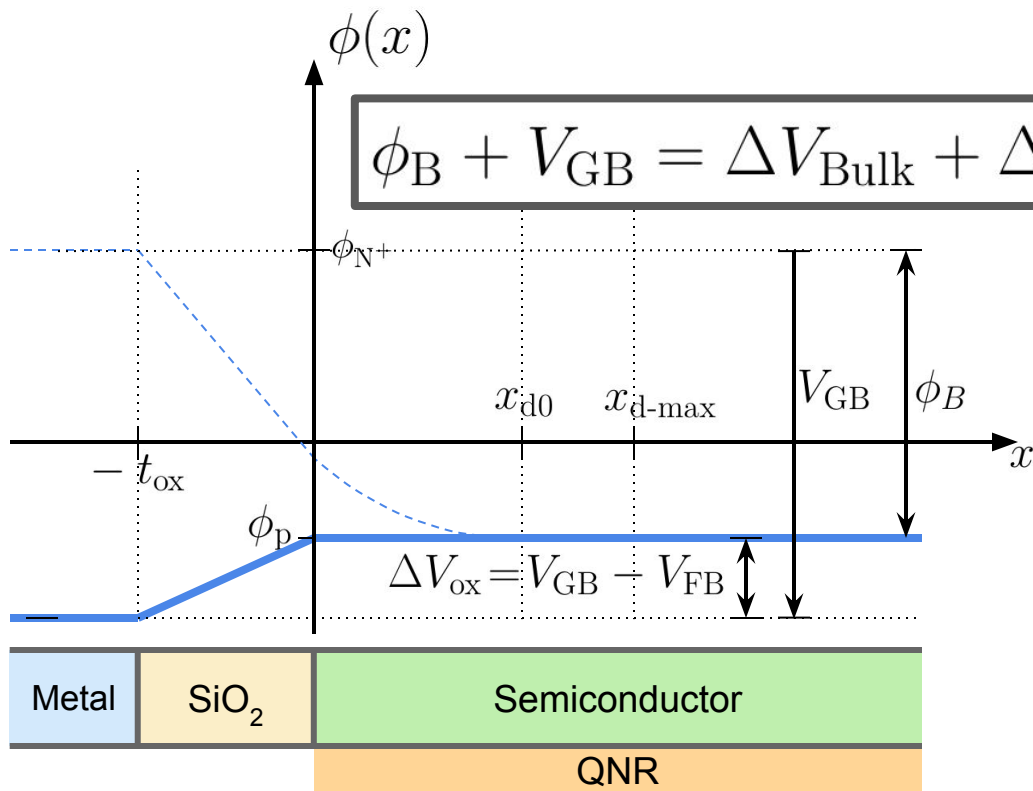
Resultados

$$V_{GB} = -2$$

$$Q'_{p-o} = -253 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} = 1.03 \text{ V}$$

$$\Delta V_{\text{Bu}} = 0$$



Acumulación

<u>Resultados</u>					
V_{GB}	-2	V_{FB}	0	V_T	2
Q'_{o-s}	-253 nC/cm ²	0	125 nC/cm ²		
ΔV_{ox}	1.03 V	0	506 mV		
ΔV_{Bu}	0	0	464 mV		

Umbral

Resultados					
V_{GB}	-2	V_{FB}	0	V_T	2
Q'_{o-s}	-253 nC/cm ²	0	125 nC/cm ²		
ΔV_{ox}	1.03 V	0	506 mV		
ΔV_{Bu}	0	0	464 mV		

4

$$V_{GB} = V_T$$

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

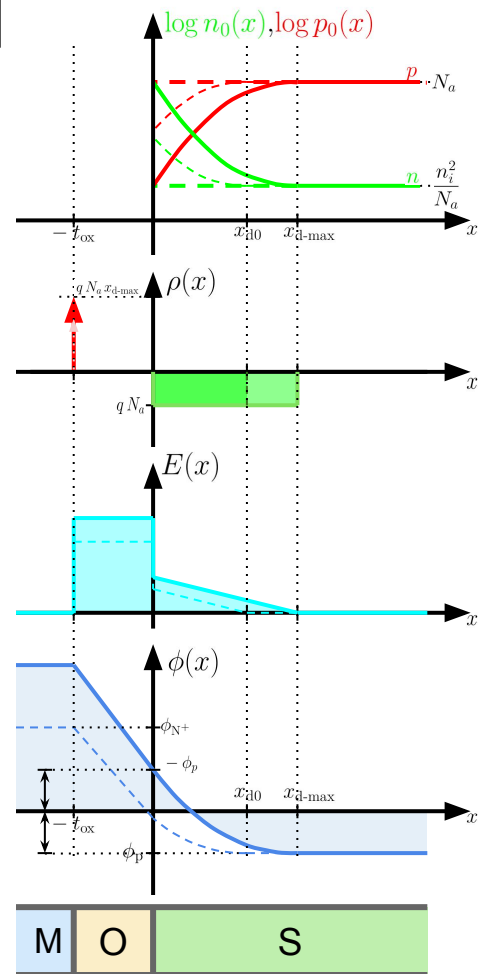
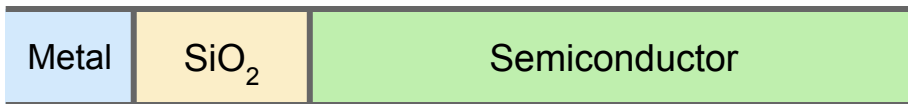
Resultados

$$V_{GB} = V_T$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = V_T$$

Diagrama de portadores en el umbral

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

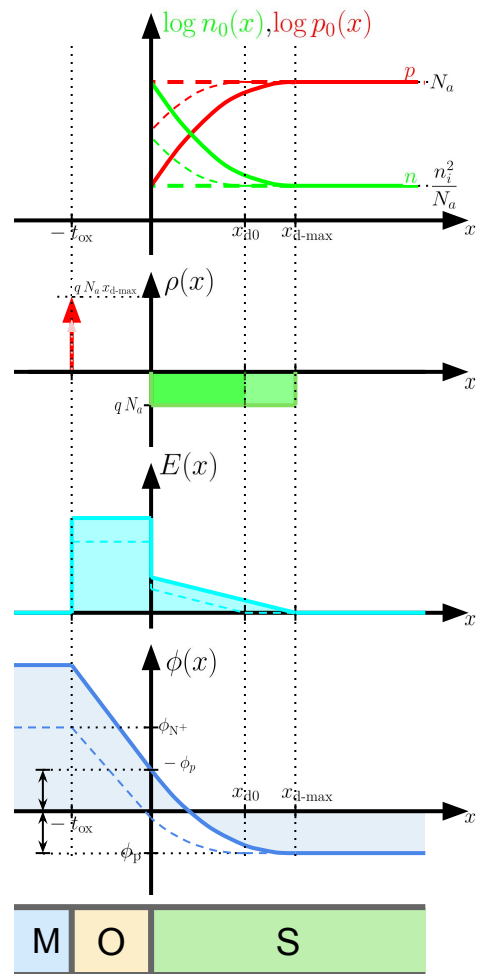
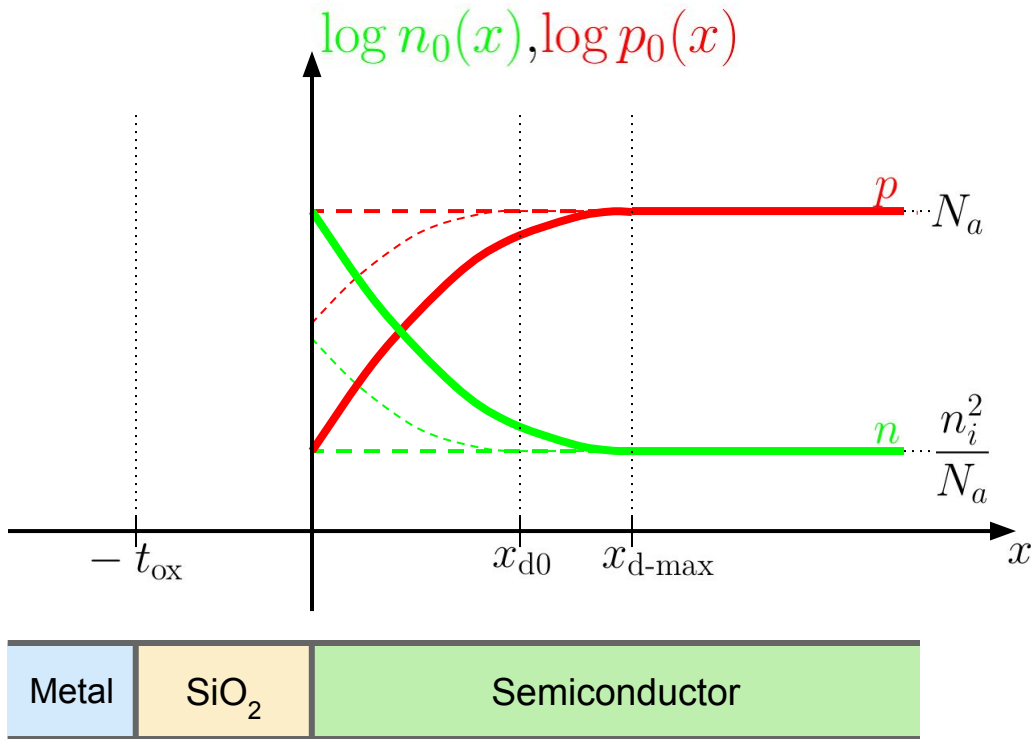
Resultados

$$V_{GB} = V_T$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = V_T$$

Diagrama de portadores en el umbral

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

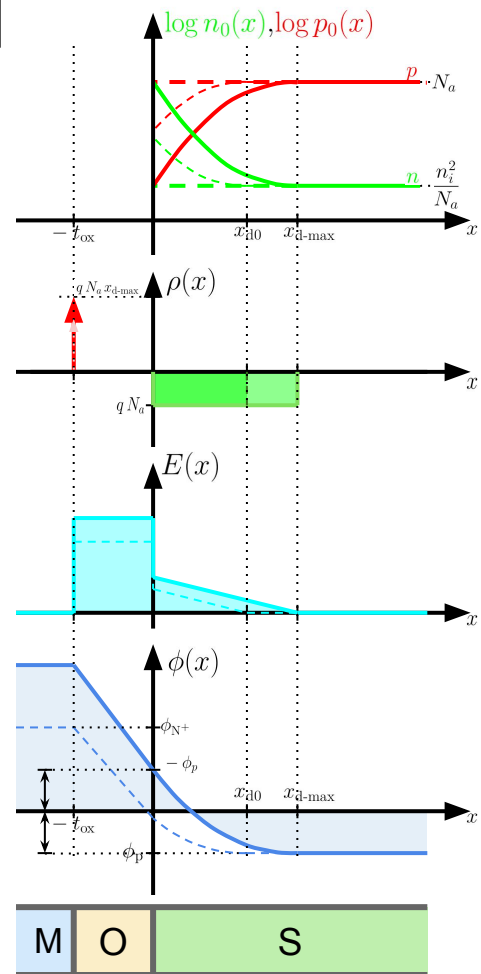
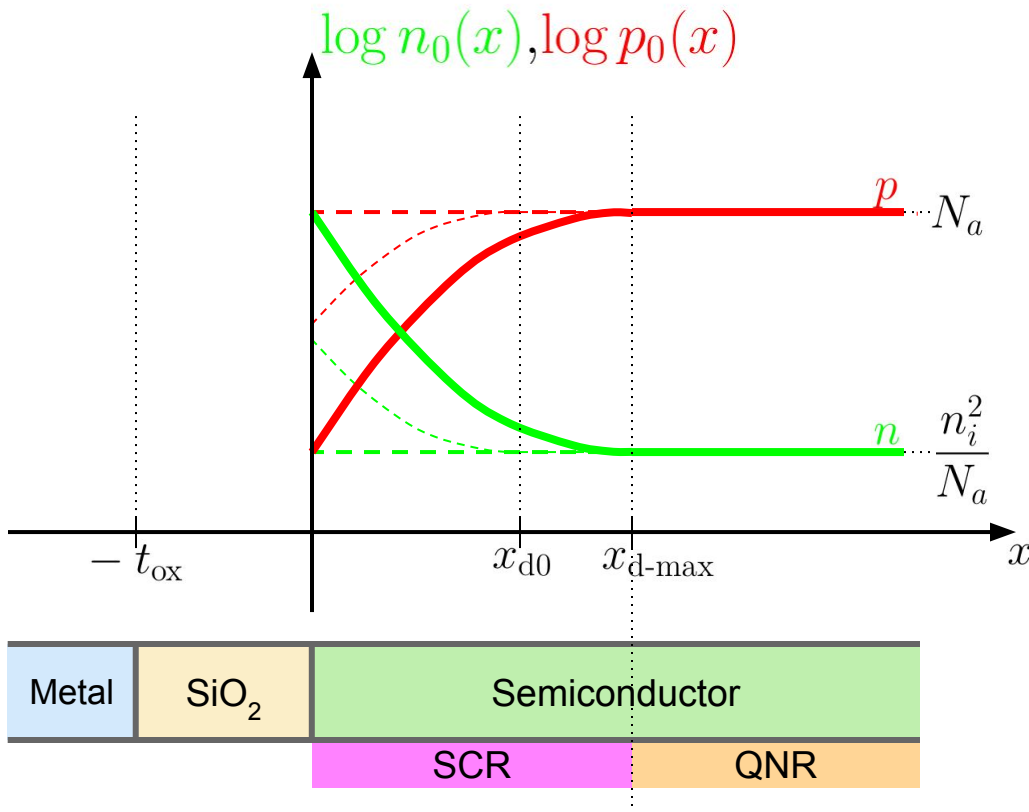
Resultados

$$V_{GB} = V_T$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = V_T$$

Diagrama de portadores en el umbral

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$Y^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

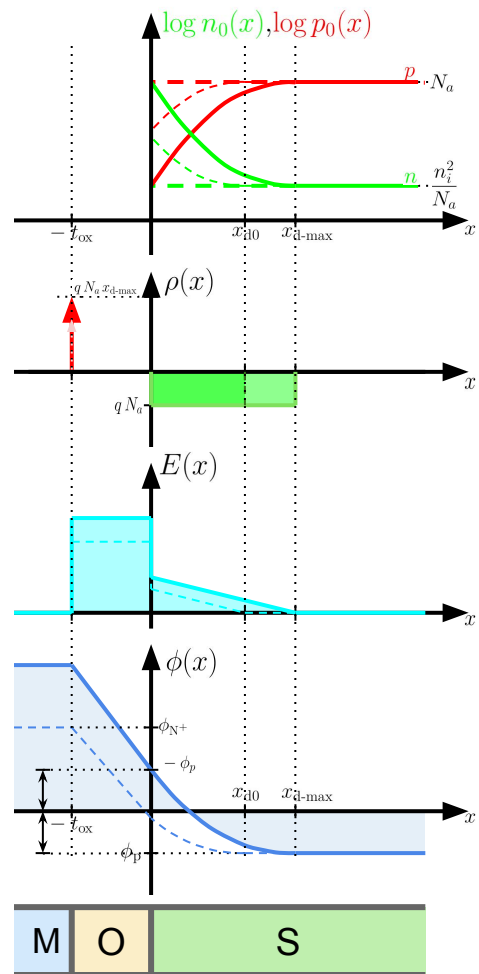
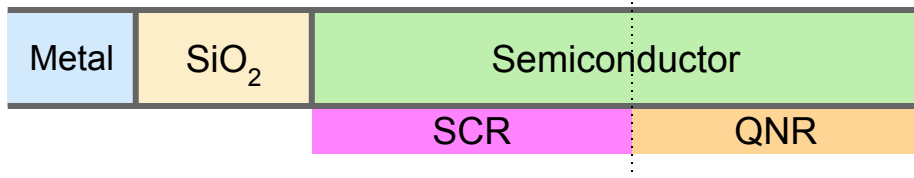
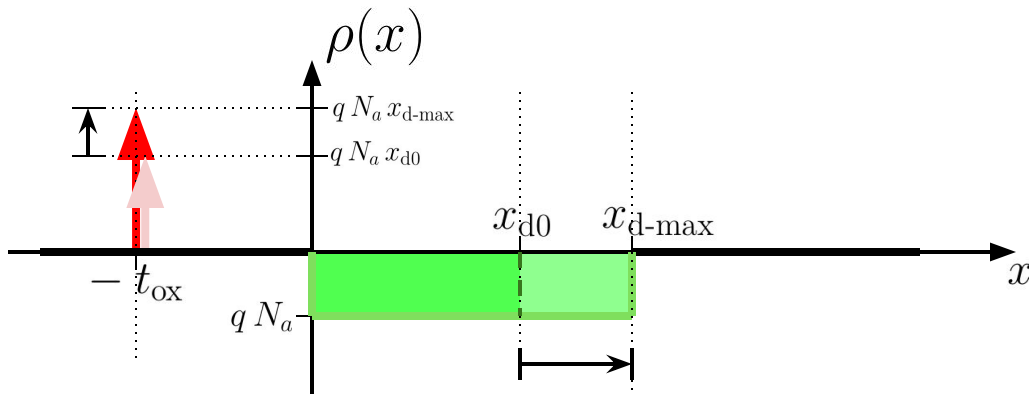
Resultados

$$V_{GB} = V_T$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = V_T$$

Diagrama de portadores en el umbral

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

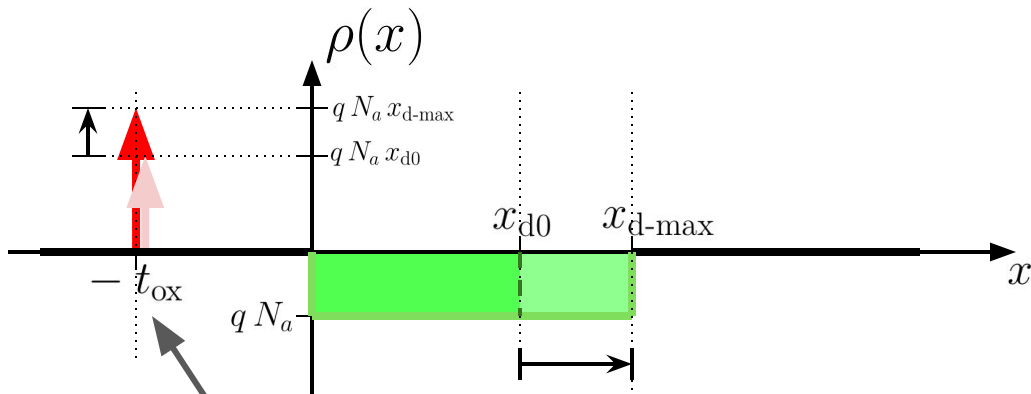
Resultados

$$V_{GB} = V_T$$

$$Q'_{\text{p-o}} =$$

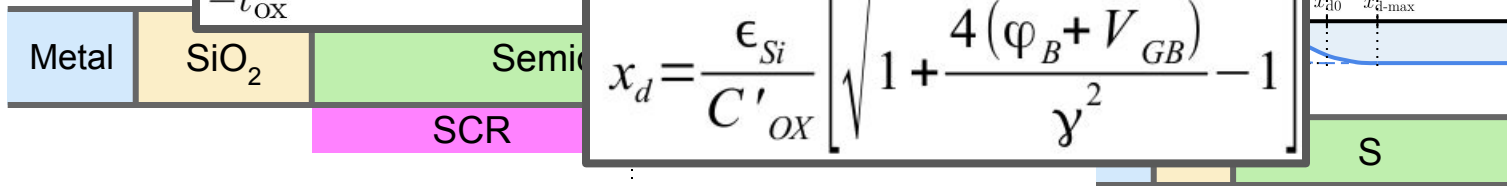
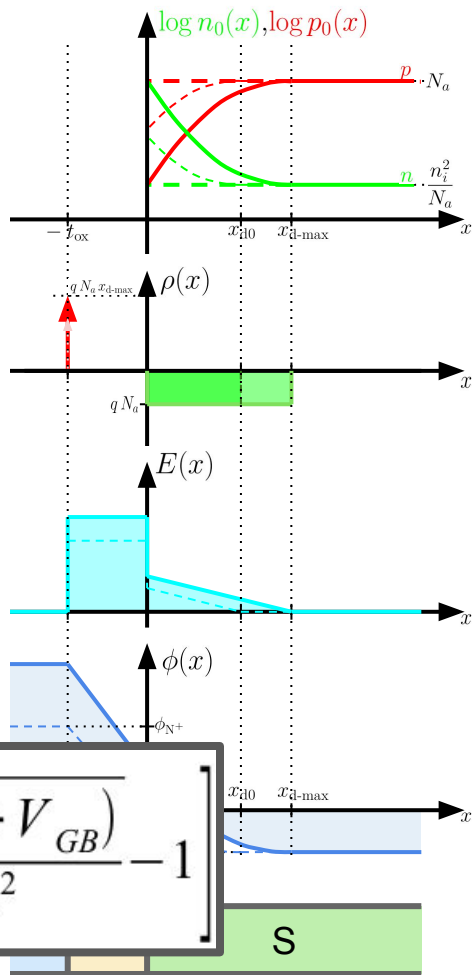
$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$\int_{-t_{\text{ox}}^-}^{-t_{\text{ox}}^+} \rho(x) dx = q N_a x_{\text{d}}$$

$$x_{\text{d}} = \frac{\epsilon_{\text{Si}}}{C'_{\text{OX}}} \left[\sqrt{1 + \frac{4(\phi_B + V_{\text{GB}})}{\gamma^2}} - 1 \right]$$



$$V_{GB} = V_T$$

Diagrama de portadores en el umbral

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{GB} = V_T$$

$$Q'_{\text{p-o}} = 166 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$

```

4
3 vgb = vt;
2 xd = esi/Coxp*(sqrt(1+4*(phib+vgb)/gamma^2)-1);
1 xmax = xd
32 Q_poly_ox_p = q*Na*xdma
1
2
N... script.m 94% ≡ 32/34 ln : 24
"script.m" 34L, 468C

```

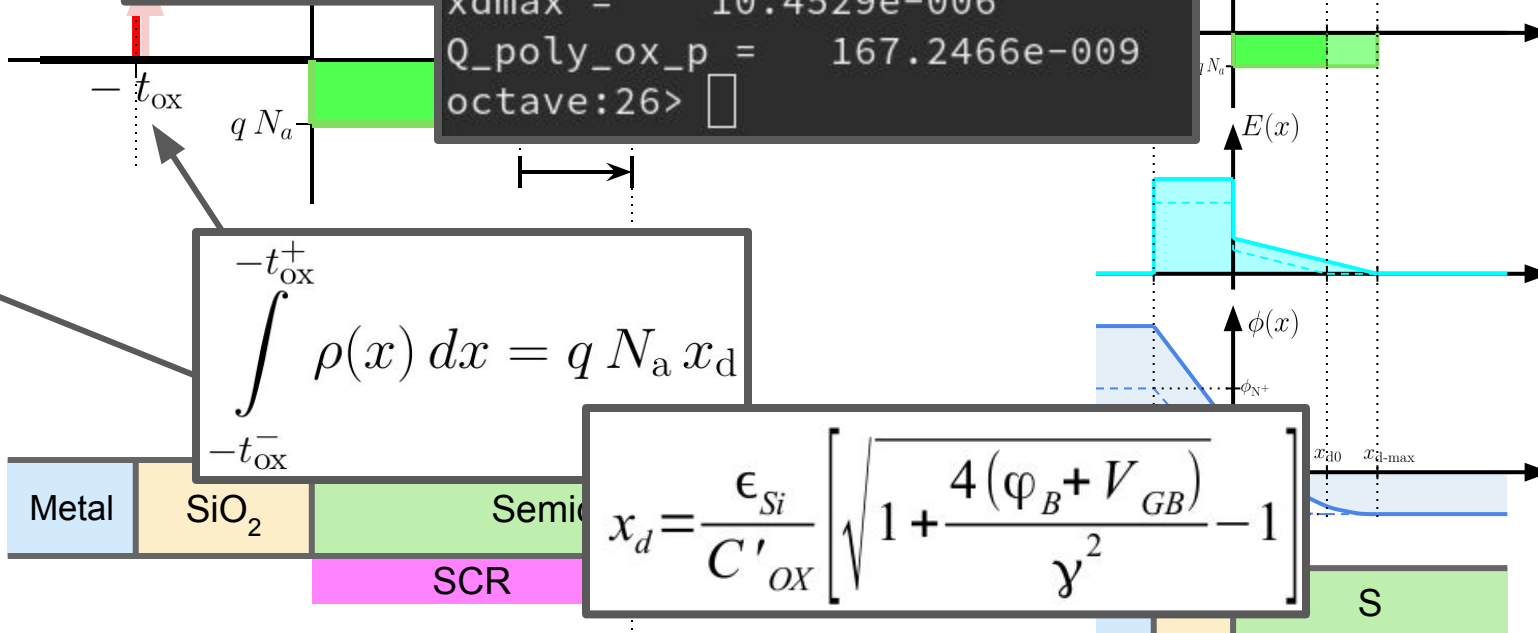
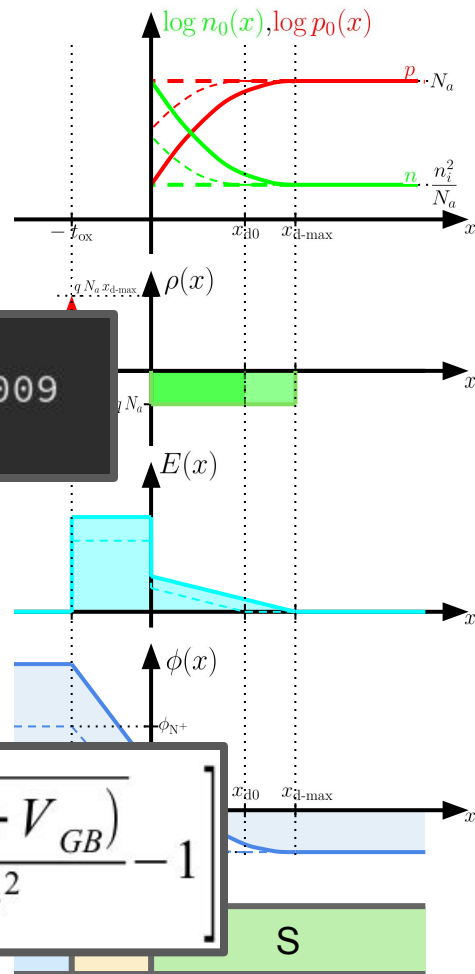
```

xdmax = 10.4529e-006
Q_poly_ox_p = 167.2466e-009
octave:26>

```

$$\int_{-t_{\text{ox}}^-}^{-t_{\text{ox}}^+} \rho(x) dx = q N_a x_d$$

$$x_d = \frac{\epsilon_{\text{Si}}}{C'_{\text{OX}}} \left[\sqrt{1 + \frac{4(\phi_B + V_{GB})}{\gamma^2}} - 1 \right]$$



$$V_{GB} = V_T$$

Diagrama de portadores en el umbral

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

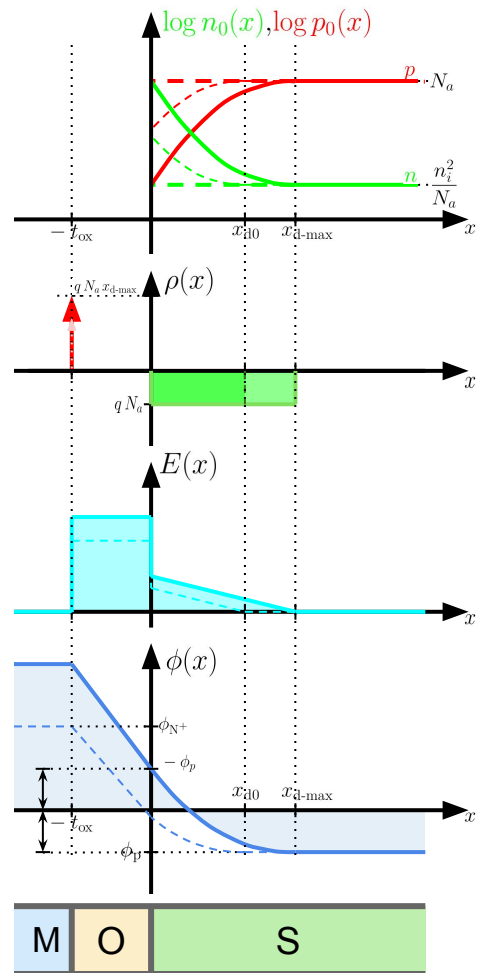
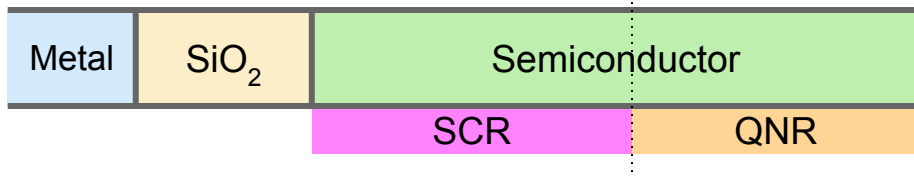
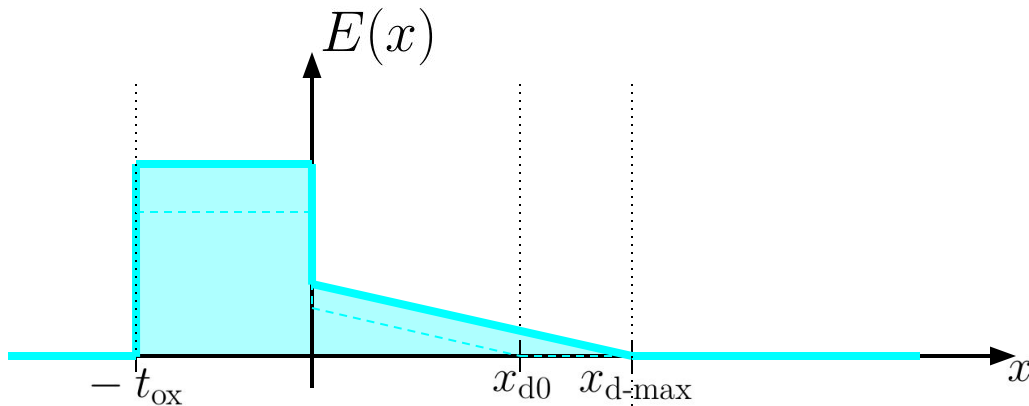
Resultados

$$V_{GB} = V_T$$

$$Q'_{\text{p-o}} = 166 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = V_T$$

Diagrama de portadores en el umbral

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

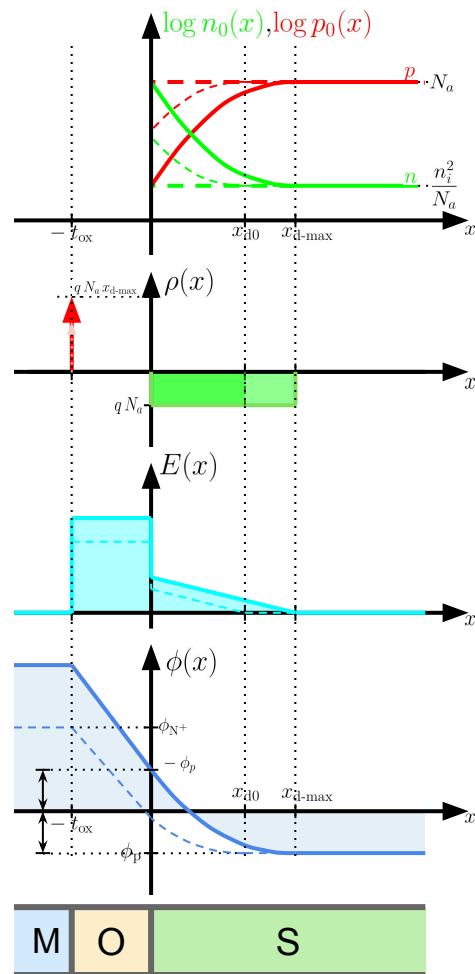
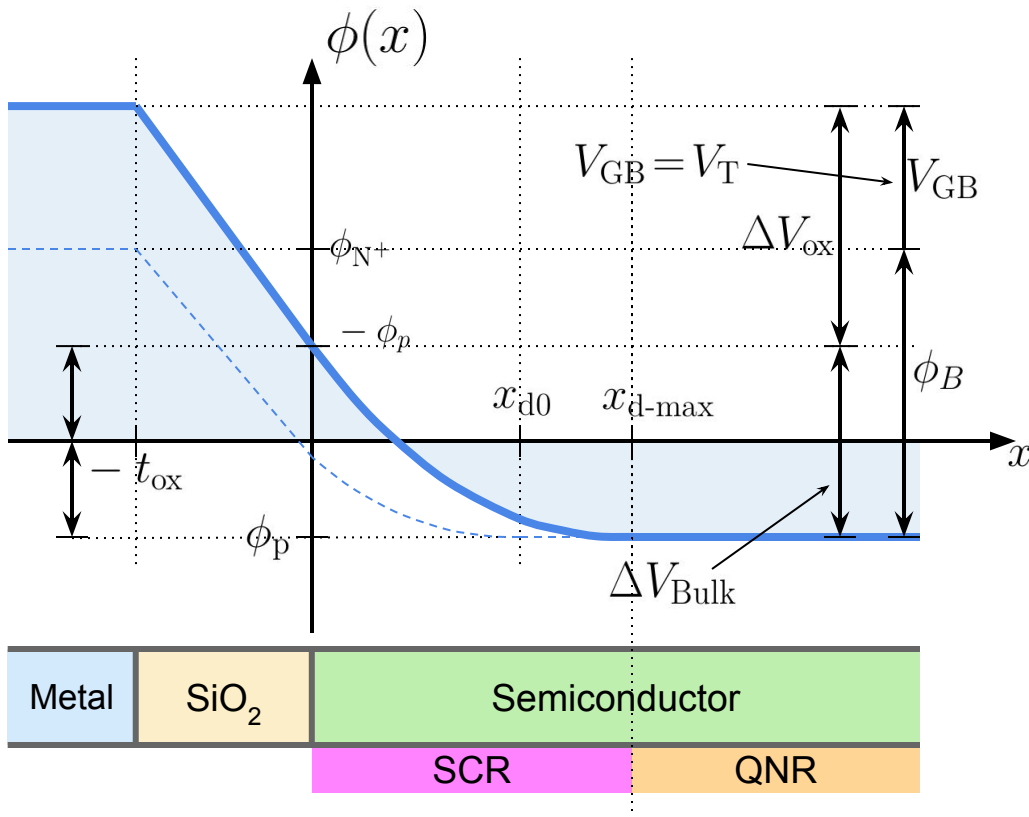
Resultados

$$V_{GB} = V_T$$

$$Q'_{\text{p-o}} = 166 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = V_T$$

Diagrama de portadores en el umbral

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

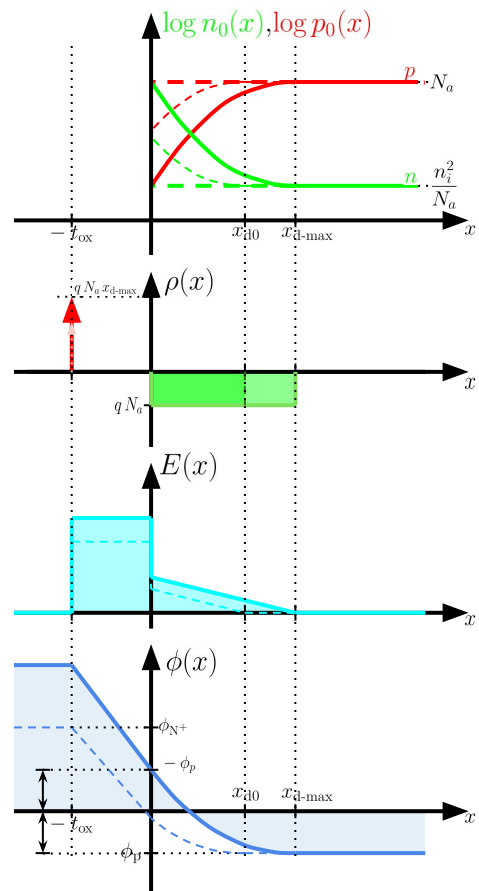
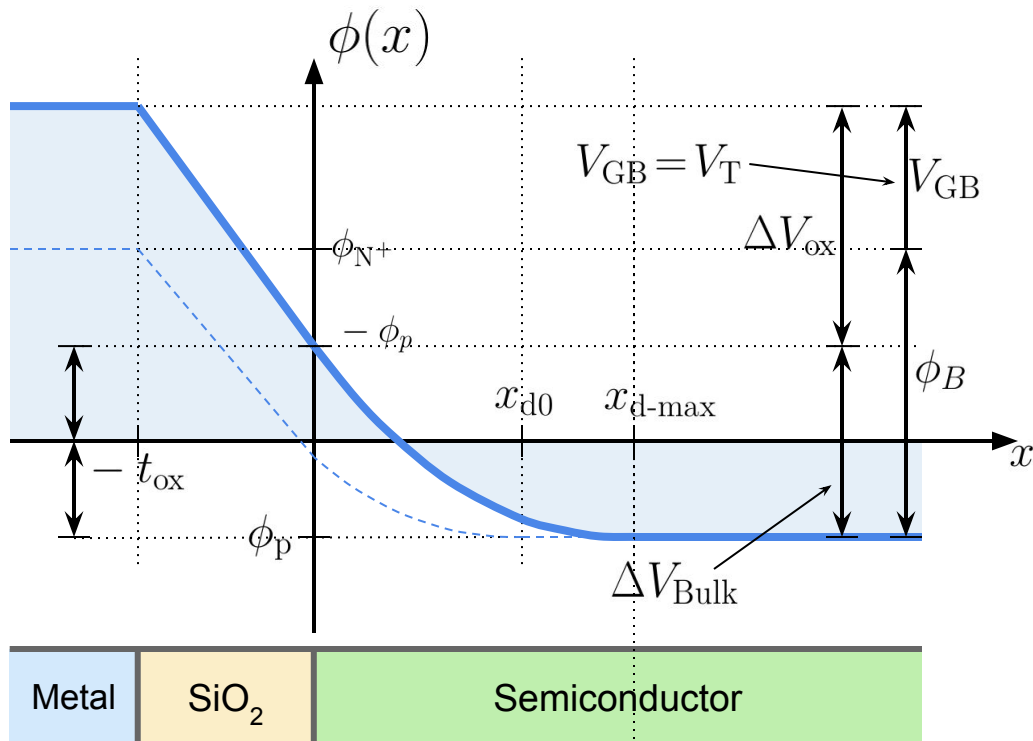
Resultados

$$V_{GB} = V_T$$

$$Q'_{\text{p-o}} = 166 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} = 840 \text{ mV}$$



$$\Delta V_{\text{Bulk}} = -2\phi_p = 2 \cdot 7.60 \text{ mV} = 840 \text{ mV}$$



$$V_{GB} = V_T$$

Diagrama de portadores en el umbral

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

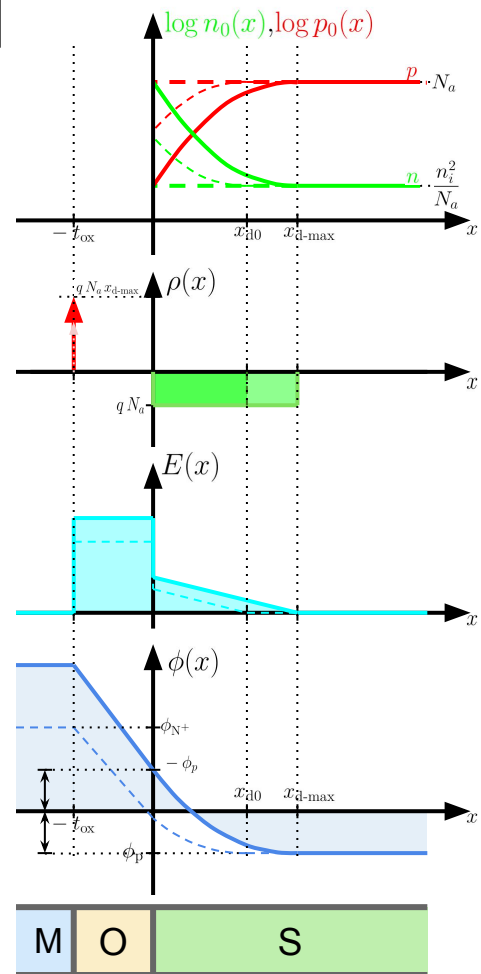
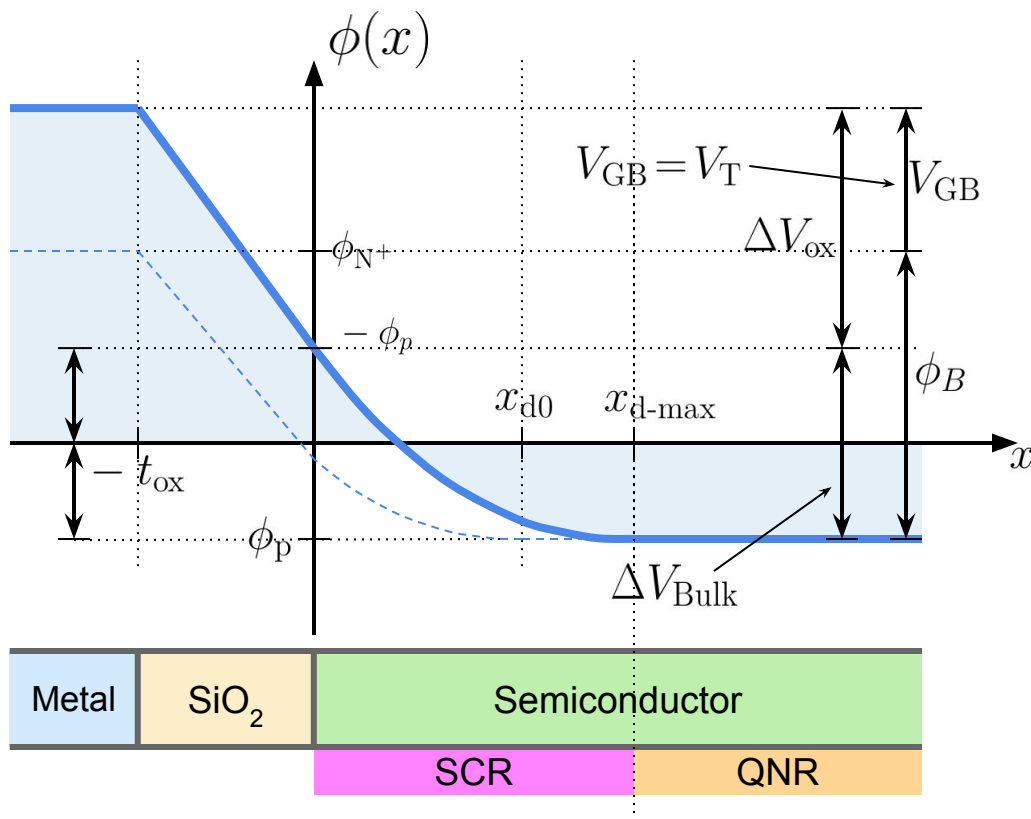
$$V_{GB} = V_T$$

$$Q'_{\text{p-o}} = 166 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} = 677 \text{ mV}$$

$$\Delta V_{\text{Bu}} = 840 \text{ mV}$$

Para hallar ΔV_{ox} nuevamente ...



$$V_{GB} = V_T$$

Diagrama de portadores en el umbral

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{GB} = V_T$$

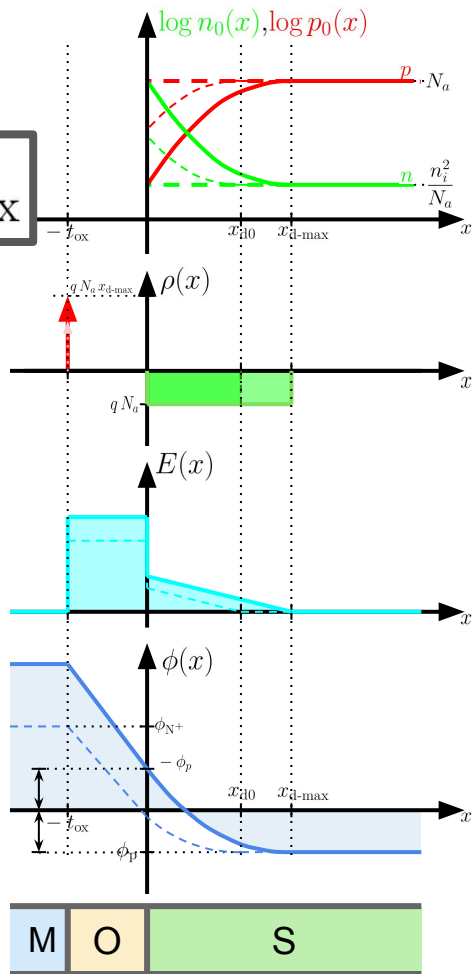
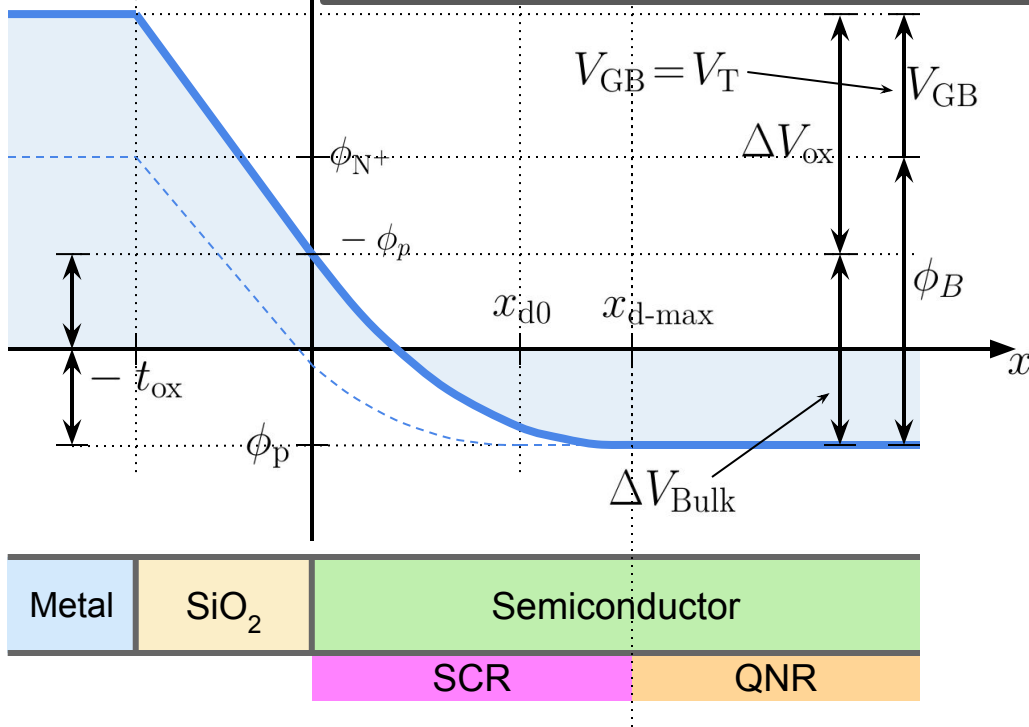
$$Q'_{p-o} = 166 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} = 677 \text{ mV}$$

$$\Delta V_{\text{Bu}} = 840 \text{ mV}$$

Para hallar ΔV_{ox} nuevamente ...

$$\phi_B + V_{GB} = \Delta V_{\text{Bulk}} + \Delta V_{\text{OX}}$$



$$V_{GB} = V_T$$

Diagrama de portadores en el umbral

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$Y^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{GB} = V_T$$

$$Q'_{p-o} = 166 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} = 677 \text{ mV}$$

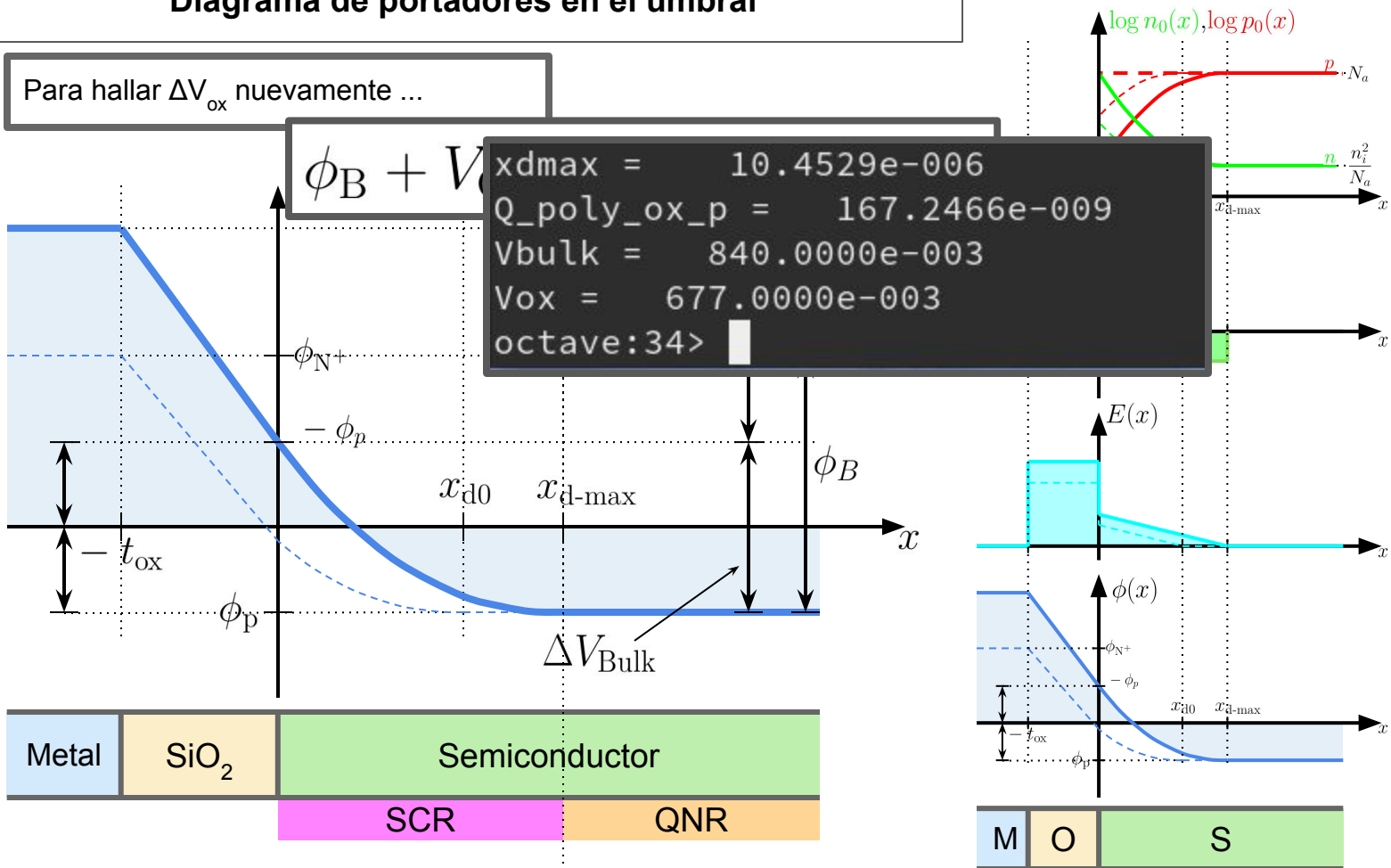
$$\Delta V_{\text{Bu}} = 840 \text{ mV}$$

Para hallar ΔV_{ox} nuevamente ...

$$\phi_B + V_T$$

```

xdmax = 10.4529e-006
Q_poly_ox_p = 167.2466e-009
Vbulk = 840.0000e-003
Vox = 677.0000e-003
octave:34>
    
```



Umbral

<u>Resultados</u>					
V_{GB}	-2	V_{FB}	0	V_T	2
Q'_{o-s}	-253 nC/cm ²	0	125 nC/cm ²	166 nC/cm ²	
ΔV_{ox}	1.03 V	0	506 mV	677 mV	
ΔV_{Bu}	0	0	464 mV	840 mV	

Inversión

Resultados					
V_{GB}	-2	V_{FB}	0	V_T	2
Q'_{o-s}	-253 nC/cm ²	0	125 nC/cm ²	166 nC/cm ²	
ΔV_{ox}	1.03 V	0	506 mV	677 mV	
ΔV_{Bu}	0	0	464 mV	840 mV	

5

$$V_{GB} = 2$$

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

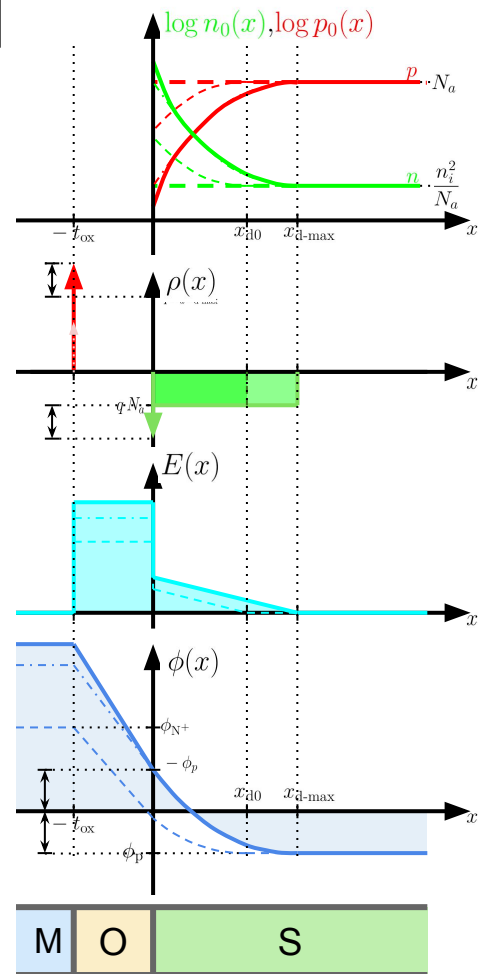
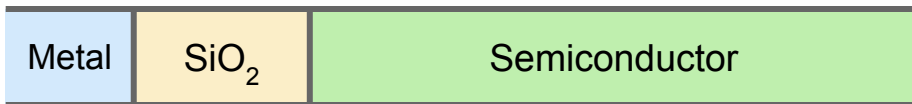
Resultados

$$V_{GB} = 2$$

$$Q'_{\text{p-o}} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = 2$$

Diagrama de portadores en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

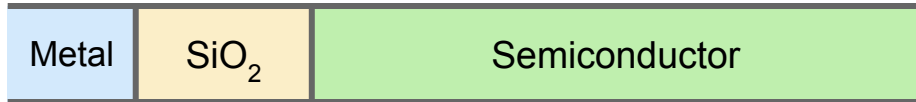
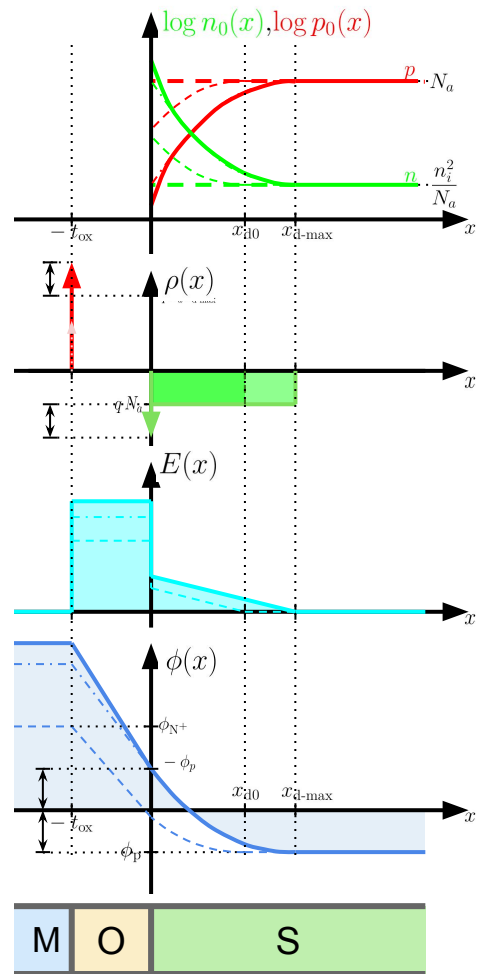
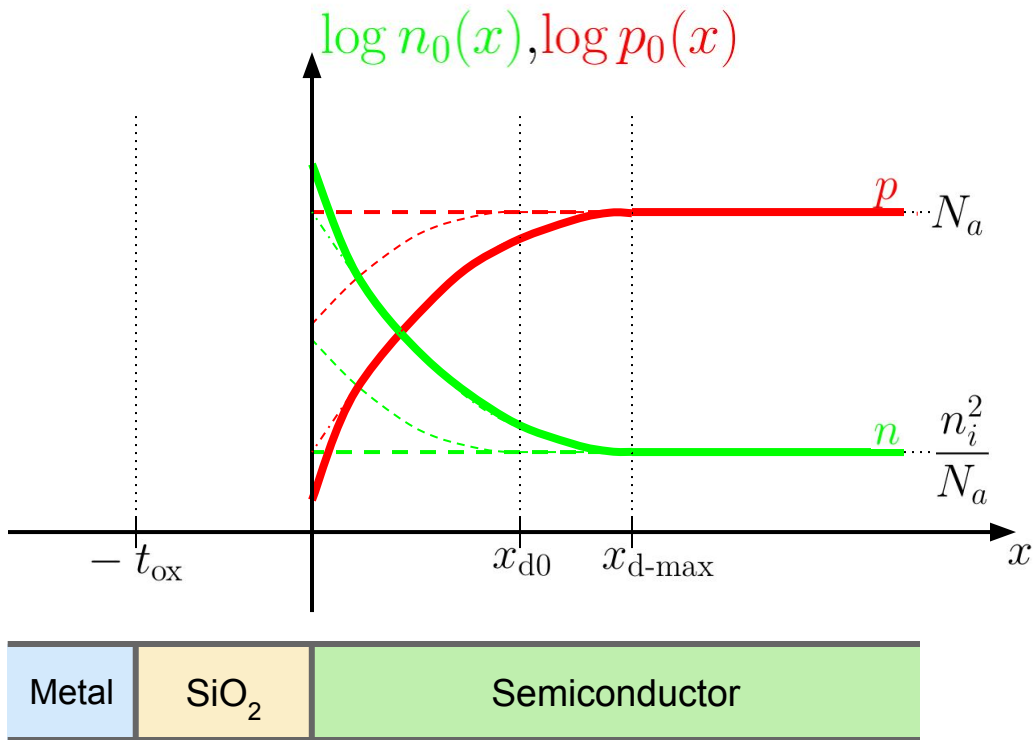
Resultados

$$V_{GB} = 2$$

$$Q'_{p-o} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = 2$$

Diagrama de portadores en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$V^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

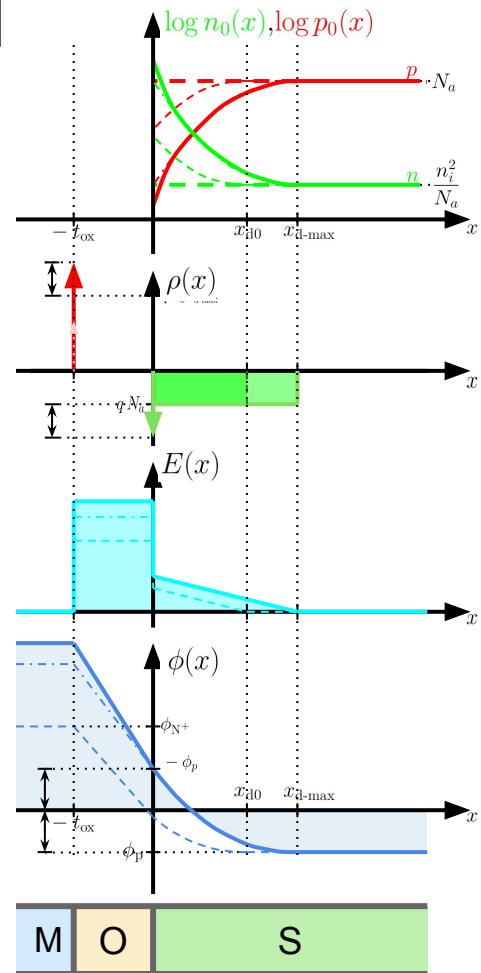
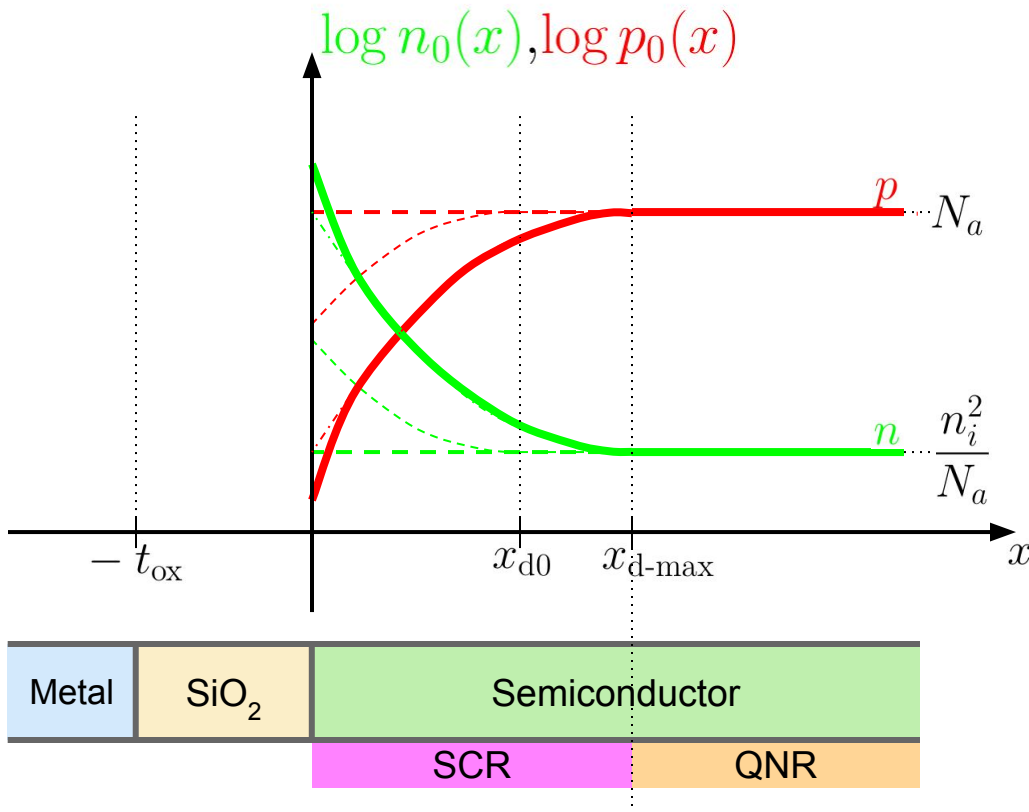
Resultados

$$V_{GB} = 2$$

$$Q'_{p-o} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = 2$$

Diagrama de densidad de carga en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

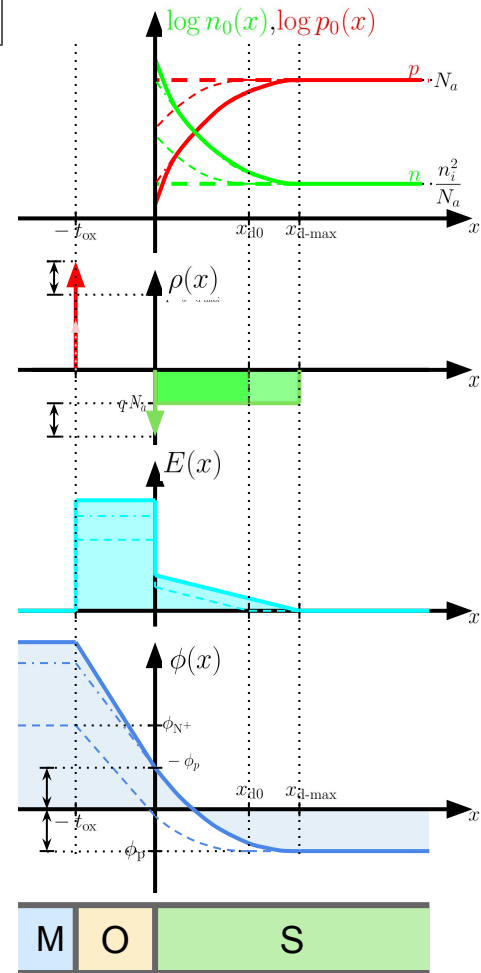
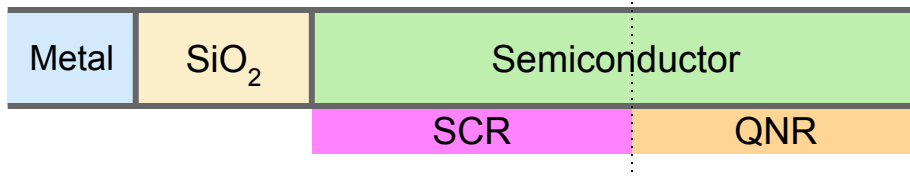
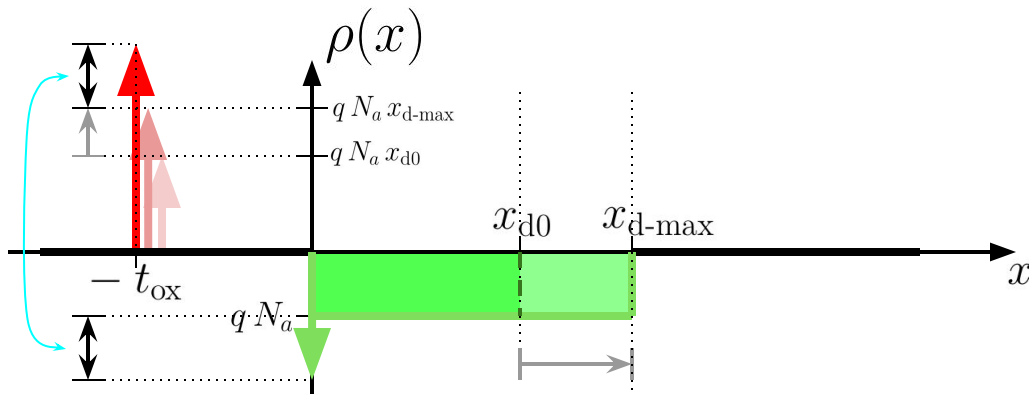
Resultados

$$V_{GB} = 2$$

$$Q'_{p-o} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = 2$$

Diagrama de densidad de carga en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

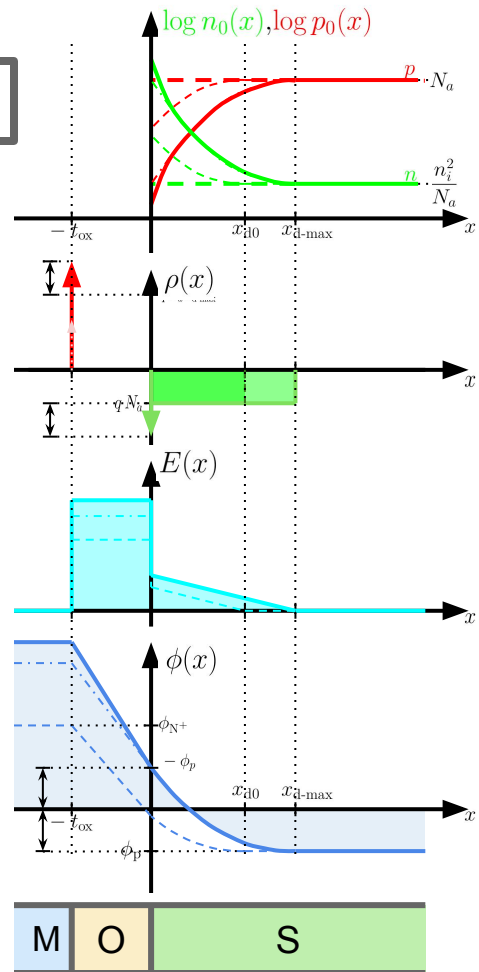
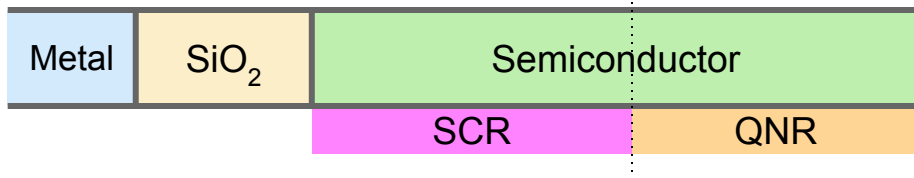
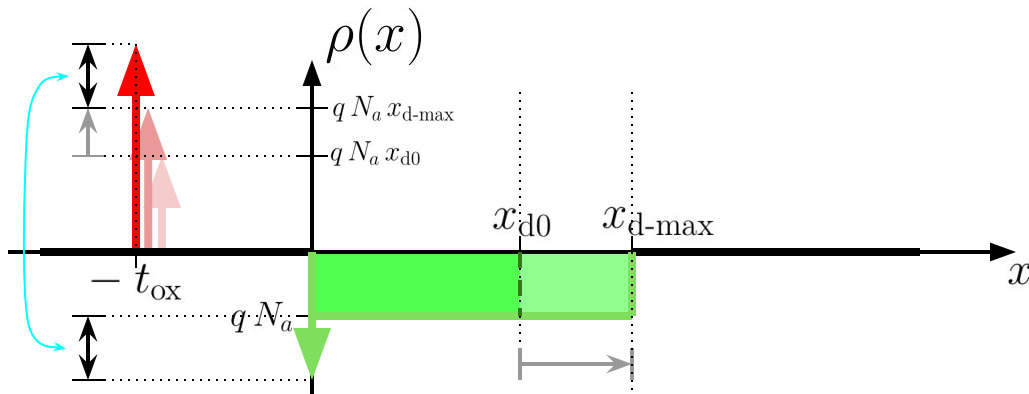
$$V_{GB} = 2$$

$$Q'_{p-o} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$

Para hallar Q'_{p-o} consideramos ...



$$V_{GB} = 2$$

Diagrama de densidad de carga en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

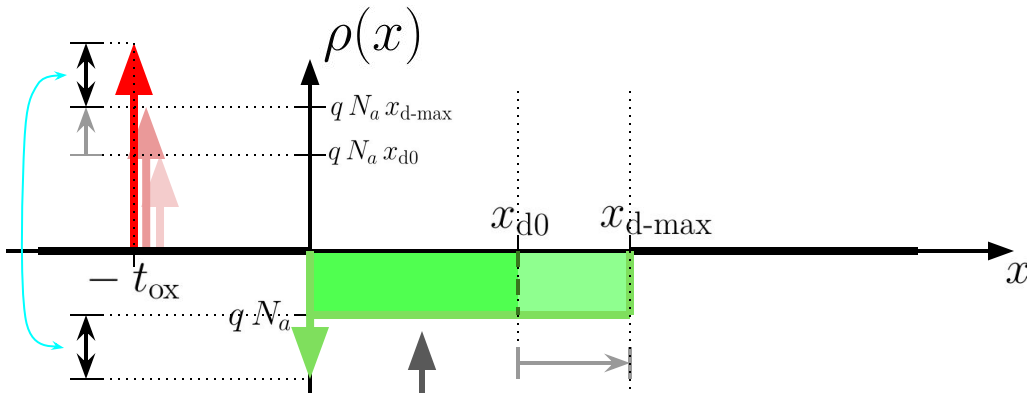
$$V_{GB} = 2$$

$$Q'_{p-o} =$$

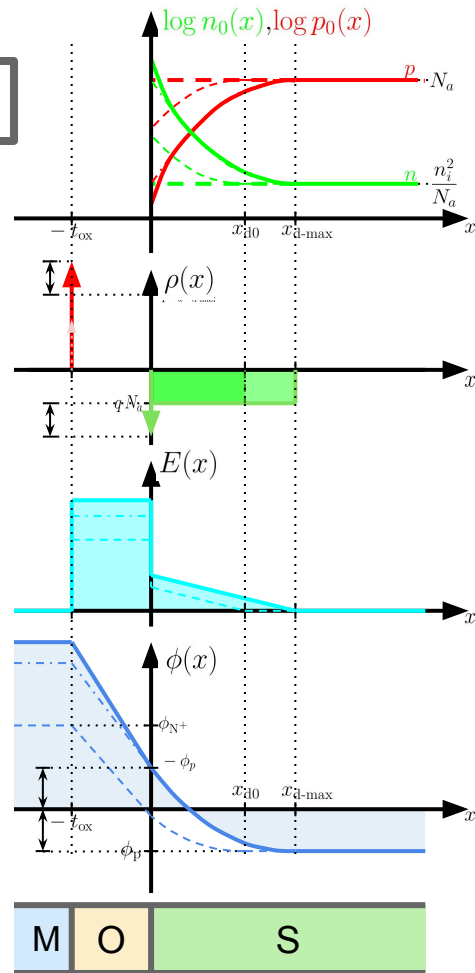
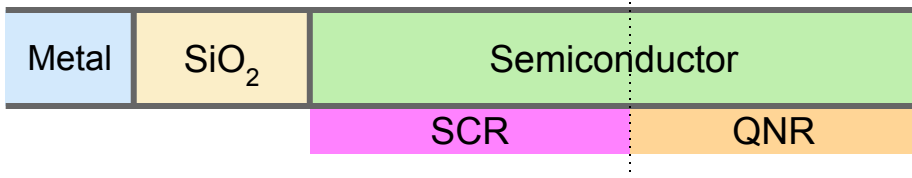
$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$

Para hallar Q'_{p-o} consideramos ...



... la carga fija en la SCR ...



$$V_{GB} = 2$$

Diagrama de densidad de carga en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

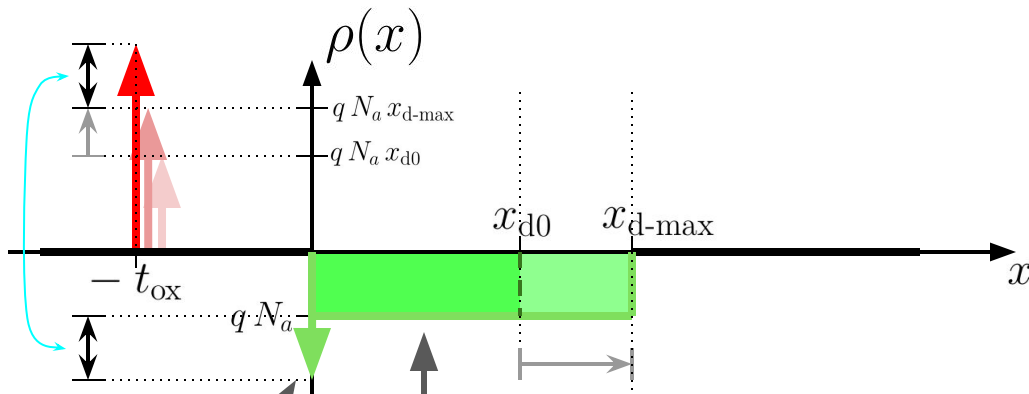
$$V_{GB} = 2$$

$$Q'_{p-o} =$$

$$\Delta V_{\text{ox}} =$$

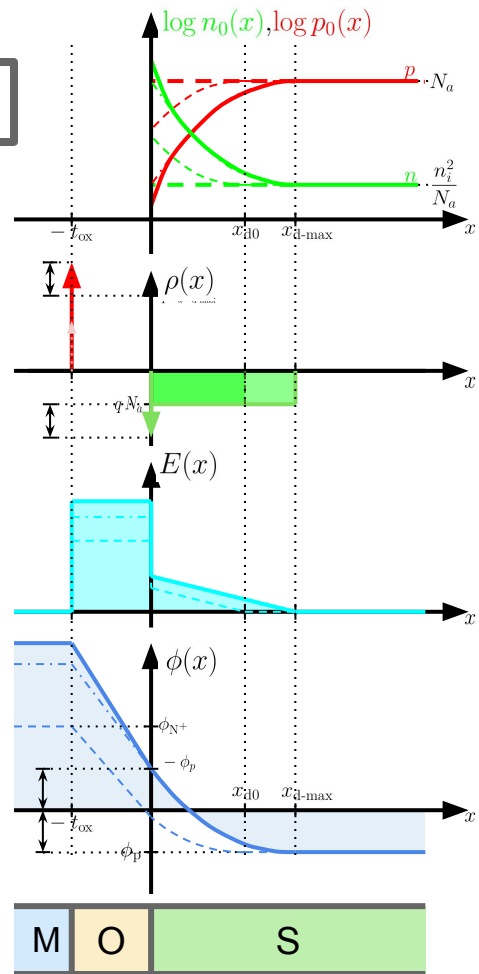
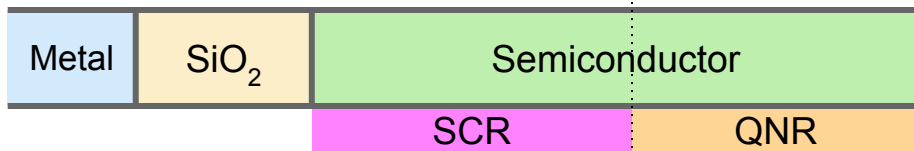
$$\Delta V_{\text{Bu}} =$$

Para hallar Q'_{p-o} consideramos ...



... la carga fija en la SCR ...

... y la carga que aporta la delta en la interfaz ox-sc



$$V_{GB} = 2$$

Diagrama de densidad de carga en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$Y^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

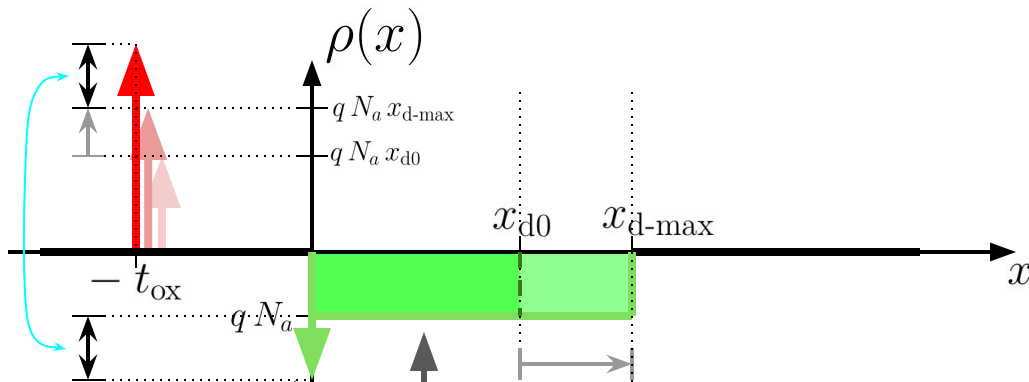
$$V_{GB} = 2$$

$$Q'_{p-o} =$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{BU}} =$$

Para hallar Q'_{p-o} consideramos ...

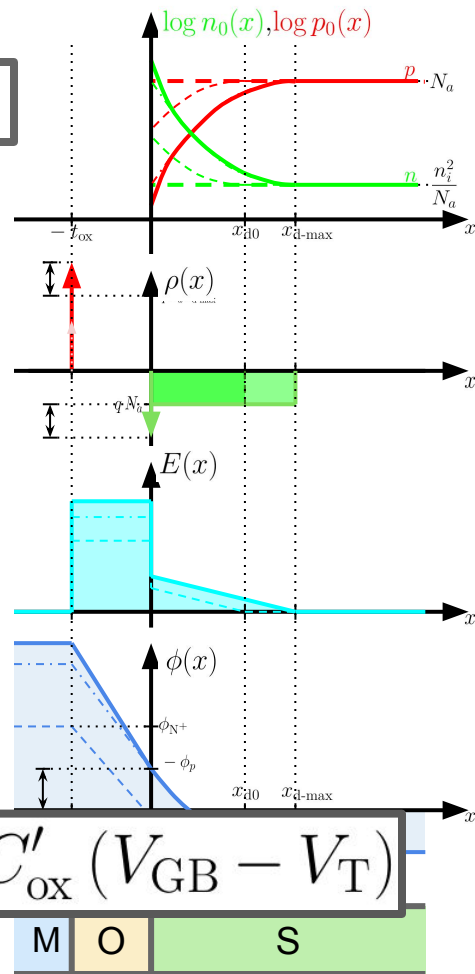


... la carga fija en la SCR ...

... y la carga que aporta la delta en la interfaz ox-sc

Nuevamente consideramos que la estructura MOS se comporta como un CPPP, pero ahora, luego de pasar V_T

$$Q'_{\text{poly-ox}} = q N_a x_{d-\text{max}} + C'_{\text{OX}} (V_{GB} - V_T)$$



M O S

$$V_{GB} = 2$$

Diagrama de densidad de carga en inversión

Datos

Poly-N y Subs. P

$$N_{Bulk} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$Y^2 = 0.545 \text{ V}$$

$$C'_{OX} = 246 \text{ nF/cm}^2$$

$$V_{FB} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{GB} = 2$$

$$Q'_{p-o} = 524 \text{ nC/cm}^2$$

$$\Delta V_{ox} =$$

$$\Delta V_{BU} =$$

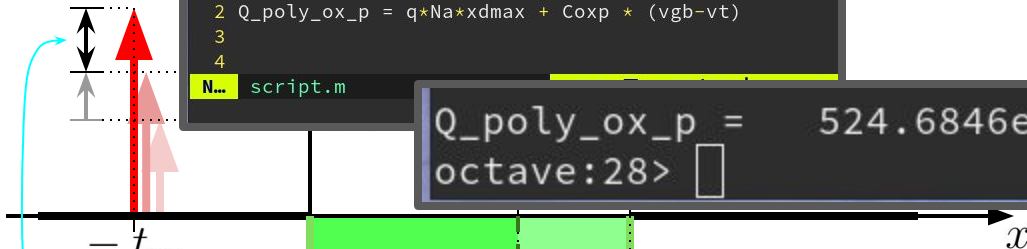
Para hallar Q' consideramos ...

```

35
1 vgb = 2;
2 Q_poly_ox_p = q*Na*xdmax + Cexp * (vgb-vt)
3
4
N... script.m
  
```

```

Q_poly_ox_p = 524.6846e-009
octave:28>
  
```

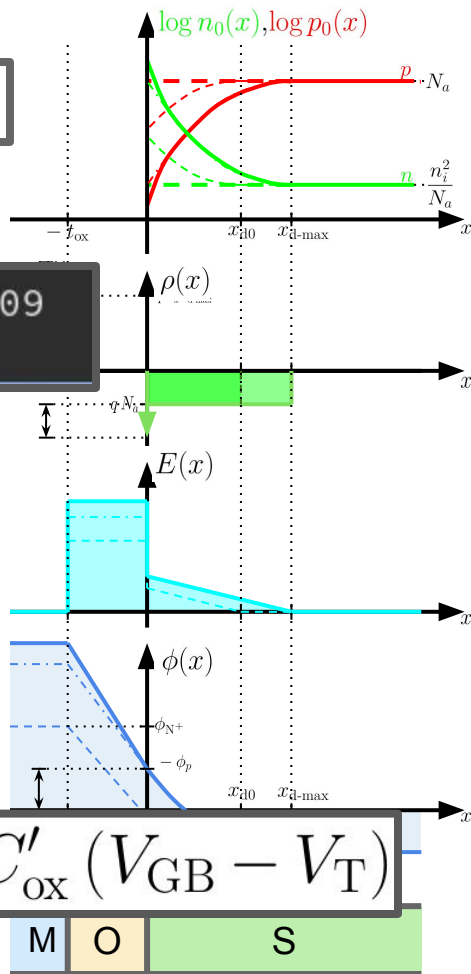


... la carga fija en la SCR ...

... y la carga que aporta la delta en la interfaz ox-sc

Nuevamente consideramos que la estructura MOS se comporta como un CPPP, pero ahora, luego de pasar V_T

$$Q'_{poly-ox} = q N_a x_{d-max} + C'_{OX} (V_{GB} - V_T)$$



$$V_{GB} = 2$$

Diagrama de portadores en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

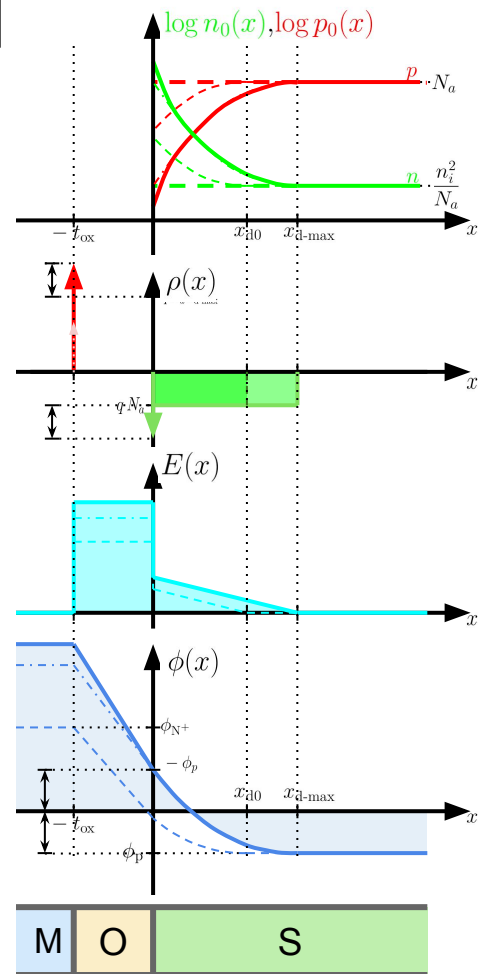
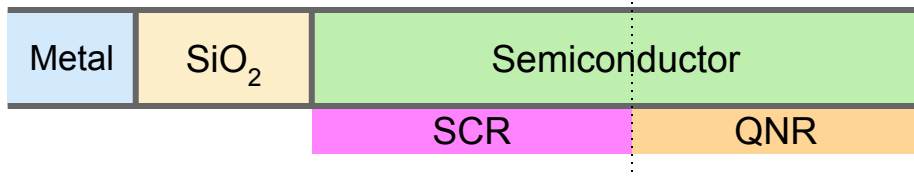
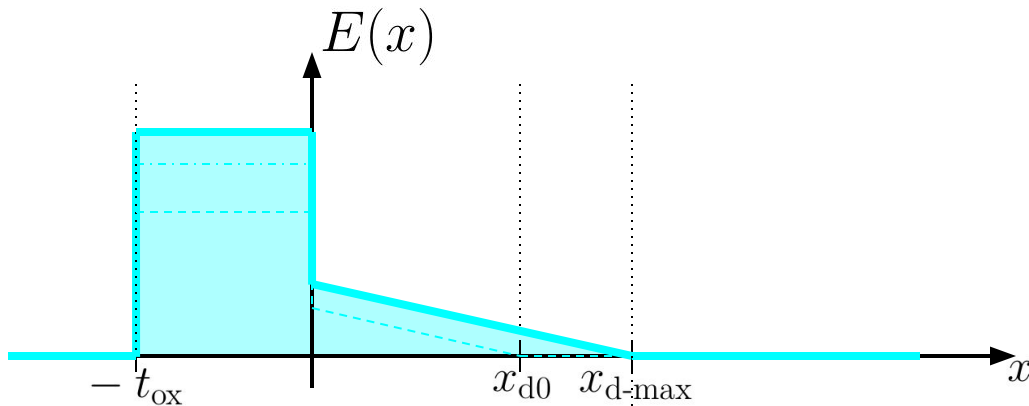
Resultados

$$V_{GB} = 2$$

$$Q'_{\text{p-o}} = 524 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = 2$$

Diagrama de portadores en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

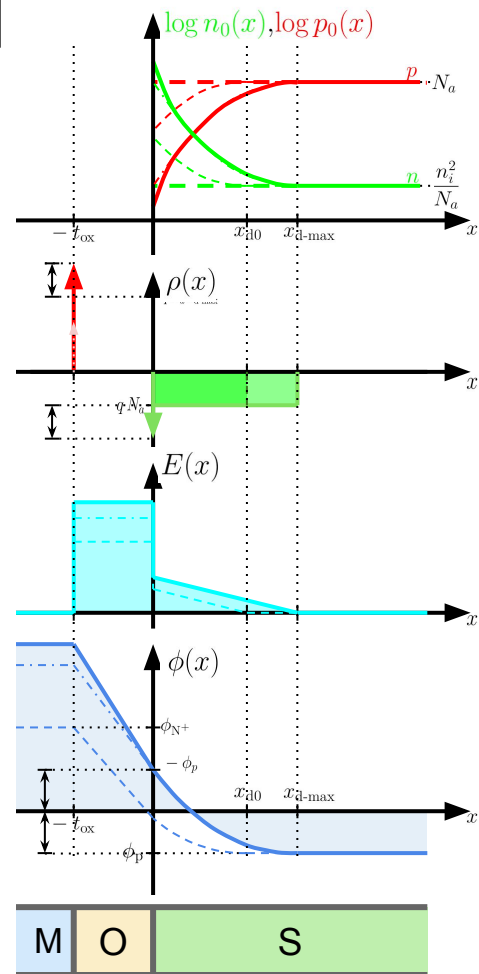
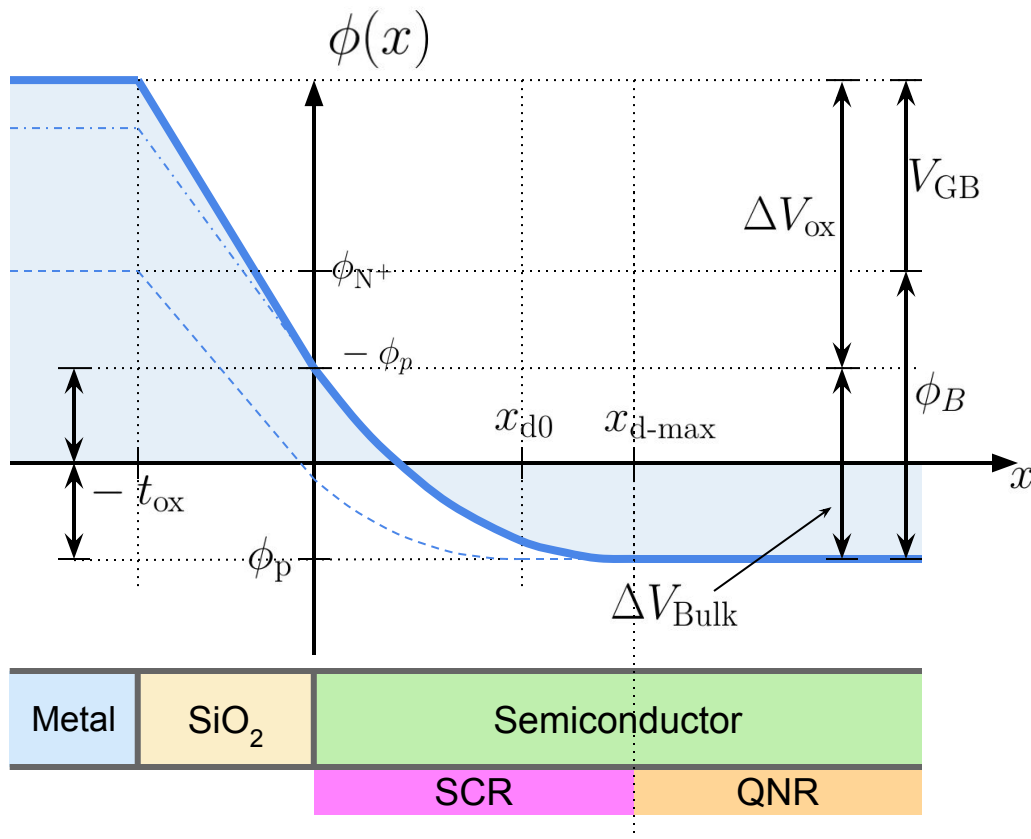
Resultados

$$V_{GB} = 2$$

$$Q'_{p-o} = 524 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$



$$V_{GB} = 2$$

Diagrama de portadores en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

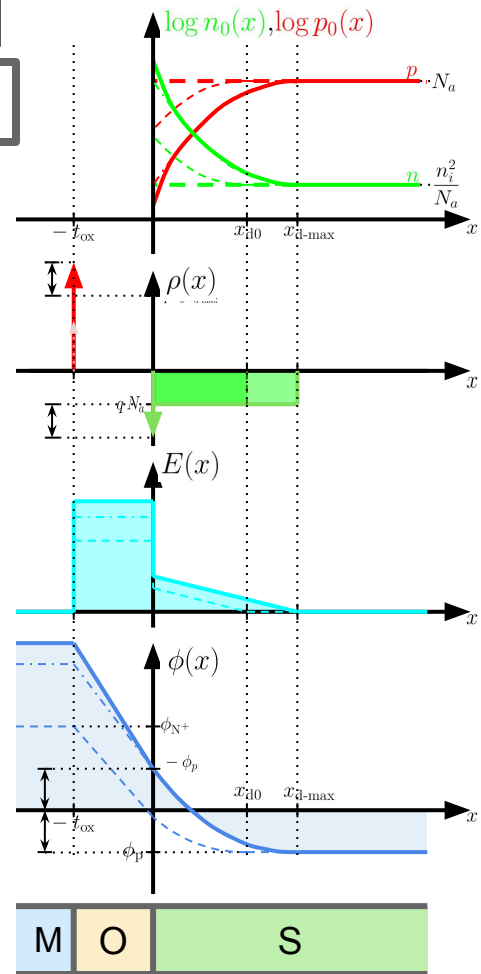
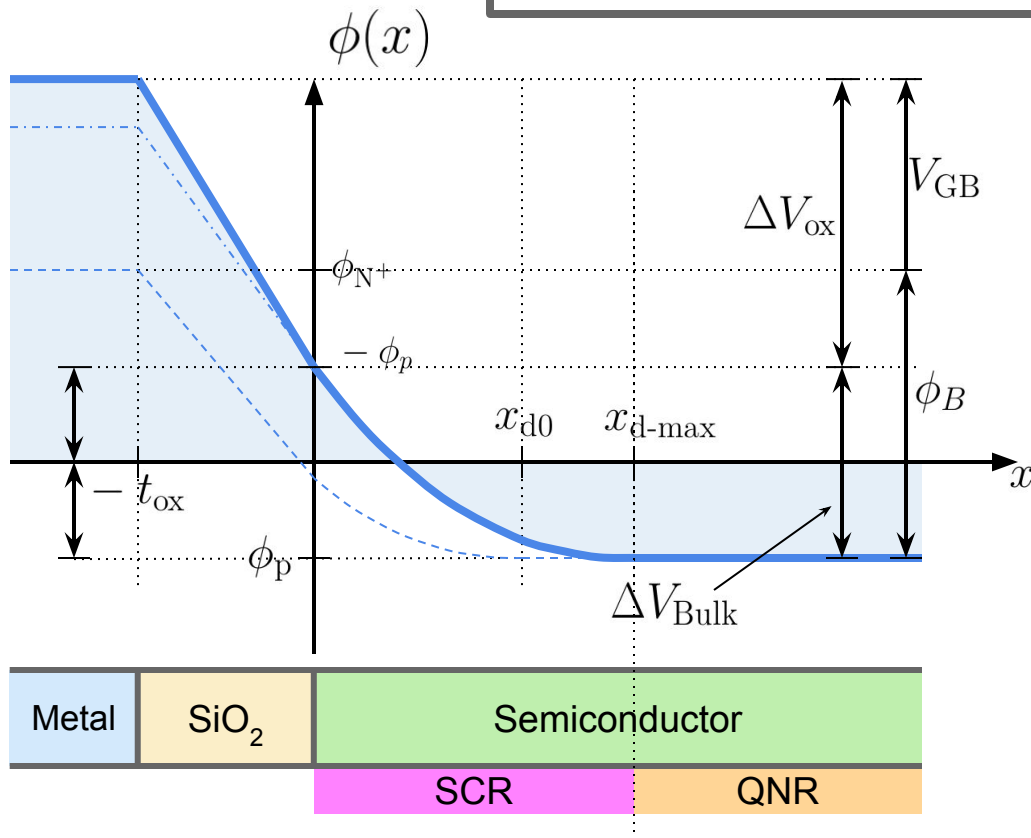
$$V_{GB} = 2$$

$$Q'_{p-o} = 524 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} =$$

ΔV_{ox} es el mismo que en el umbral.



$$V_{GB} = 2$$

Diagrama de portadores en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

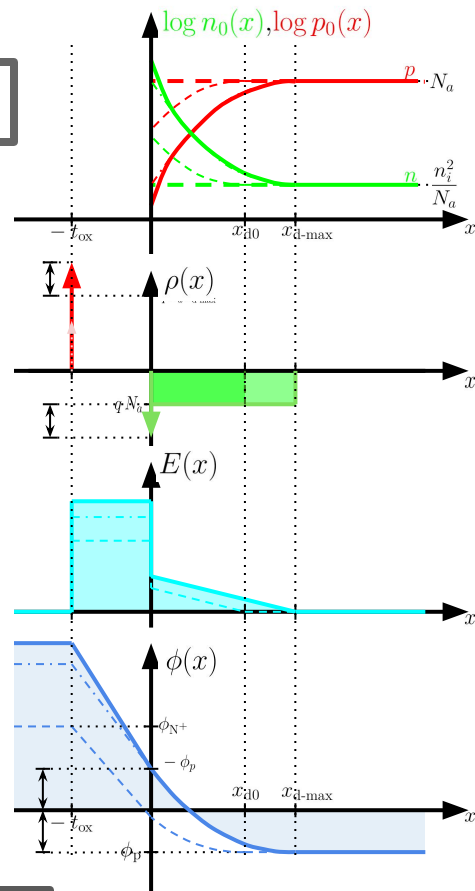
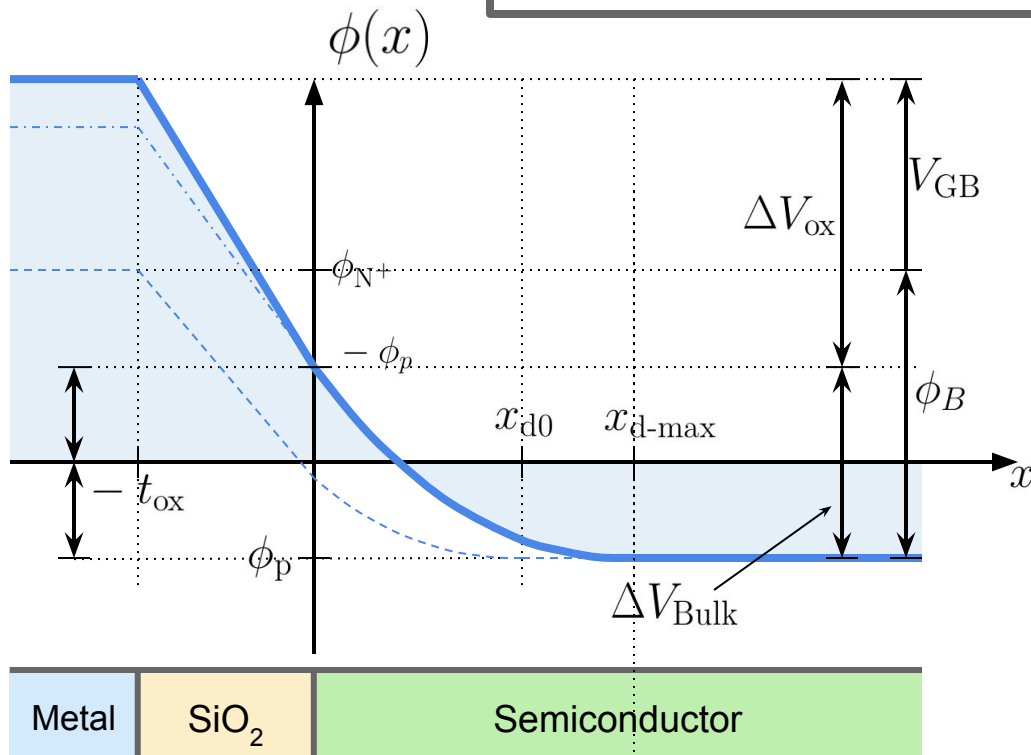
$$V_{GB} = 2$$

$$Q'_{p-o} = 524 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} = 840 \text{ mV}$$

ΔV_{ox} es el mismo que en el umbral.



$$\Delta V_{\text{ox}} = -2\phi_p = 2 \cdot 7 \cdot 60 \text{ mV} = 840 \text{ mV}$$



$$V_{GB} = 2$$

Diagrama de portadores en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

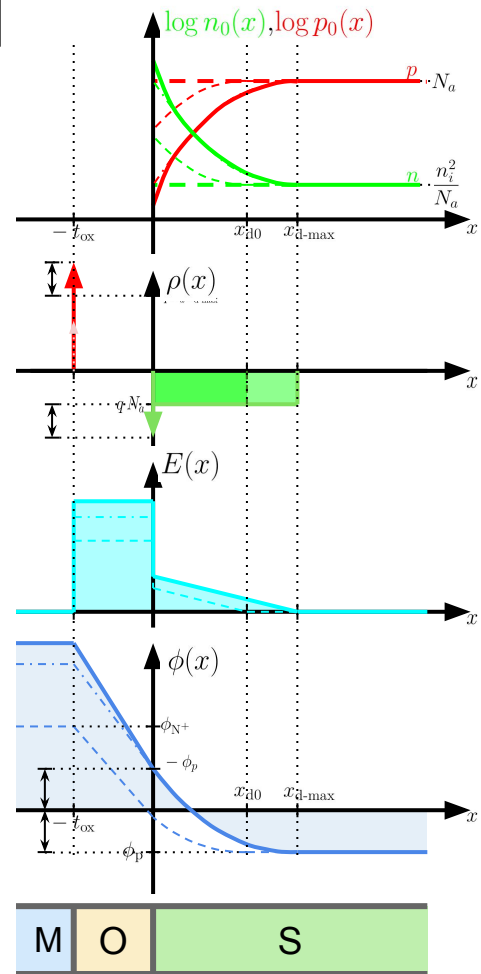
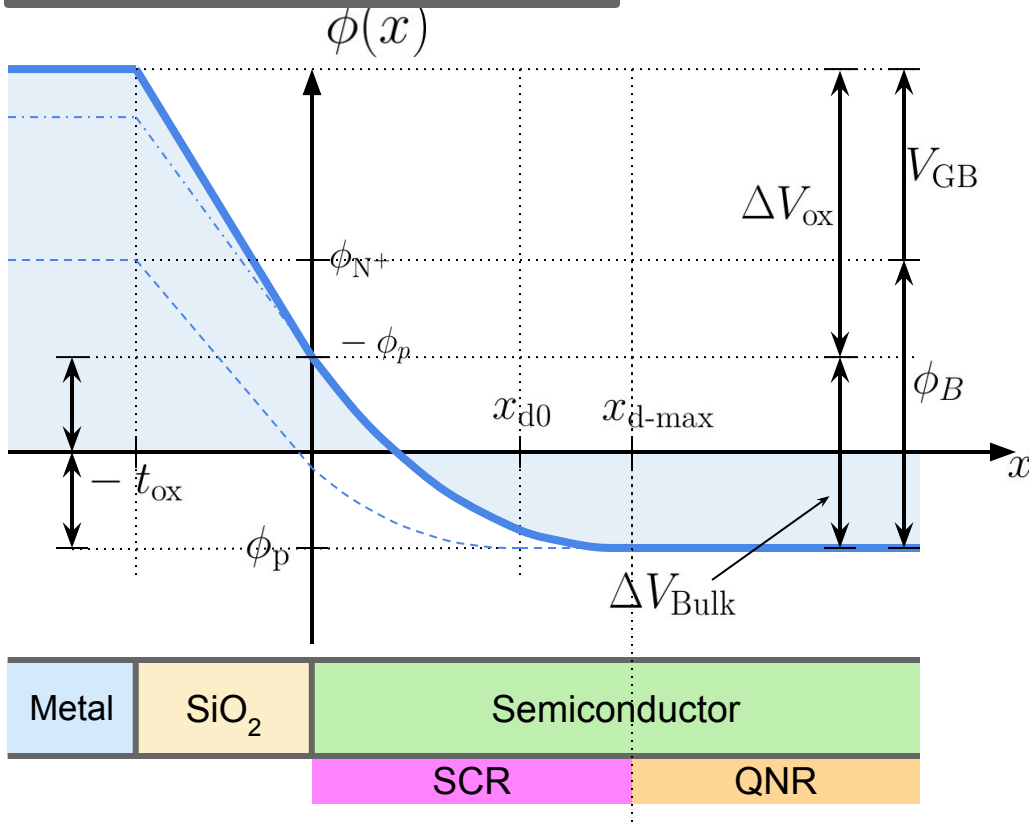
$$V_{GB} = 2$$

$$Q'_{p-o} = 524 \text{ nC/cm}^2$$

$$\Delta V_{\text{ox}} =$$

$$\Delta V_{\text{Bu}} = 840 \text{ mV}$$

Para hallar ΔV_{ox} nuevamente ...



$$V_{GB} = 2$$

Diagrama de portadores en inversión

Datos

Poly-N y Subs. P

$$N_{\text{Bulk}} = 10^{17} \text{ cm}^{-3}$$

$$V_T = 0.547 \text{ V}$$

$$\gamma^2 = 0.545 \text{ V}$$

$$C'_{\text{OX}} = 246 \text{ nF/cm}^2$$

$$V_{\text{FB}} = -\phi_B = -0.97 \text{ V}$$

Resultados

$$V_{\text{GB}} = 2$$

$$Q'_{\text{p-o}} = 524 \text{ nC/cm}^2$$

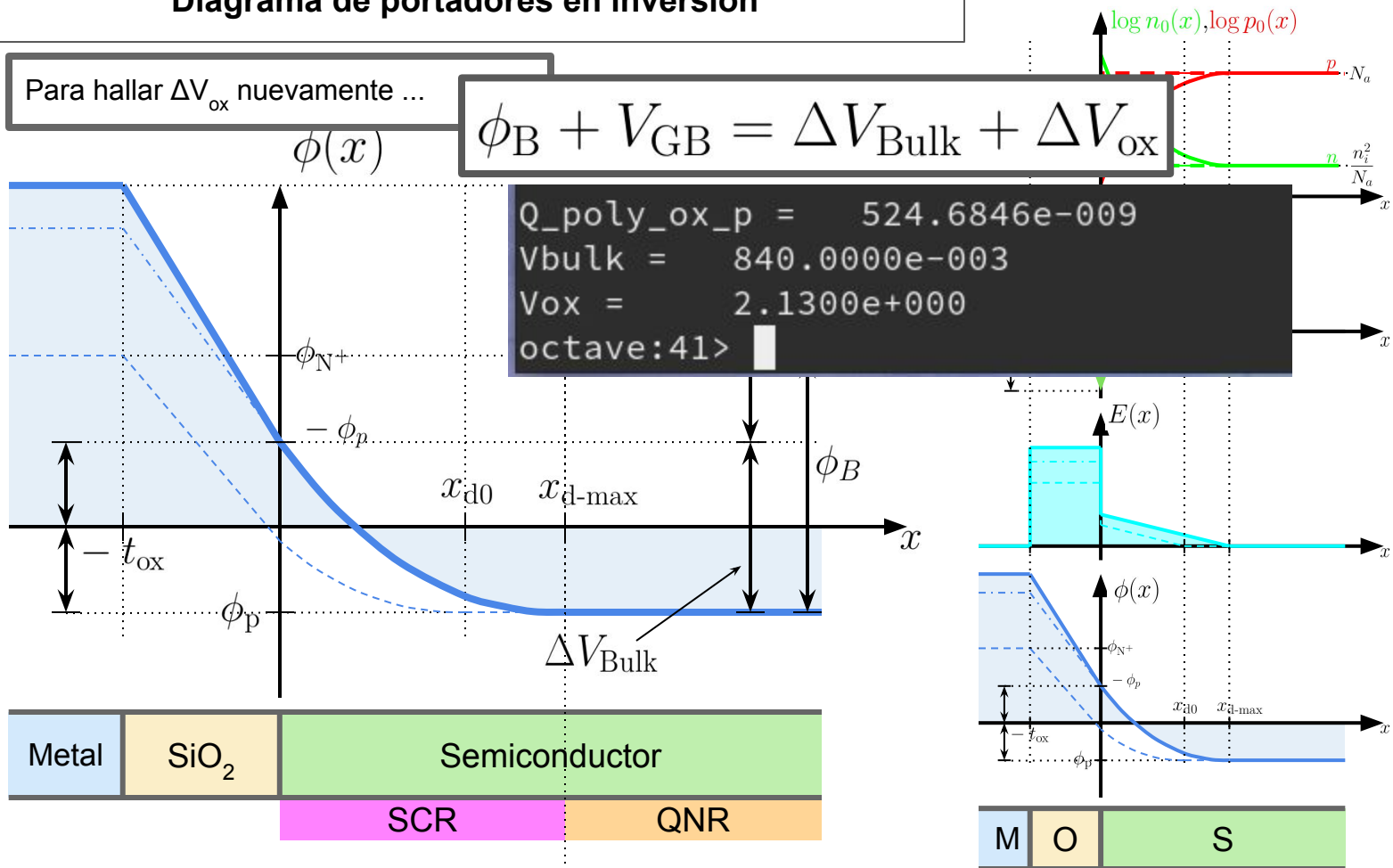
$$\Delta V_{\text{ox}} = 2.13 \text{ V}$$

$$\Delta V_{\text{Bu}} = 840 \text{ mV}$$

Para hallar ΔV_{ox} nuevamente ...

$$\phi_B + V_{\text{GB}} = \Delta V_{\text{Bulk}} + \Delta V_{\text{ox}}$$

```
Q_poly_ox_p = 524.6846e-009
Vbulk = 840.0000e-003
Vox = 2.1300e+000
octave:41>
```



Resultados

V_{GB}	-2	V_{FB}	0	V_T	2
Q'_{o-s}	-253 nC/cm ²	0	125 nC/cm ²	166 nC/cm ²	524 nC/cm ²
ΔV_{ox}	1.03 V	0	506 mV	677 mV	2.13 V
ΔV_{Bu}	0	0	464 mV	840 mV	840 mV

Todos los casos juntos

