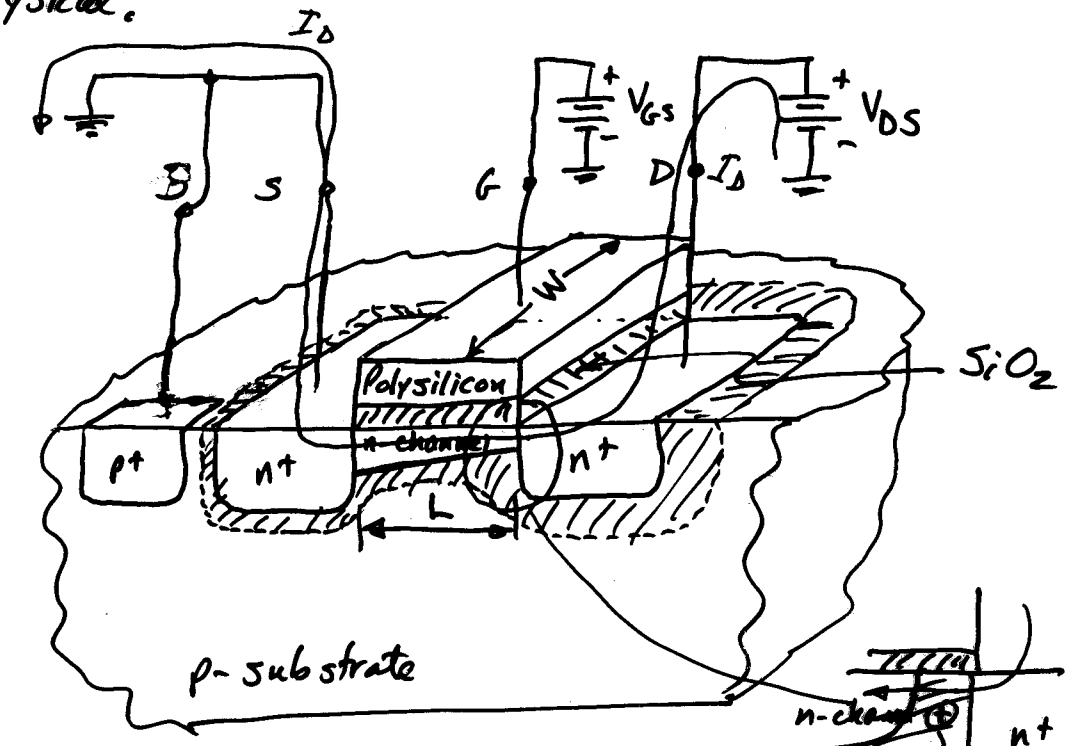
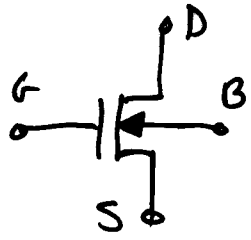
MOSFET TRANSISTOR

NMOS Structure

Physical:



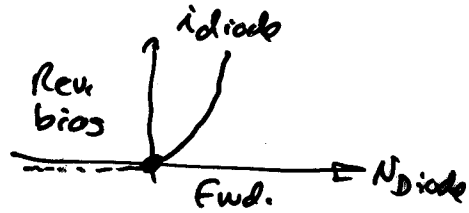
Symbol:



Operation:

1.) When $V_{GS} > V_T$ (threshold voltage) a channel forms underneath the polysilicon.

2.) If $V_{DS} > 0$, then a current I_D flows.



Comments:

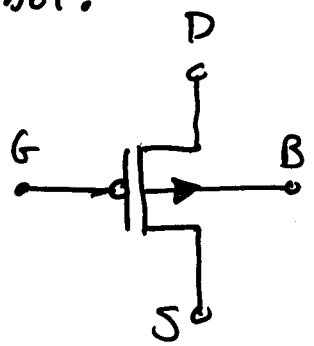
1.) Depletion region due to the pn junction isolates the transistor from others in the same substrate.

2.) Drain and source are interchangeable.

PMOS Transistor

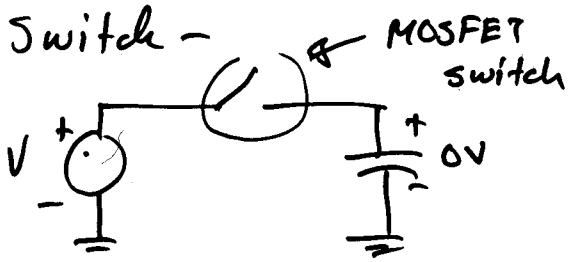
Physical: Use the same diagram as for NMOS but reverse polarities and dopings.

Symbol:



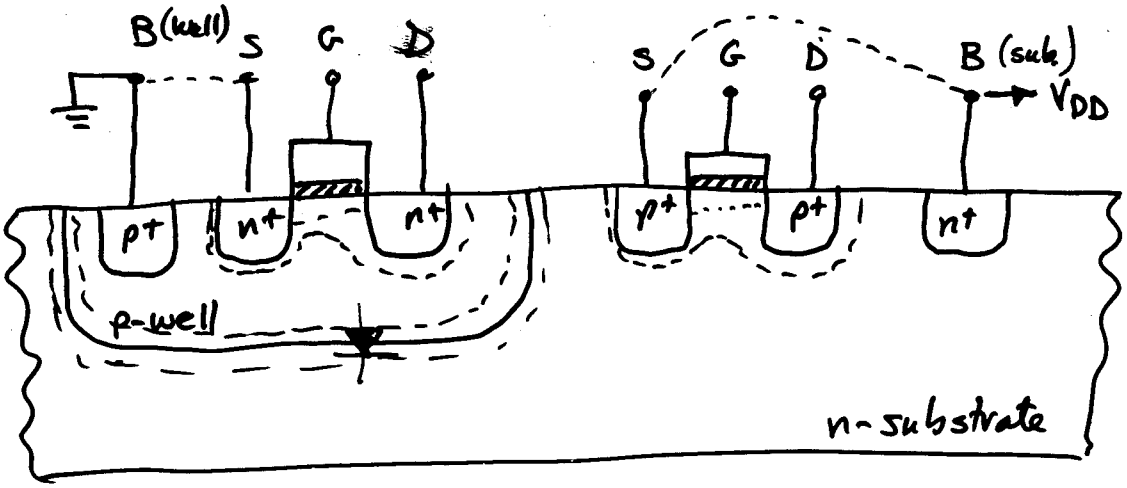
NMOS:
D is larger potential
S is smaller "

PMOS:
D is smaller potential
S is larger "



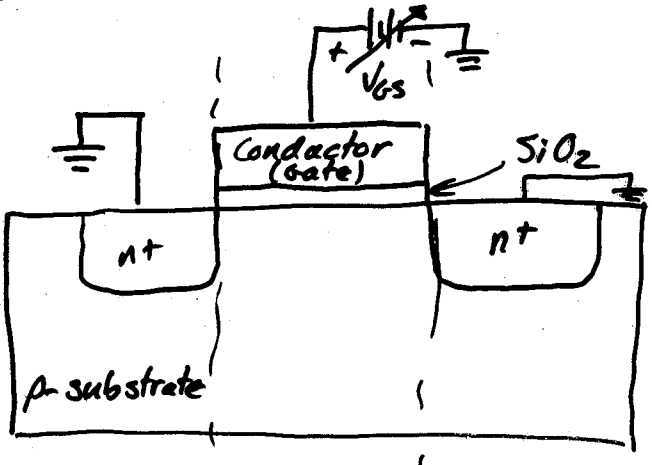
CMOS Transistors

Physical:



THRESHOLD VOLTAGE OF THE MOS TRANSISTOR

What happens as V_{GS} increases from zero?

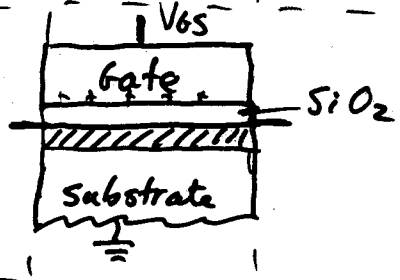


$V_{GS}<0$

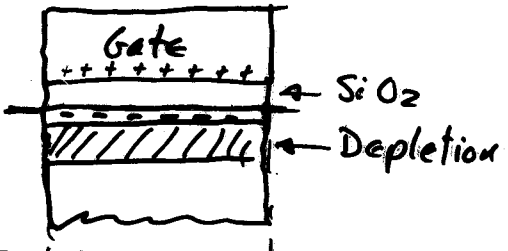
Accumulation

0V

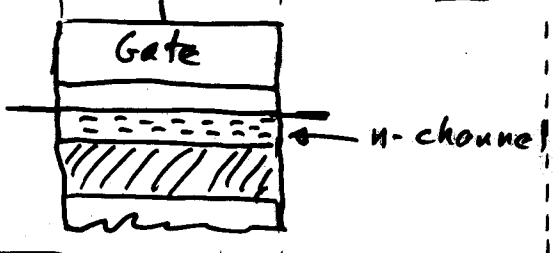
1.) A depletion region forms under the gate. There are no holes, only negatively charged atoms.



2.) A thin layer of mobile electrons appear at the surface of the silicon.
(Weak inversion)

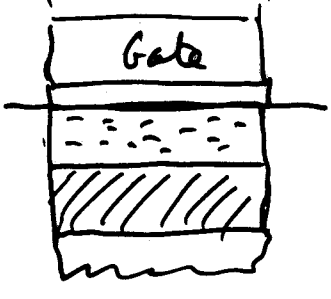


3.) Finally, the mobile electron concentration equals the mobile hole concentration in the semiconductor (substrate). $V_{GS}=V_T$
(Strong inversion)



4.) Further increases simply increase the channel depth and the electron concentration is much greater than the hole concentration.

V_{GS} increase



NEXT —
Components that make up the V_T.