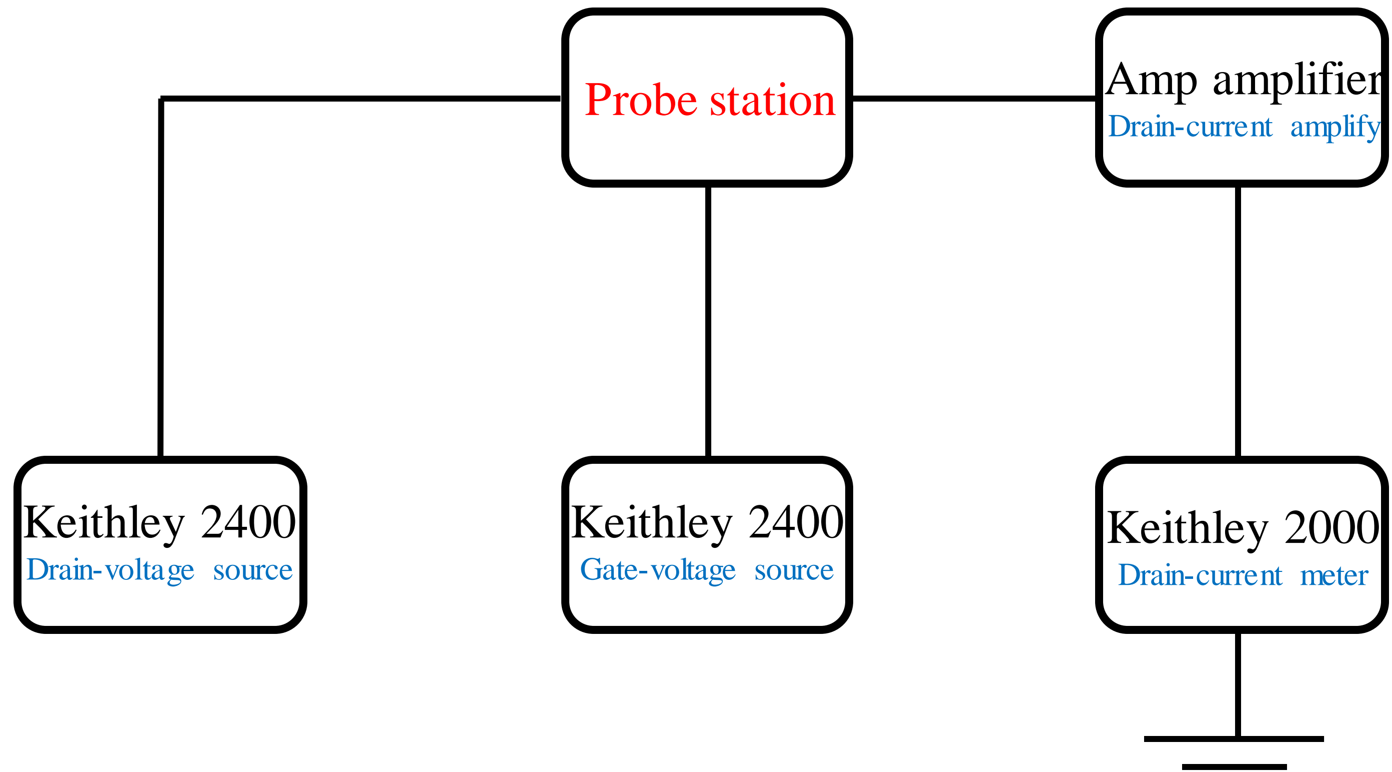
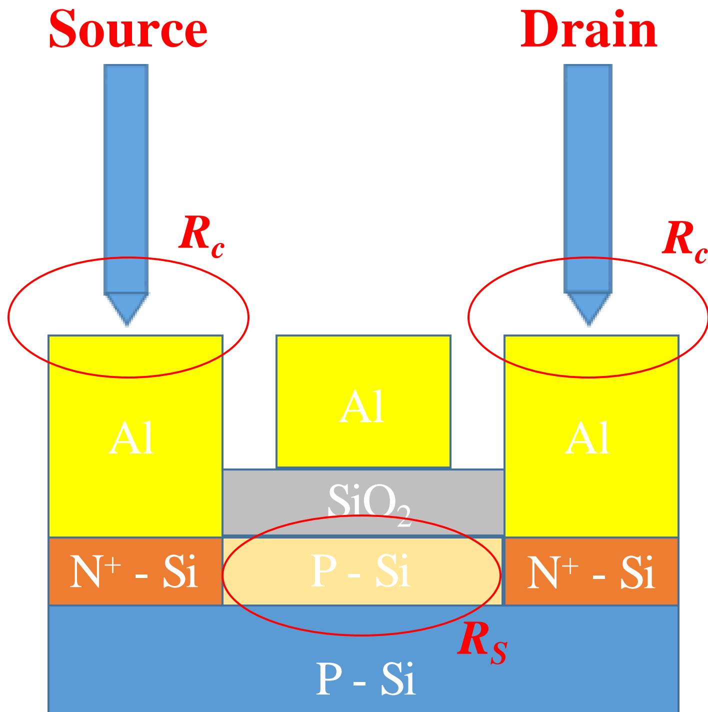
量測系統示意圖



二點探針量測 (Two-probe measurement)

N-type MOSFET



Total Resistance $= R_{total} = 2R_c + R_s + R_p$

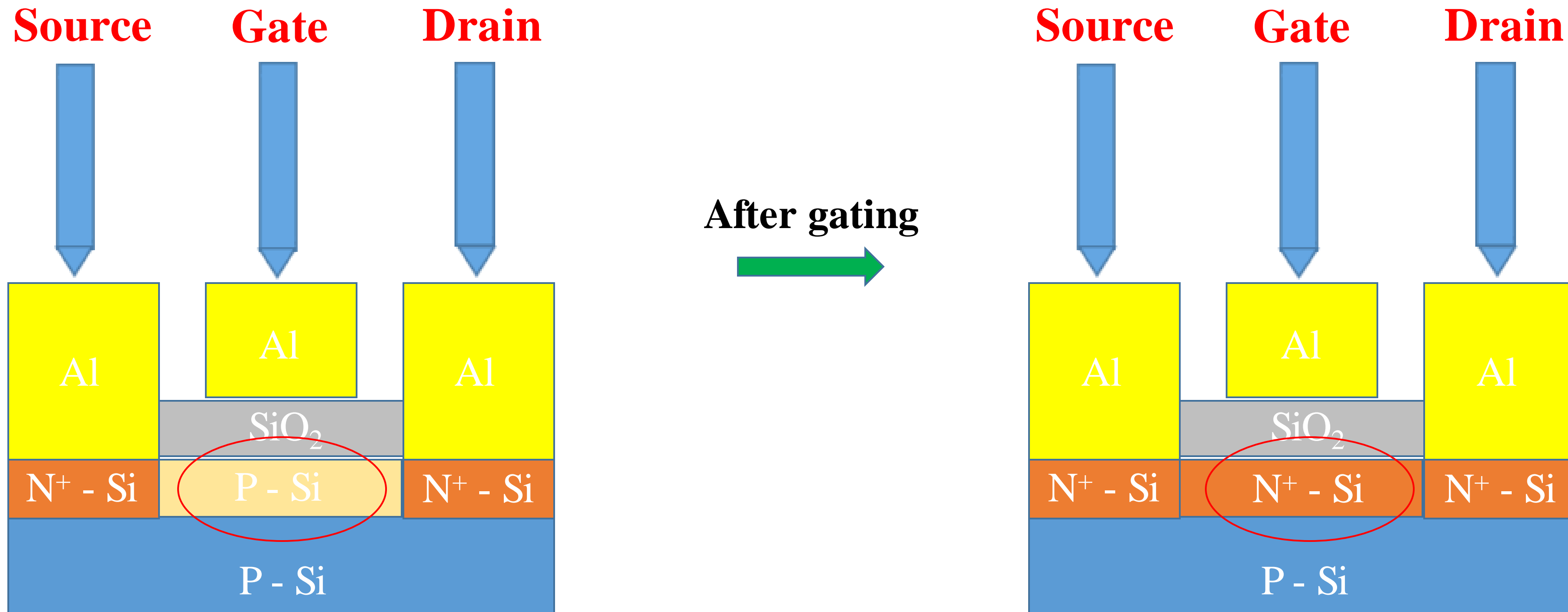
R_c = Contact resistance

R_s = Sample(Channel) resistance (P - Si)

R_p = Probe resistance (Probe, Al, N^+ - Si)

$V_{drain} = I_{drain} R_{total}$

MOSFET量測

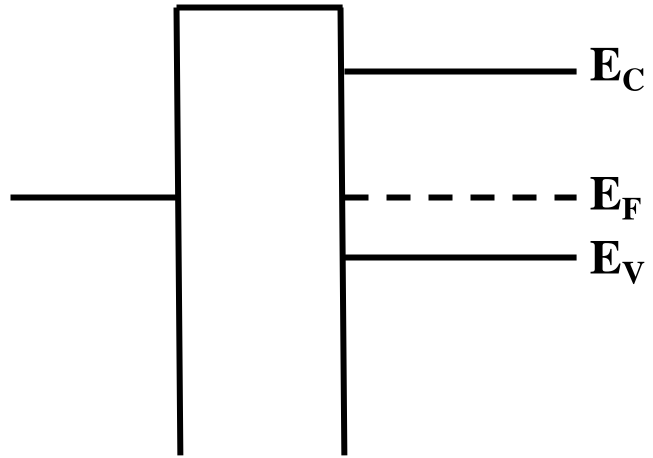


Flat-band

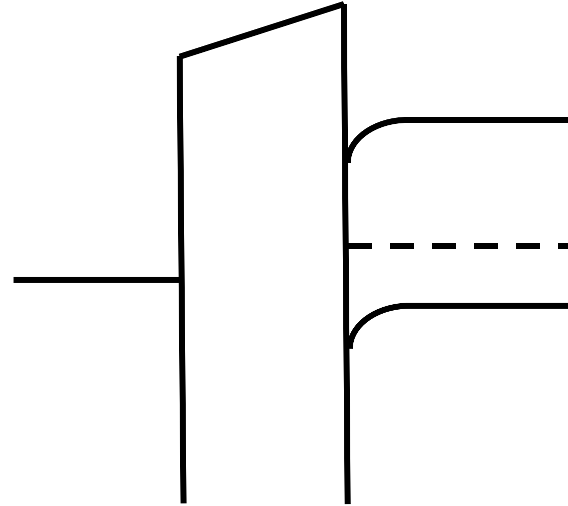
V_g induce band bending

Strong inversion (P to N^+)

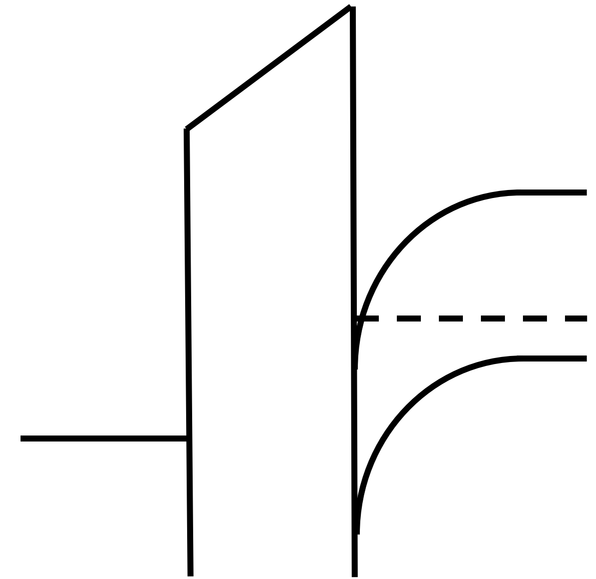
Metal (Al) **Oxide (SiO_2)** **Semi. (P - Si)**

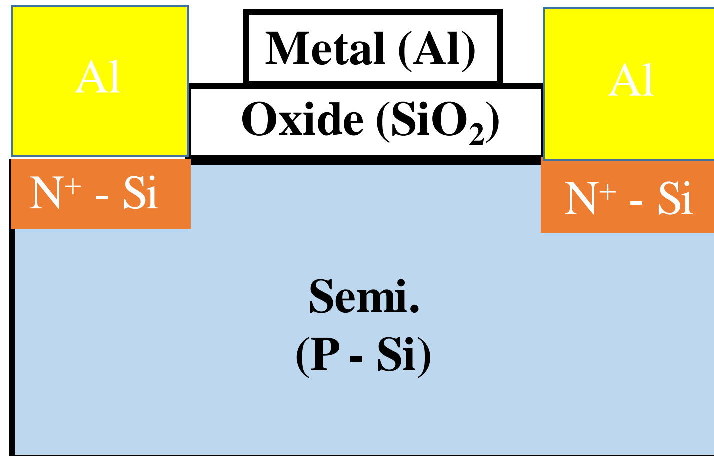


$V_g > 0$

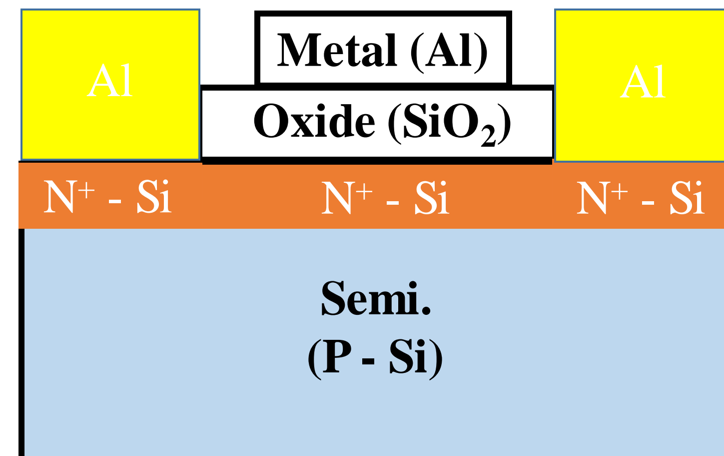


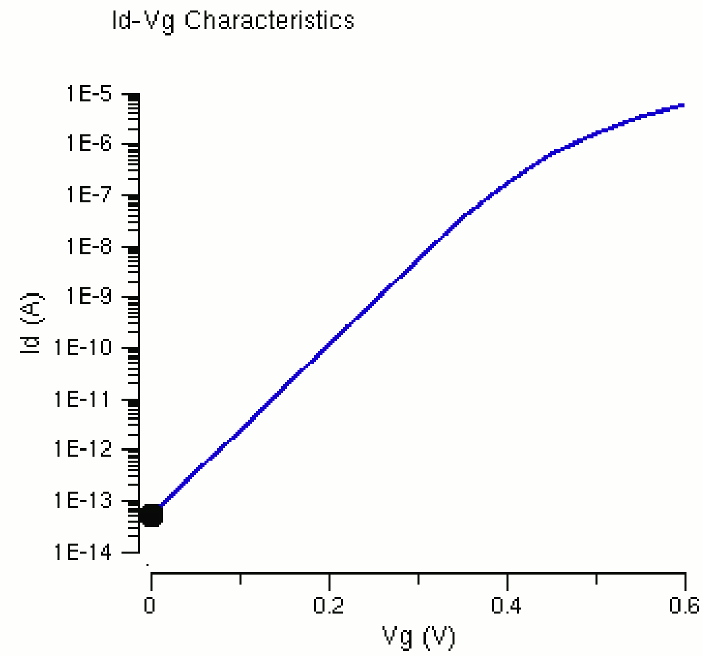
$V_g > V_{th}$

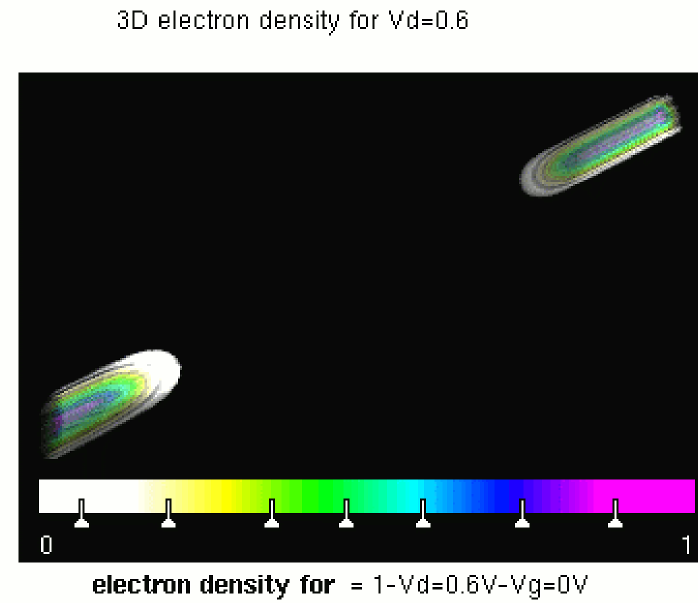




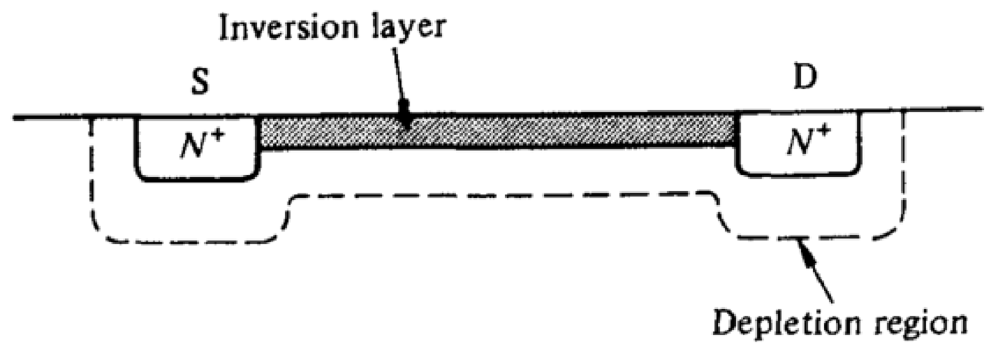
$V_g > V_{th}$

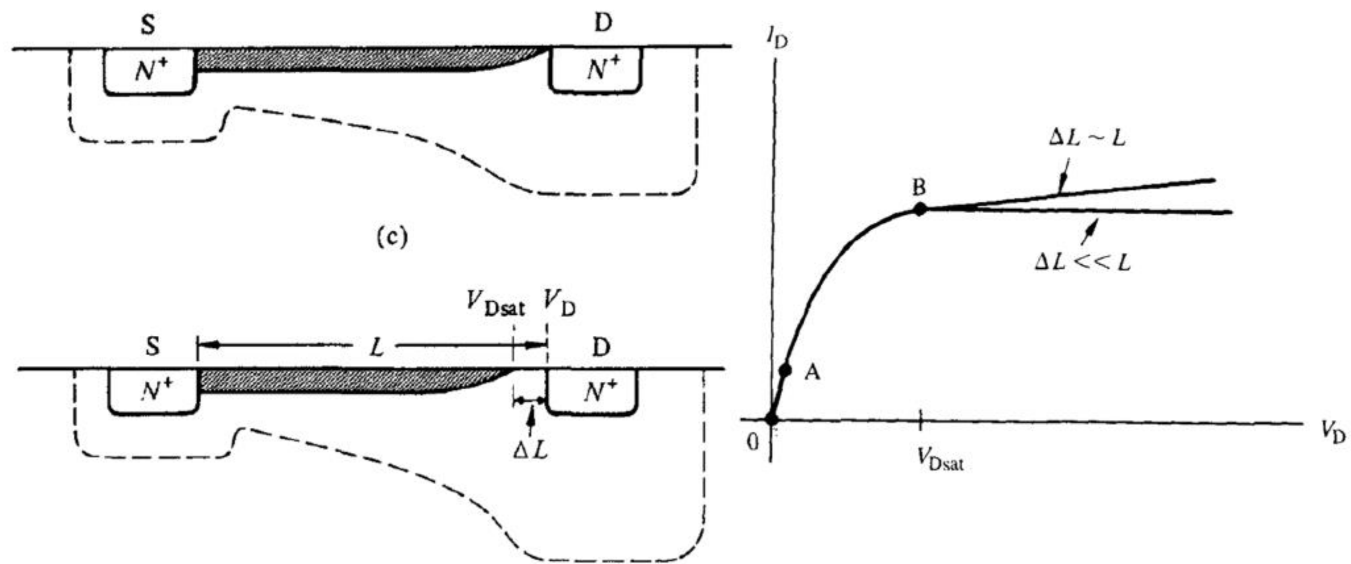






https://en.wikipedia.org/wiki/MOSFET

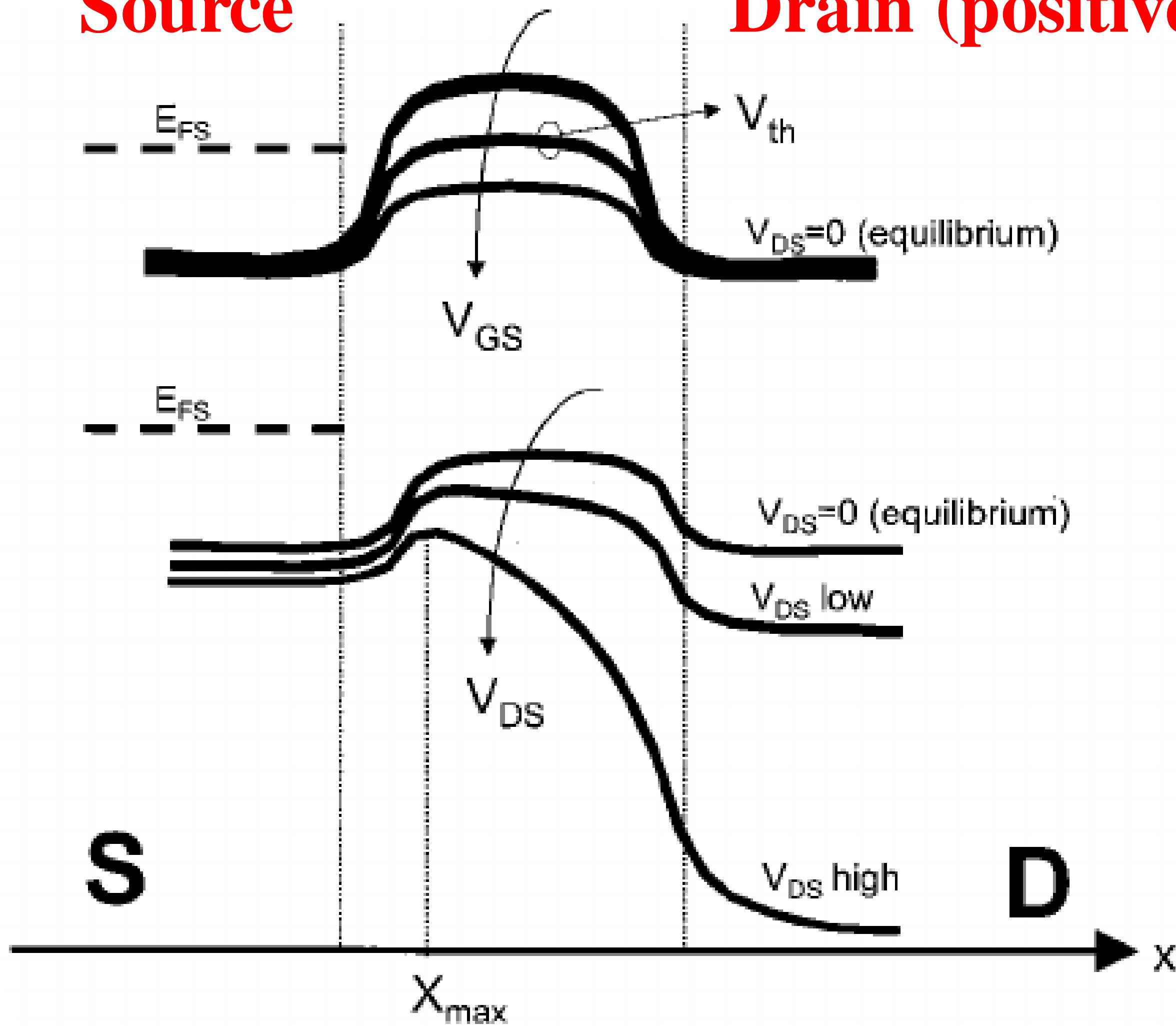

Inversion layer
S
D
N^+
N^+
Depletion region

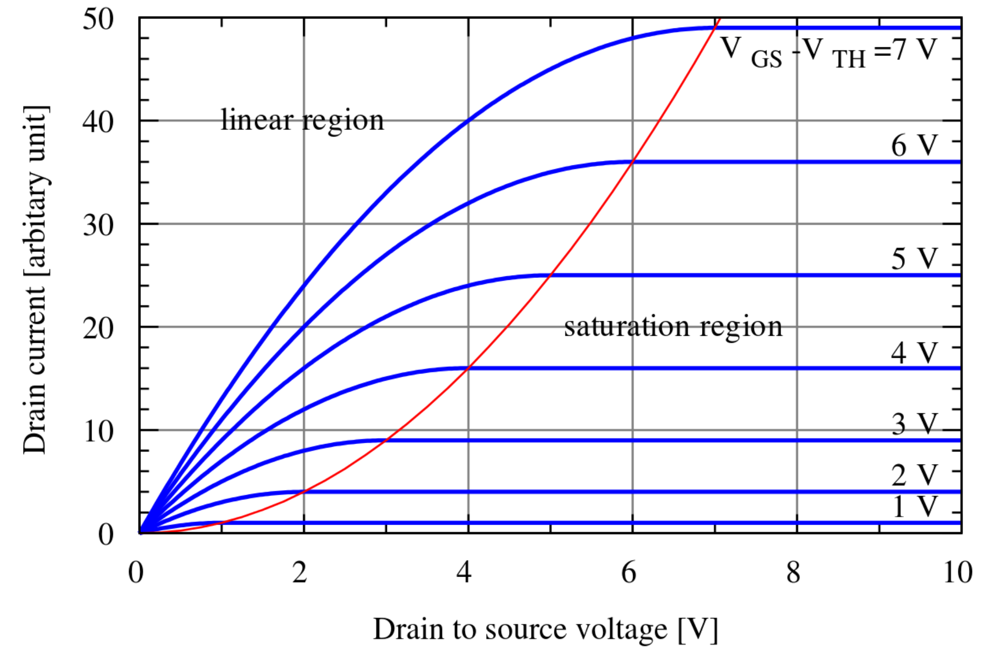

S
D
N^+
N^+
(c)
V_{Dsat} V_D
S
L
D
N^+
N^+
ΔL
I_D
$\Delta L \sim L$
B
$\Delta L << L$
A
0
V_{Dsat}
V_D

NMOS
Channel

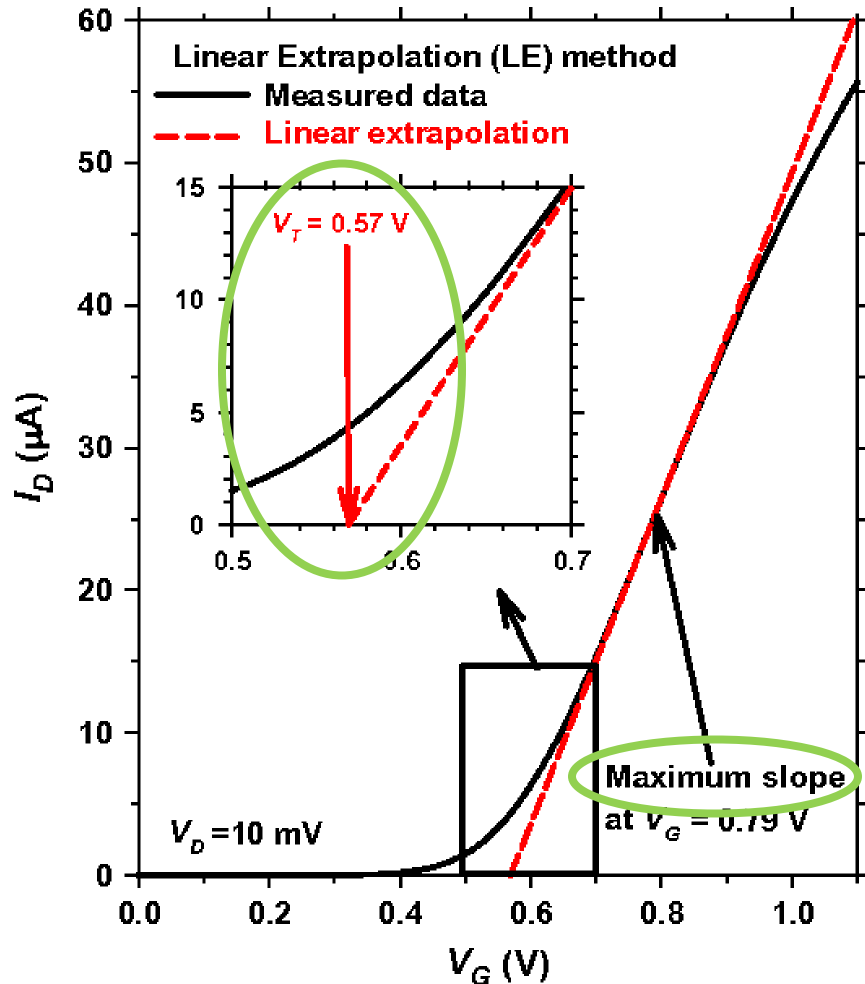
Source

Drain (positive bias)





Threshold voltage and Carrier mobility



Carrier mobility $= \mu = [dI_D/dV_G][L/(WC_iV_D)]$

dI_D/dV_G = Maximum slope

L/W = Channel length/width

V_D = Drain voltage

C_i = Capacitance ($C_i = \varepsilon_0\varepsilon_r/d$; $\varepsilon_r = 3.9$; $d = 100$ nm)

Unit of mobility = $cm^2\ V^{-1}\ s^{-1}$

https://www.semanticscholar.org/paper/Revisiting-MOSFET-threshold-voltage-extraction-Ortiz-Conde-Garc%C3%ADa-S%C3%A1nchez/e0fe6cc5e7b7841f16cbb149fd98b6e1179e5057

	Wet Oxide	Ion Implantation	Dry Oxide	Channel length/width
製程參數	SiO_2 : 500 nm	As : 1E15 cm^2 / 10 keV B : 1E15 cm^2 / 10 kev	SiO_2 : 100 nm	40 μm / 20 μm