Section 28
MOS Electrostatics & MOScap

28.2 Band diagram in equilibrium and with bias => MOScap

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School of Electrical and Computer Engineering

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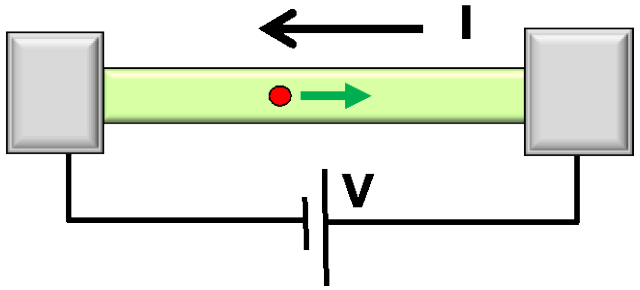
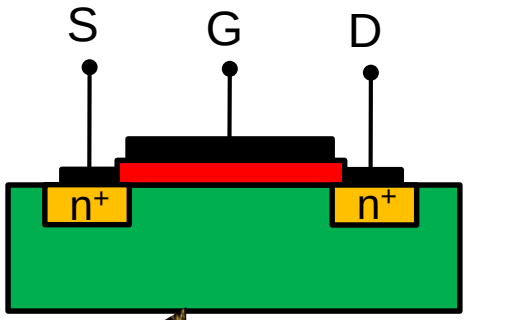


$$I = G \times V$$
$$= q \times n \times v \times A$$

charge density velocity area



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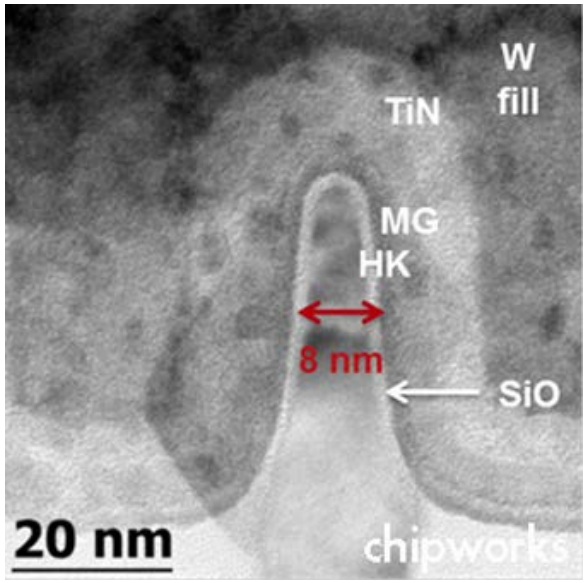
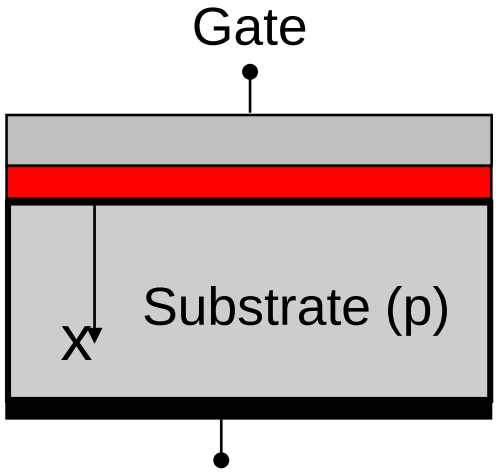
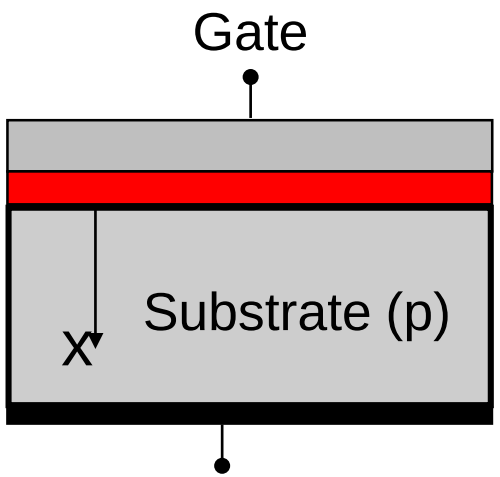


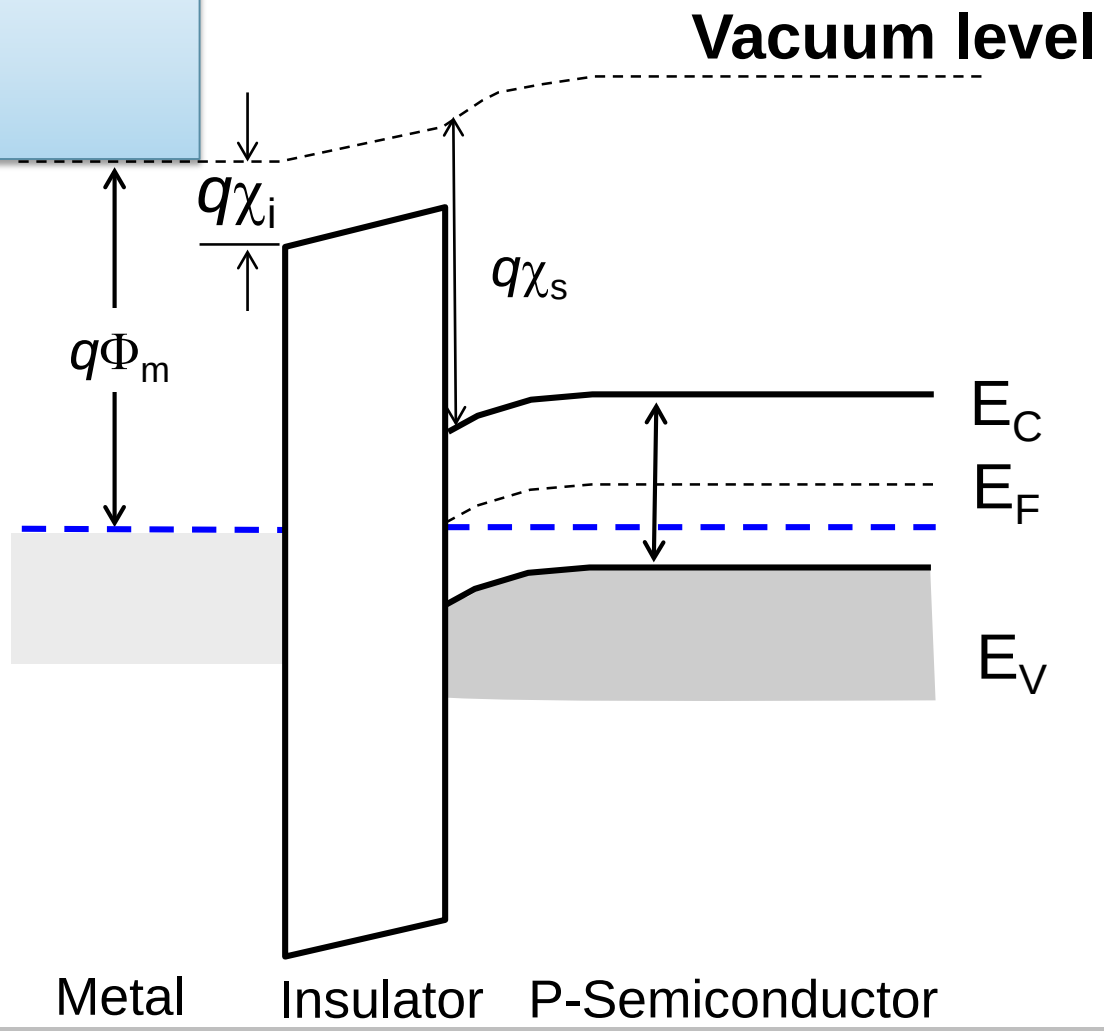


REF: Chapters 15-18 from SDF

Electrostatics of MOS Capacitor in Equilibrium

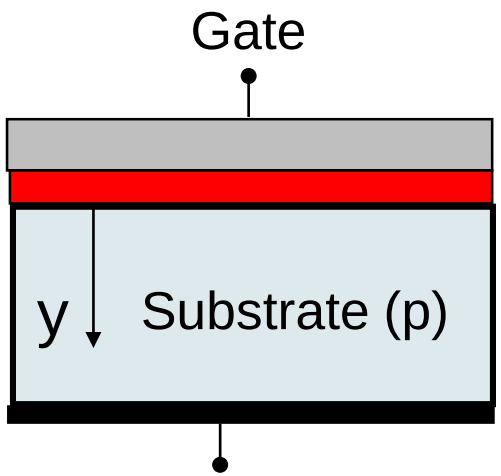
No charge in insulator
→ No band bending;
SiO2 band gap: 9eV

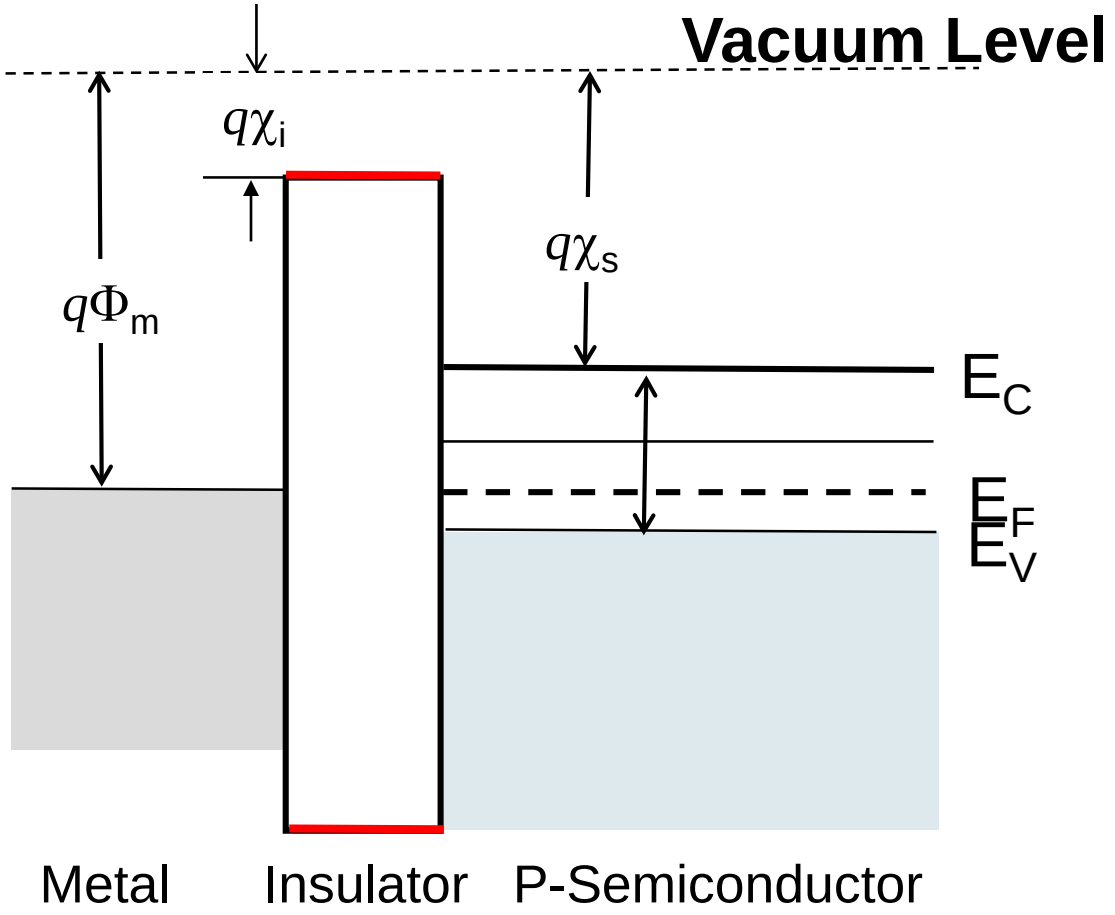




Schottky barrier with an interposed dielectric

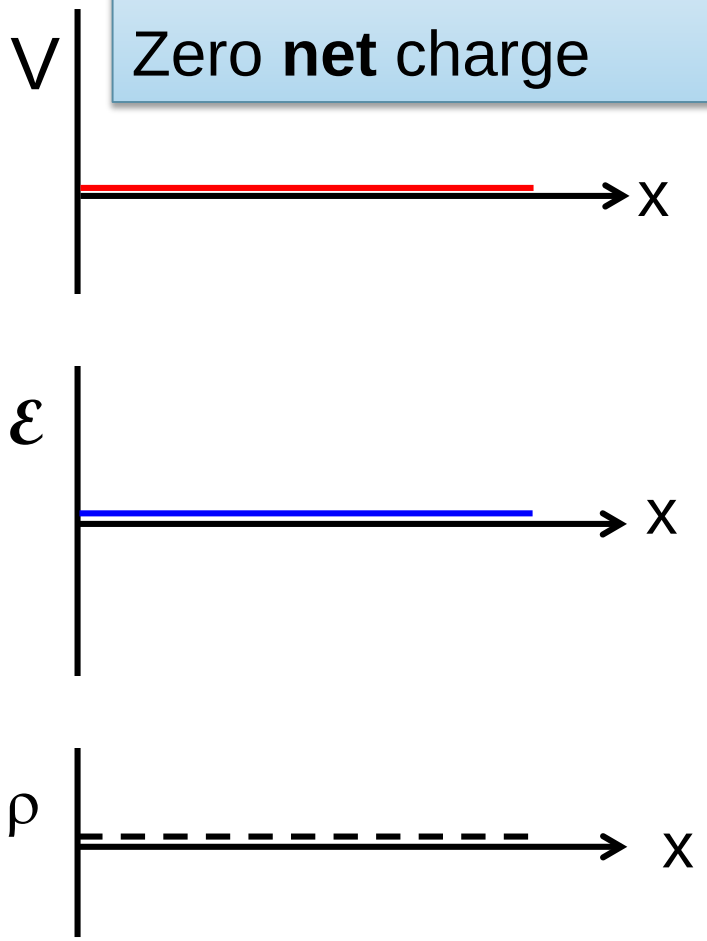
Idealized MOS Capacitor

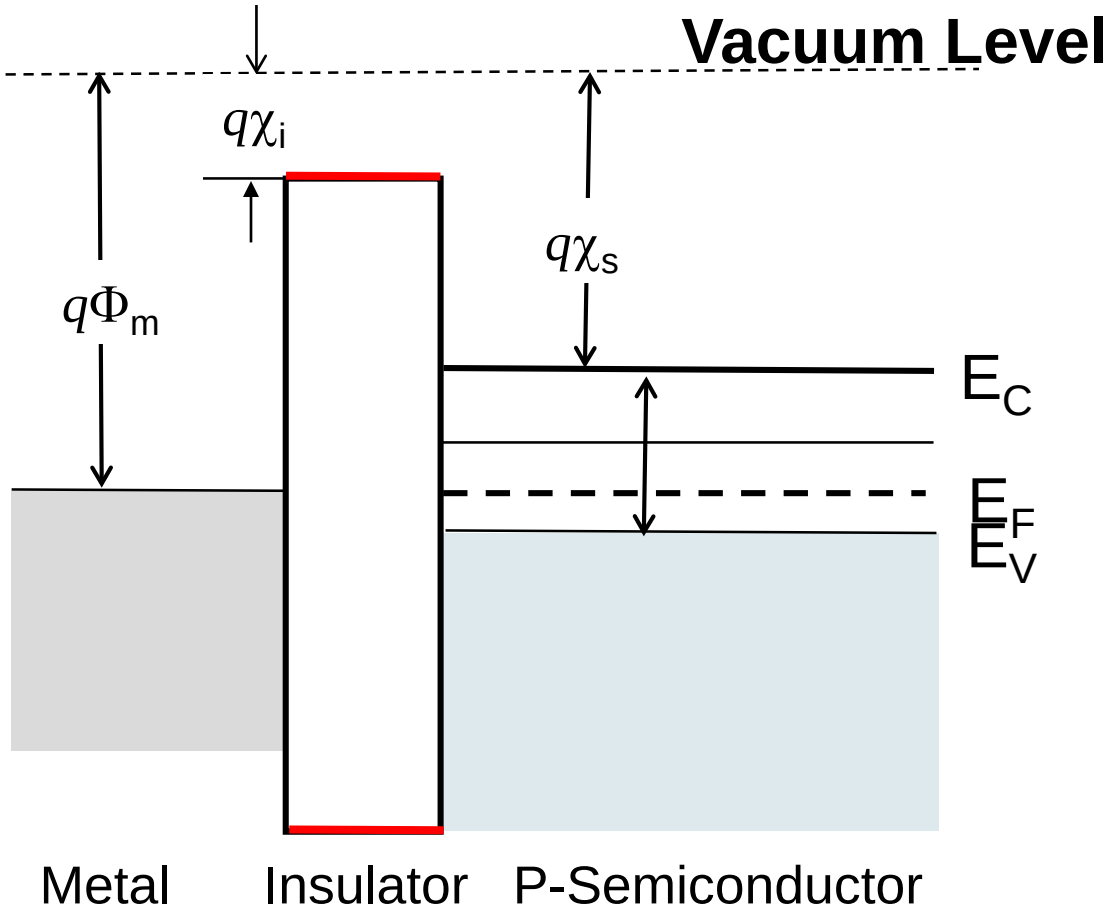




Potential, Field, Charges

Constant potential;
zero electric field
Zero **net** charge





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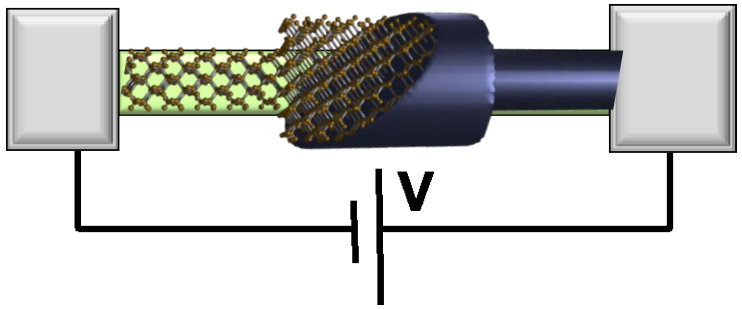
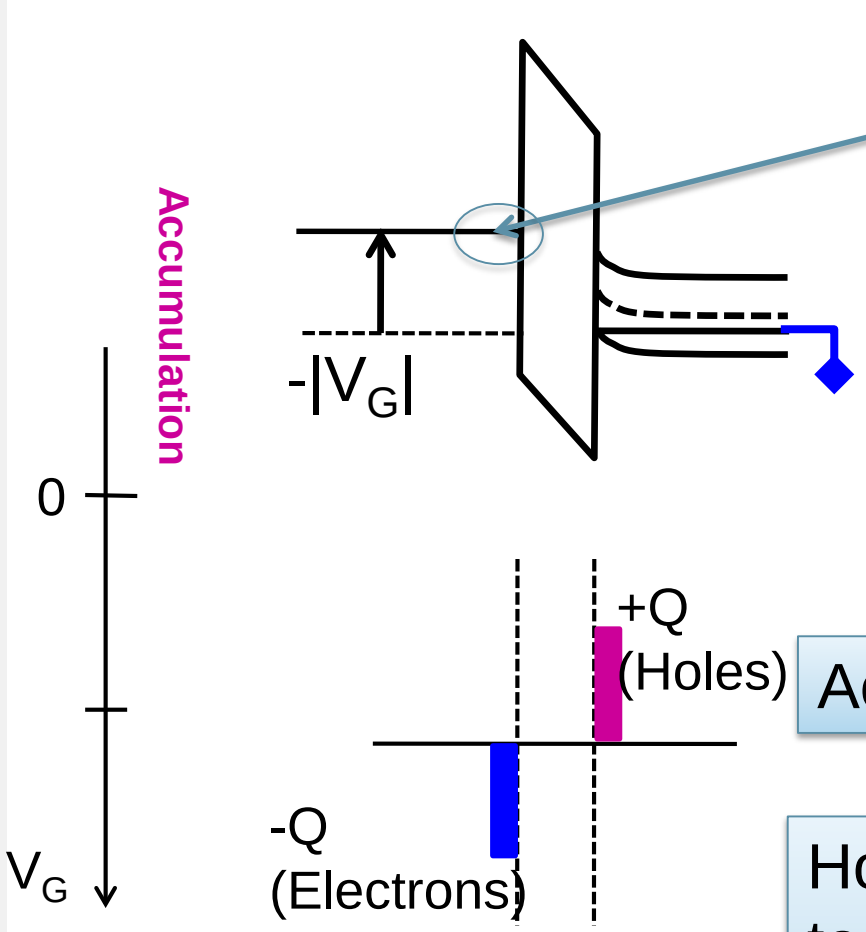


$$I = G \times V$$
$$= q \times n \times v \times A$$

charge density, velocity, area

	Equilibrium	DC	Small signal	Large Signal	Circuits
PN Diode					
Schottky Diode					
BJT/ HBT					
MOScap					

Electrostatics under Bias



Invisible band bending at metal side because of large DOS

Negative bias
Band bending
Flat Ef → no current

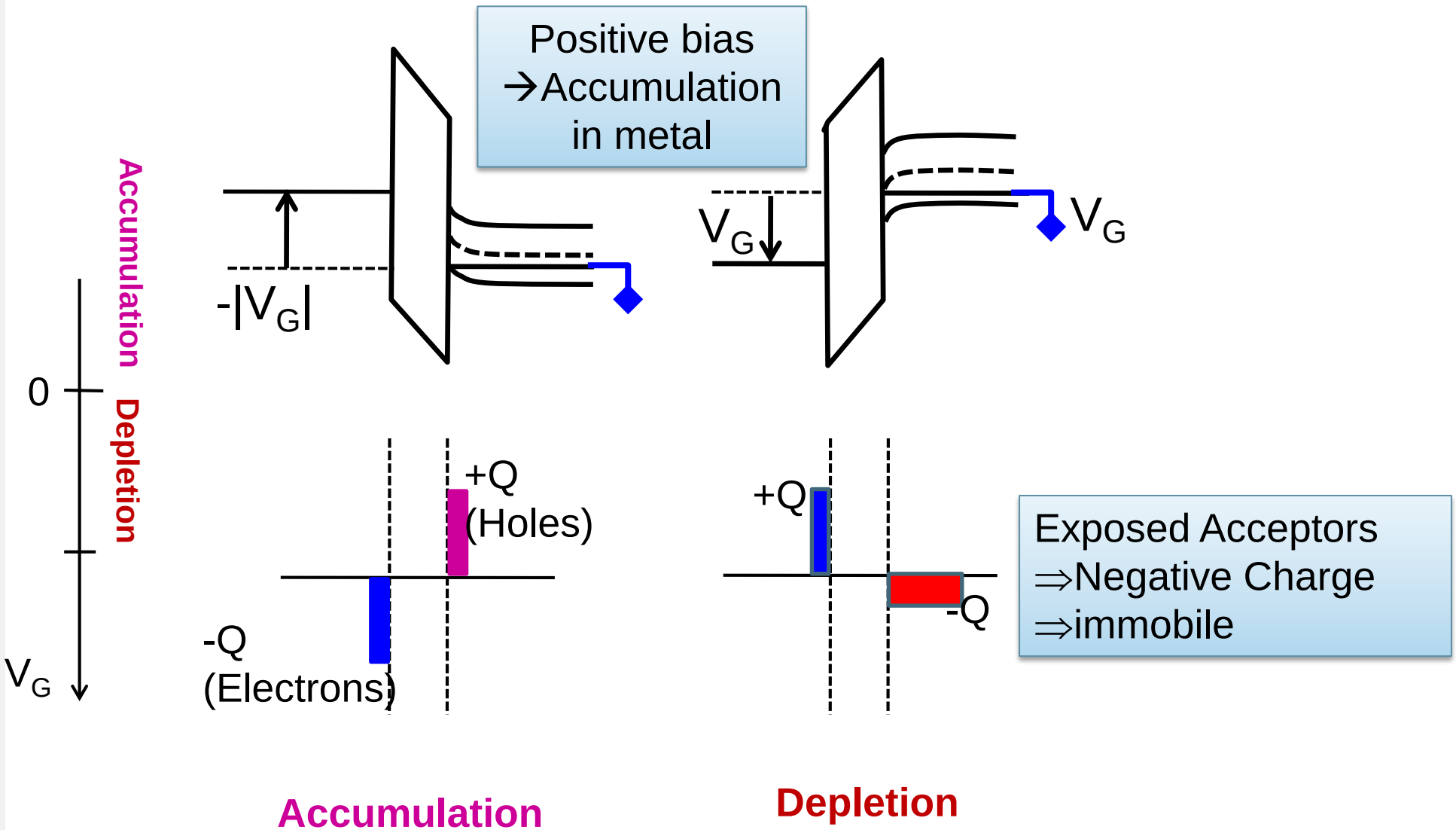
$j = n \mu dE_f/dx$

Accumulation

Holes are generated due to band bending/ Valence band come closer to Ef

Accumulation

Electrostatics under Bias



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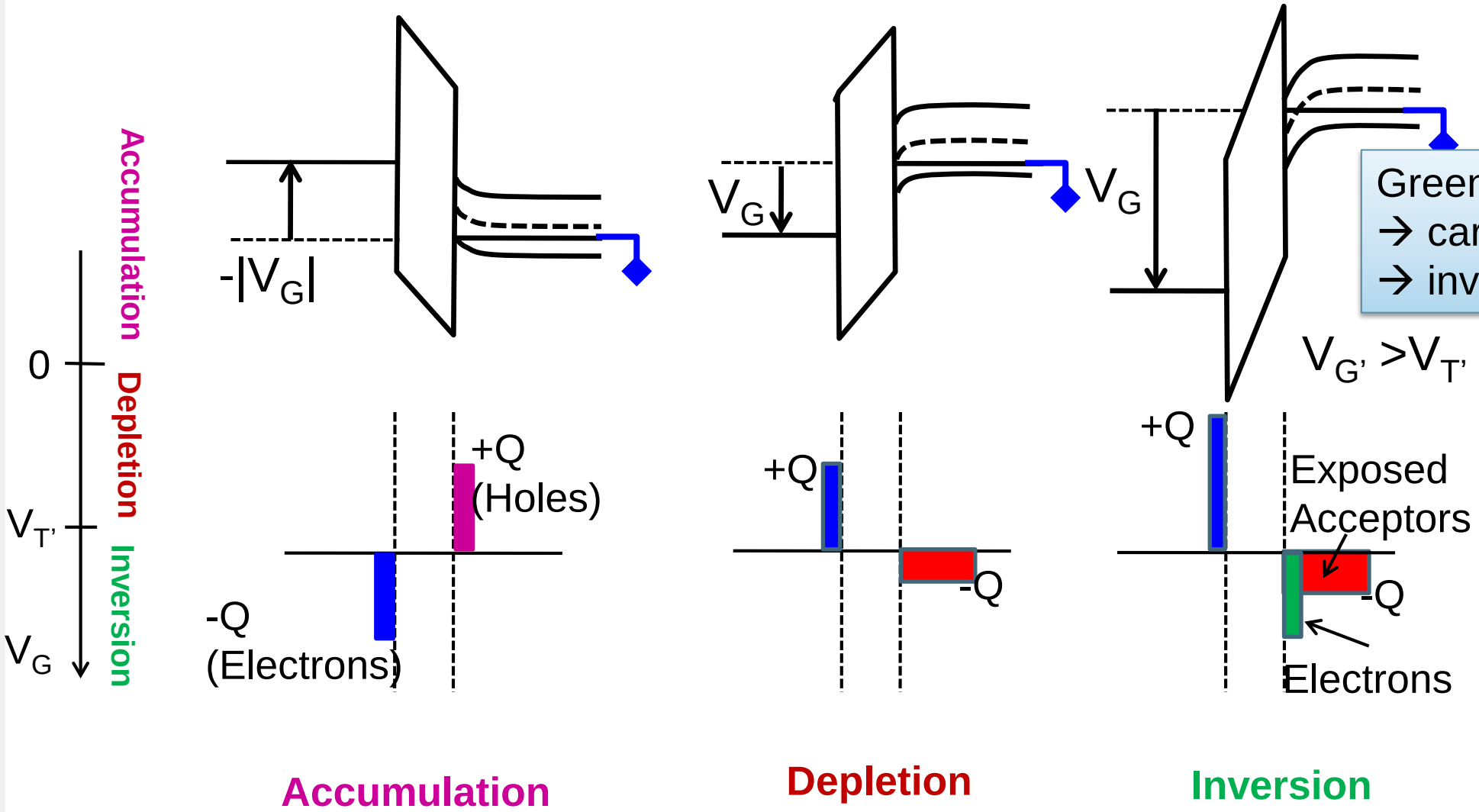

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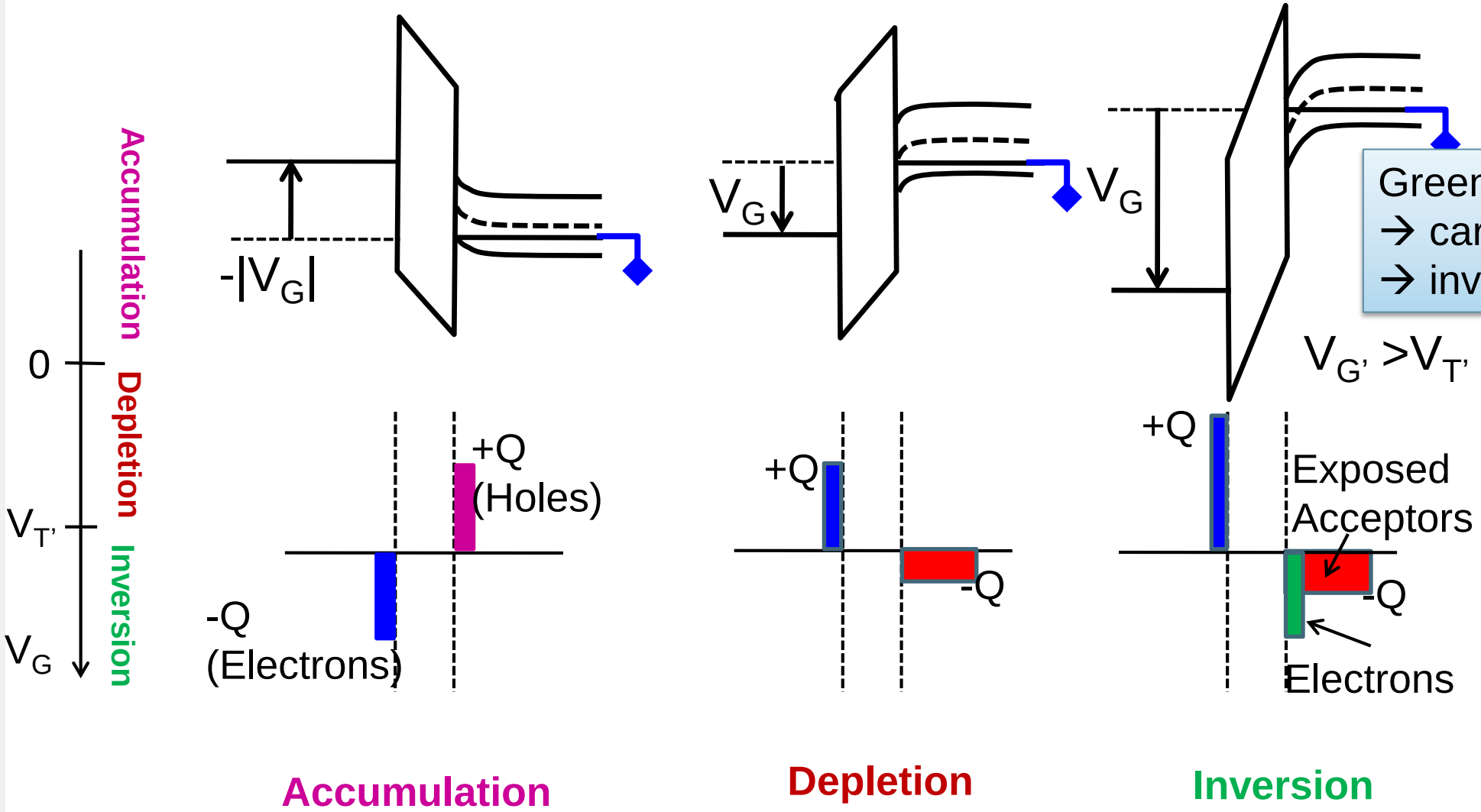
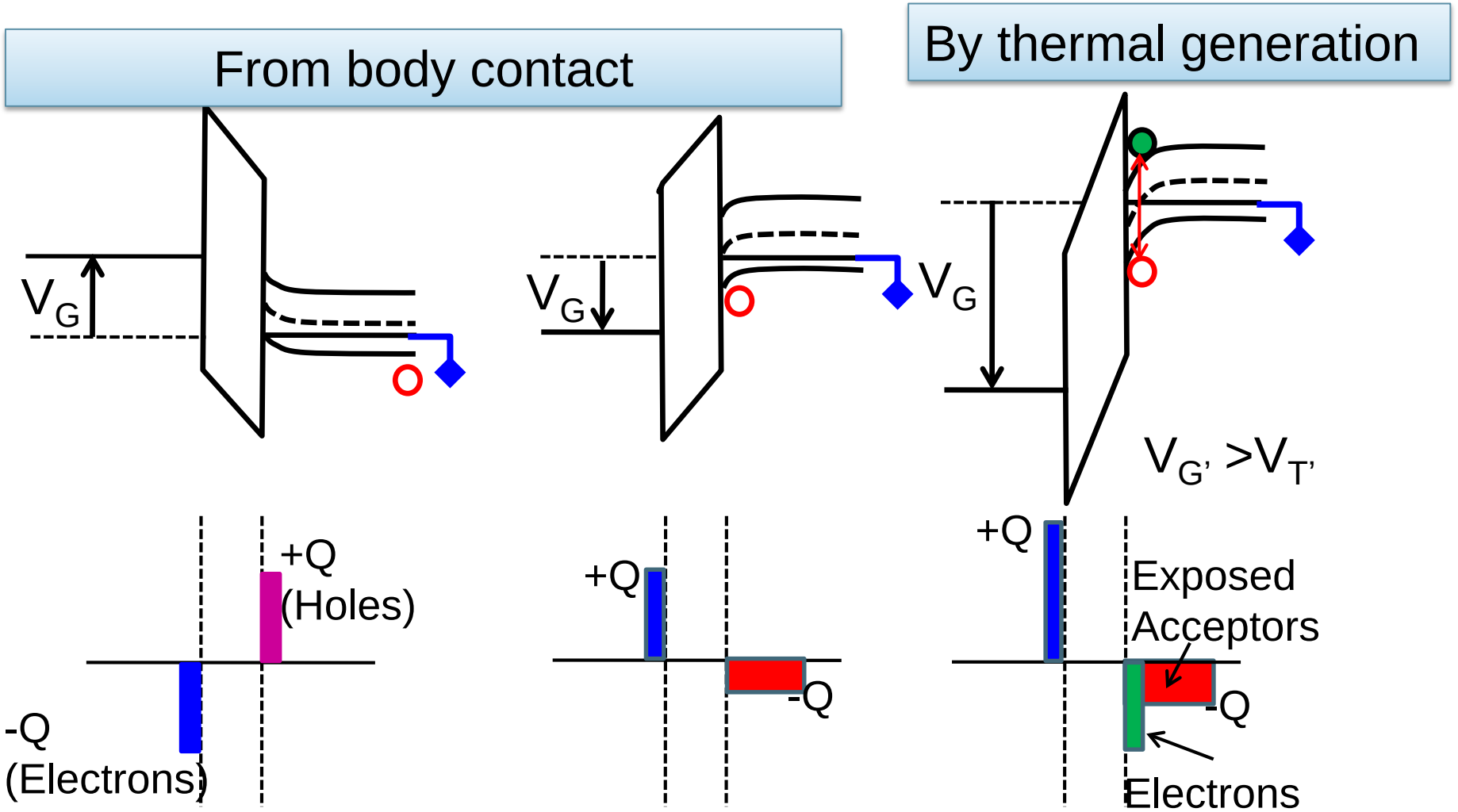
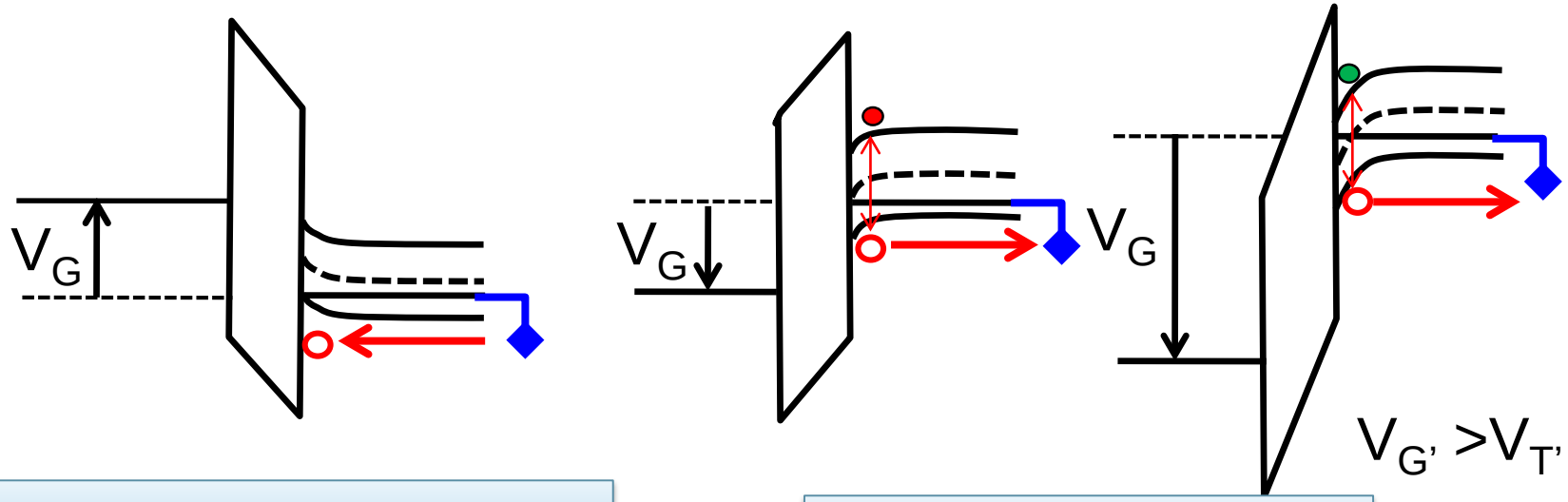


Where do charges come from?



- Integrate charge to find potential.

Response Time



Fast as sigma is large

Slower process

Dielectric Relaxation

SRH Recombination-Generation

$$\tau = \frac{\sigma}{\kappa_s \varepsilon_0}$$

$$R = \frac{np - n_i^2}{\tau_n (p + p_1) + \tau_p (n + n_1)} \rightarrow \frac{-n_i}{\tau_n + \tau_p}$$

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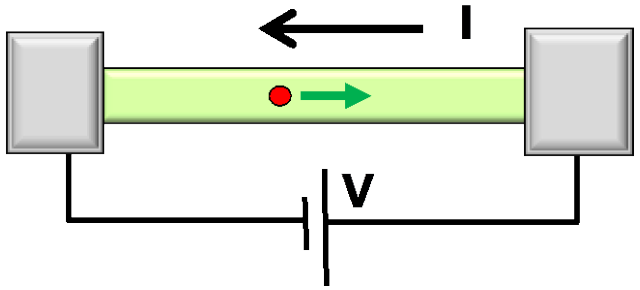

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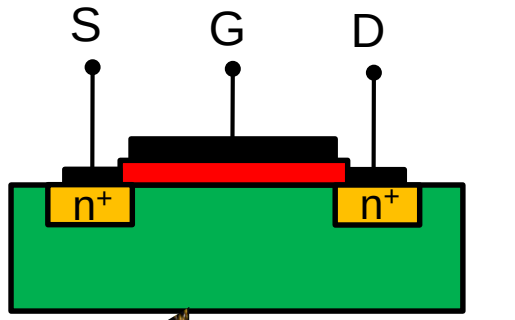

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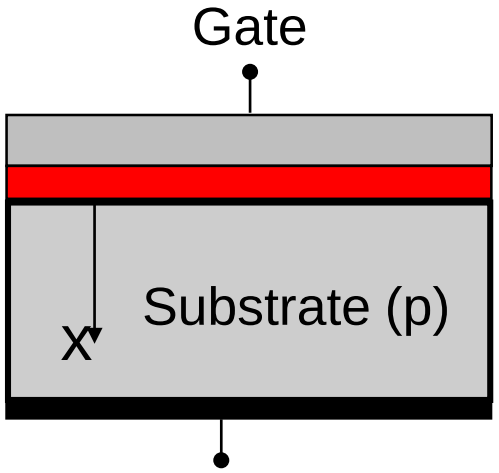

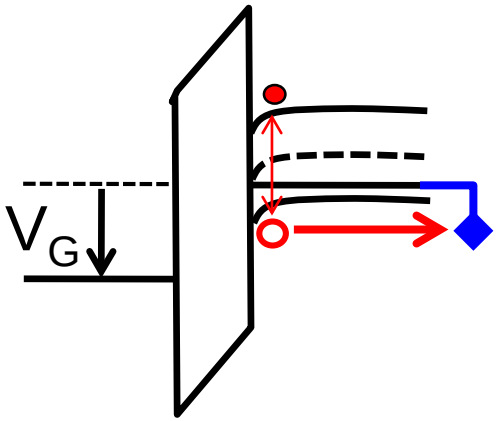

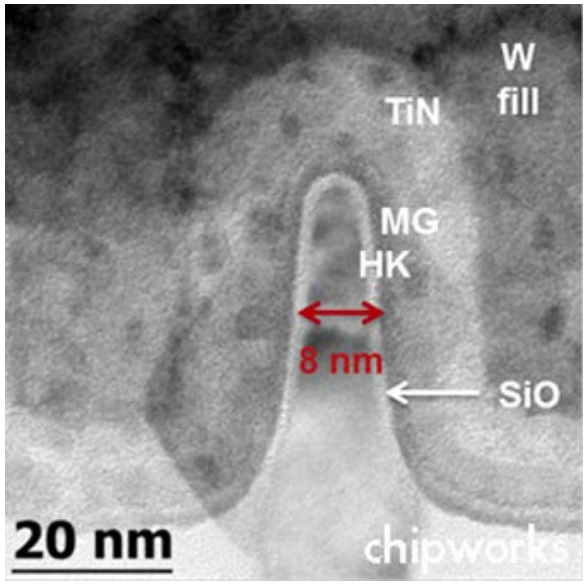

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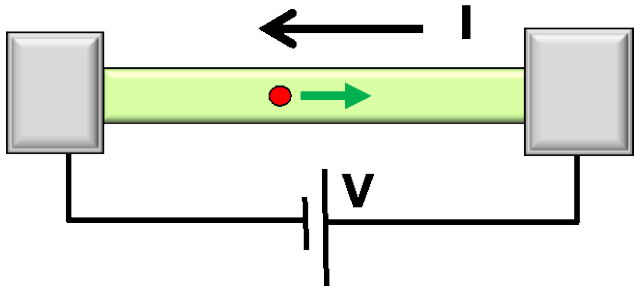

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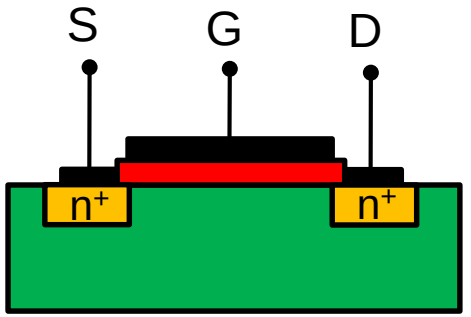

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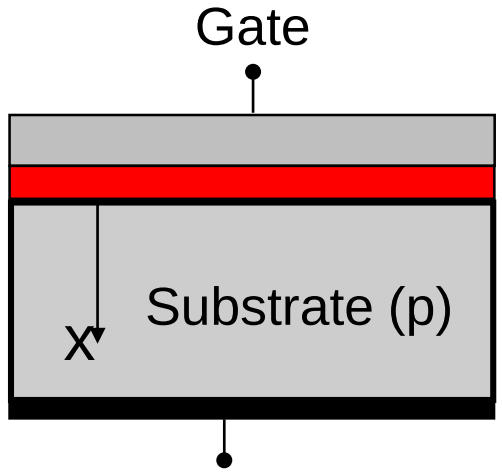

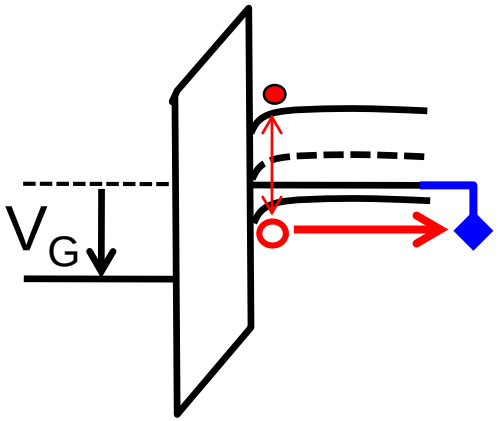

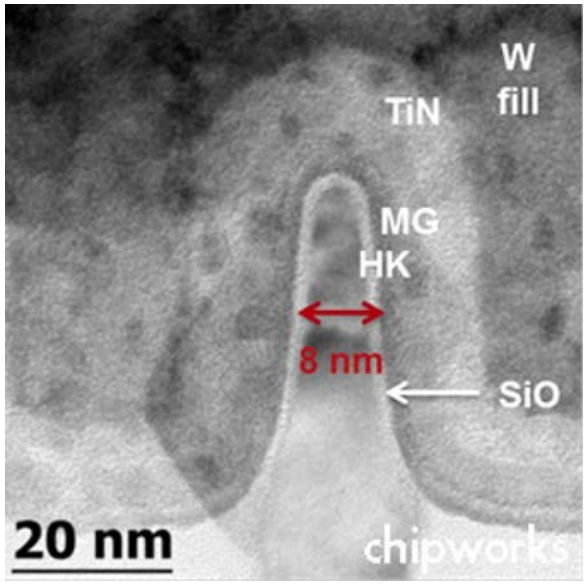

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