



Lecture

PN Junction: Minority Carrier

Distributions

Vincent Chang

Outline

Zero Bias

- Thermal equilibrium

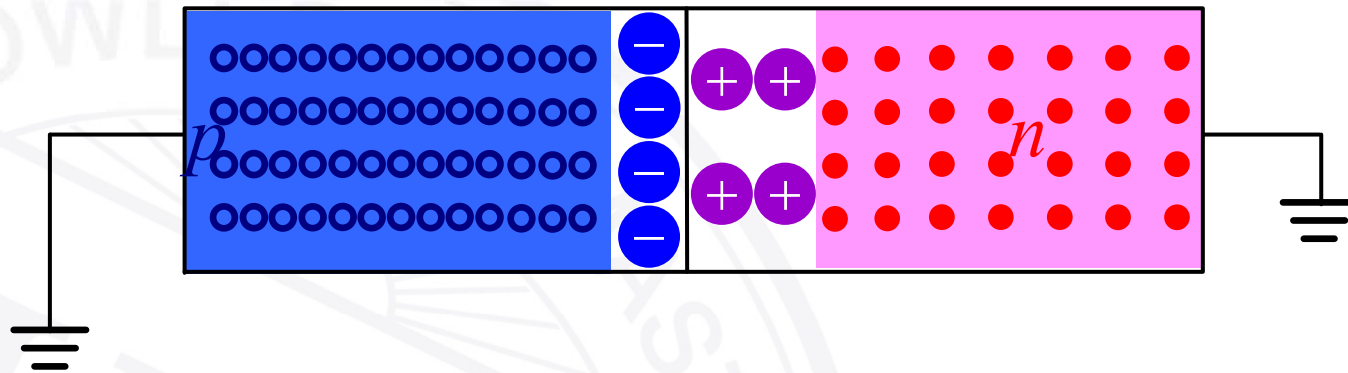
Forward Bias

- Physical meaning
- Distribution

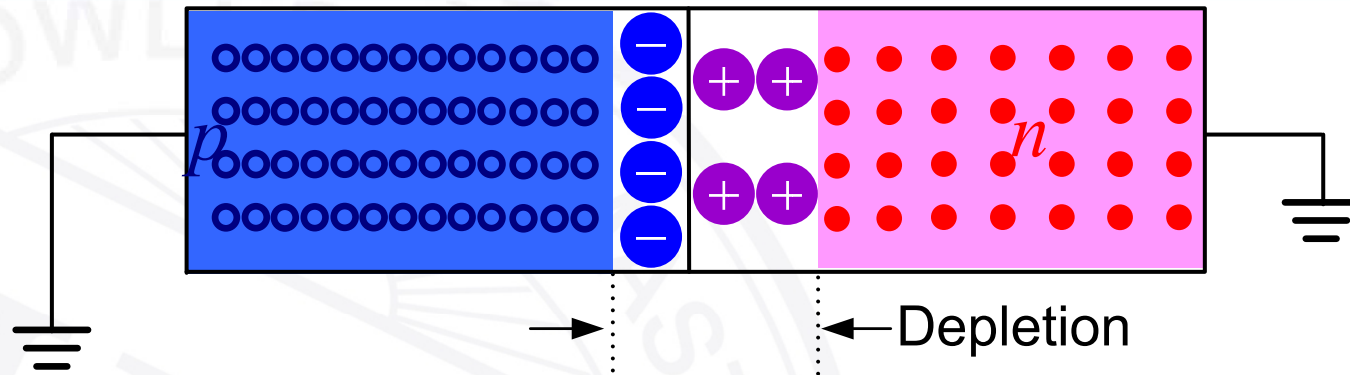
Reverse Bias

- Distribution
- Saturation current

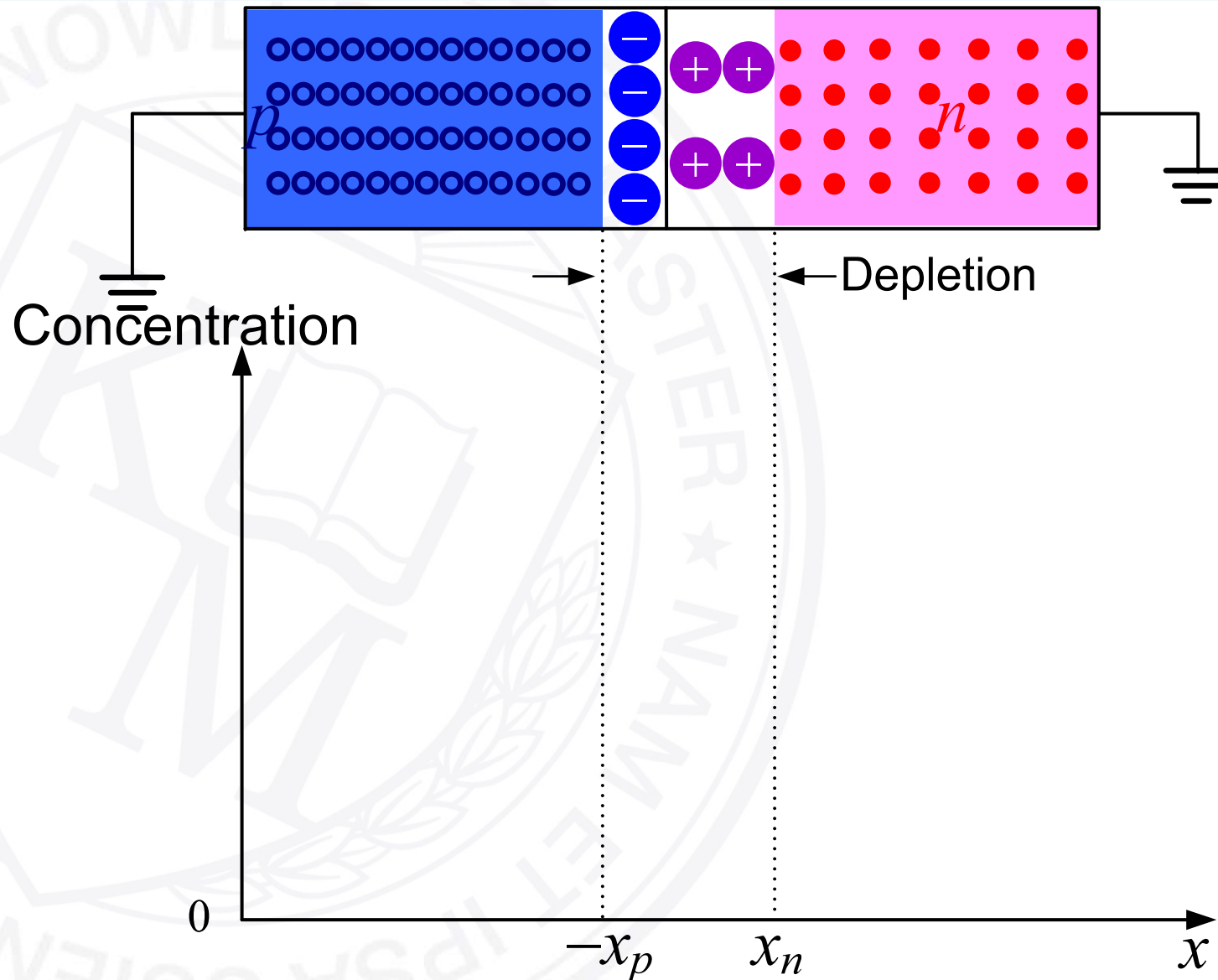
Minority Carrier Distribution—Zero Bias



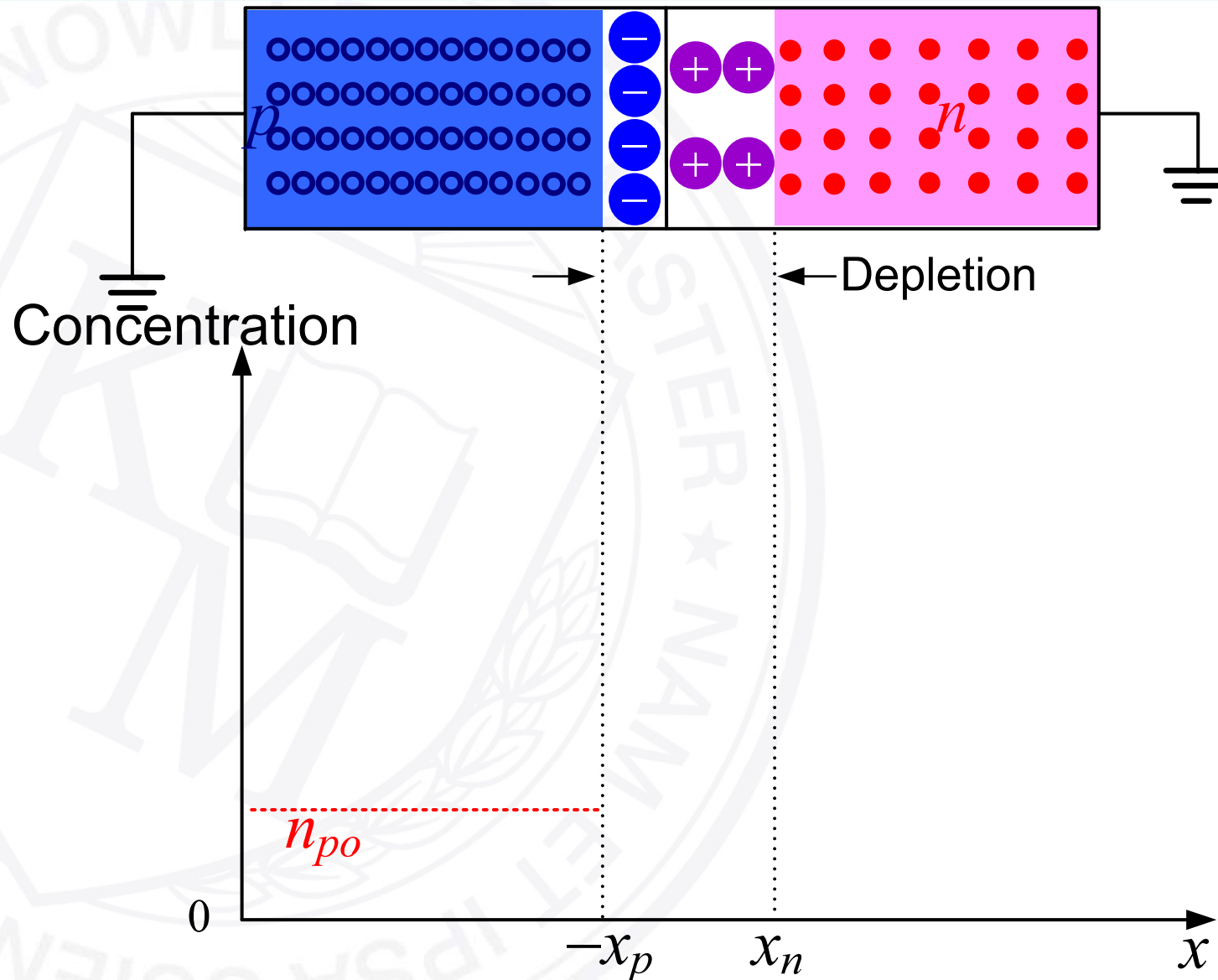
Minority Carrier Distribution—Zero Bias



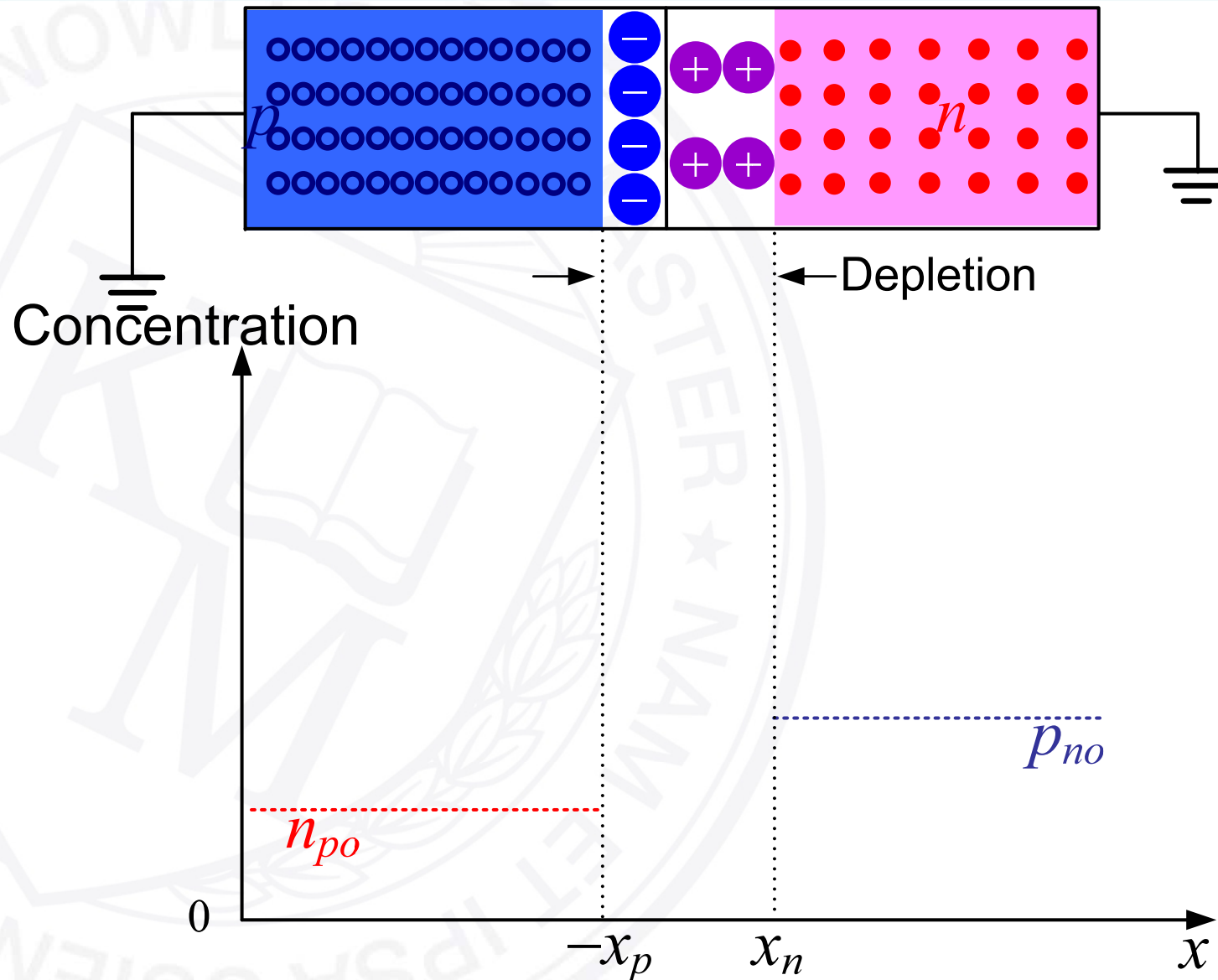
Minority Carrier Distribution—Zero Bias



Minority Carrier Distribution—Zero Bias



Minority Carrier Distribution—Zero Bias



Outline

Zero Bias

- Thermal equilibrium

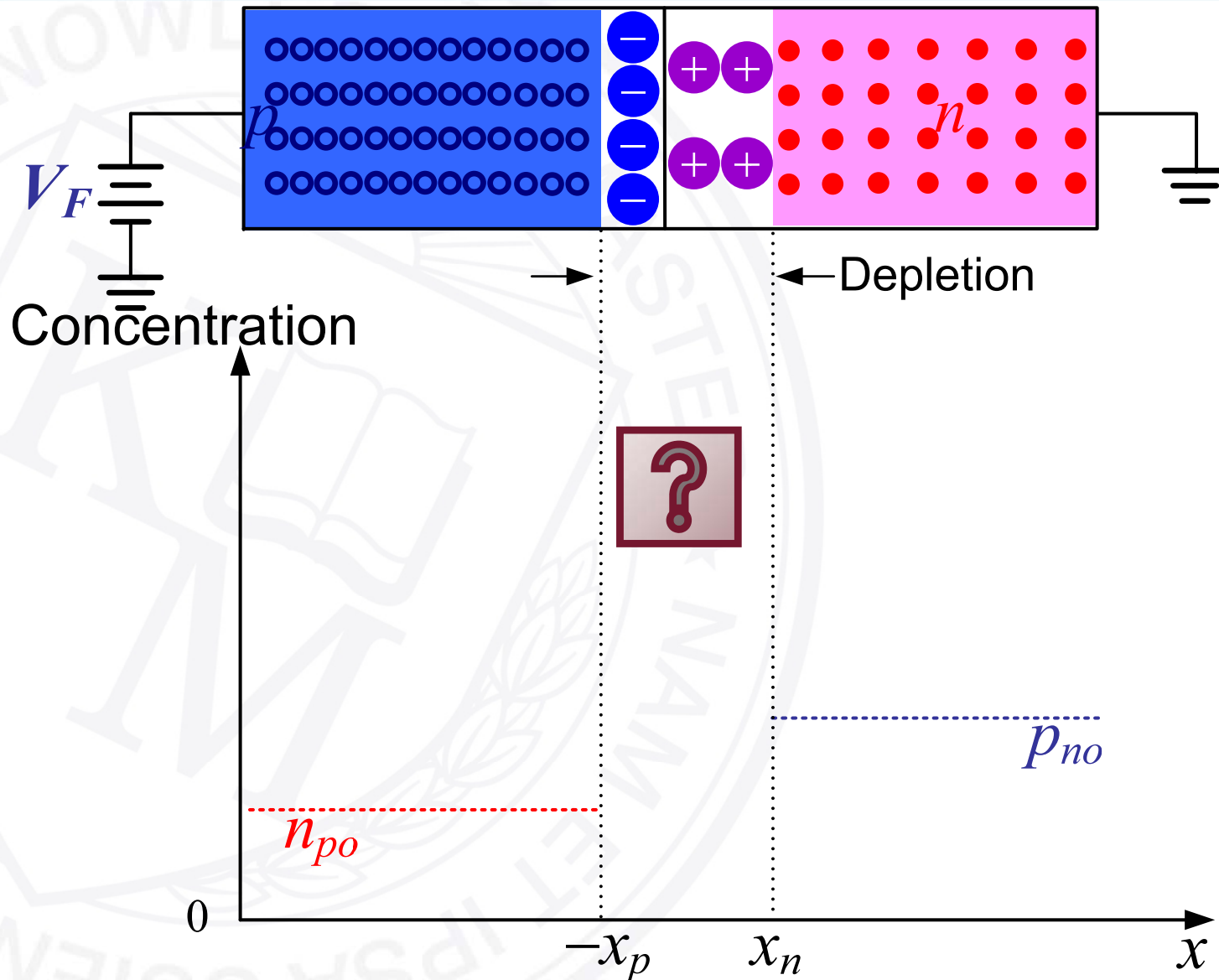
Forward Bias

- Physical meaning
- Distribution

Reverse Bias

- Distribution
- Saturation current

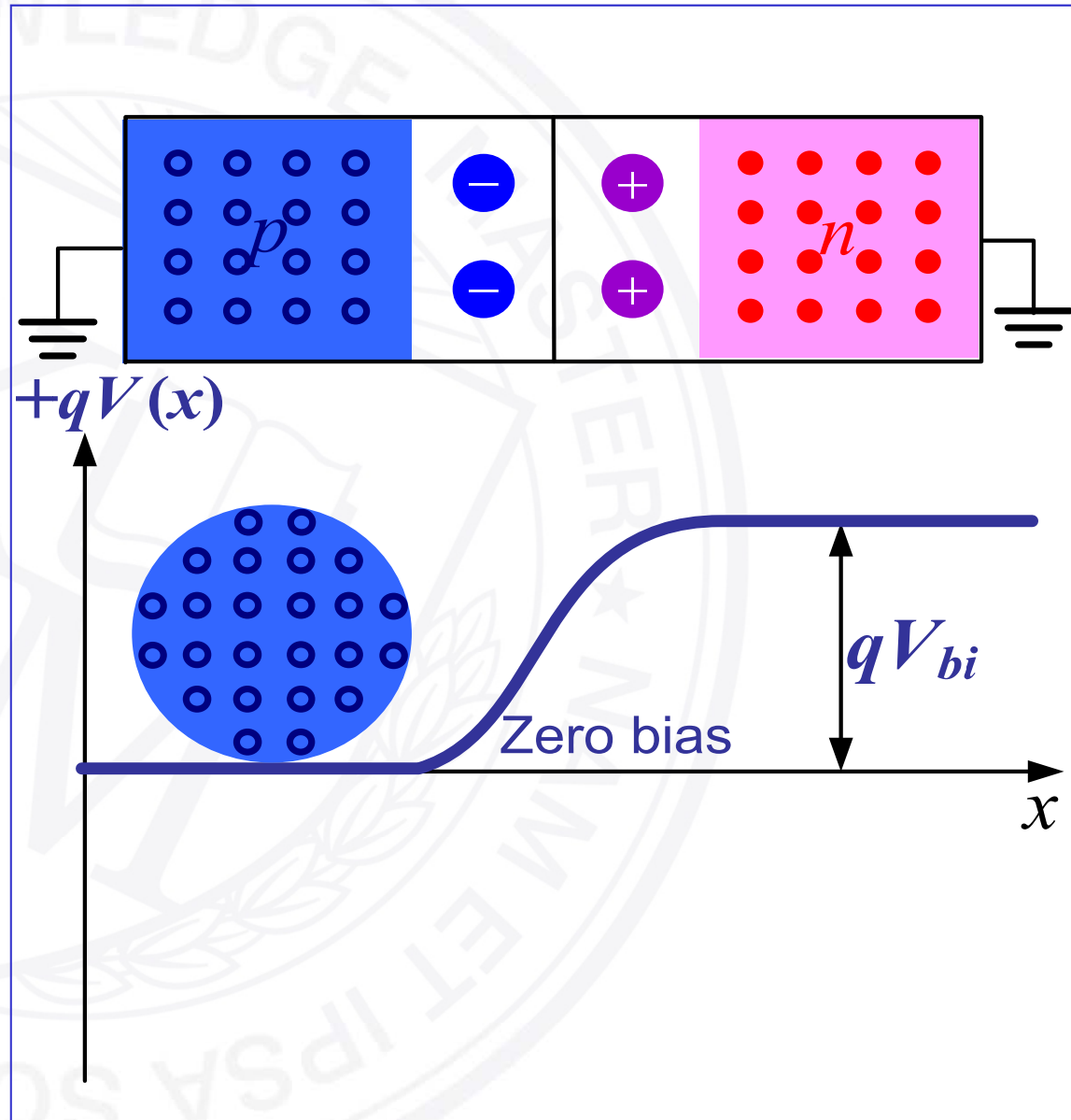
Minority Carrier Distribution—Forward



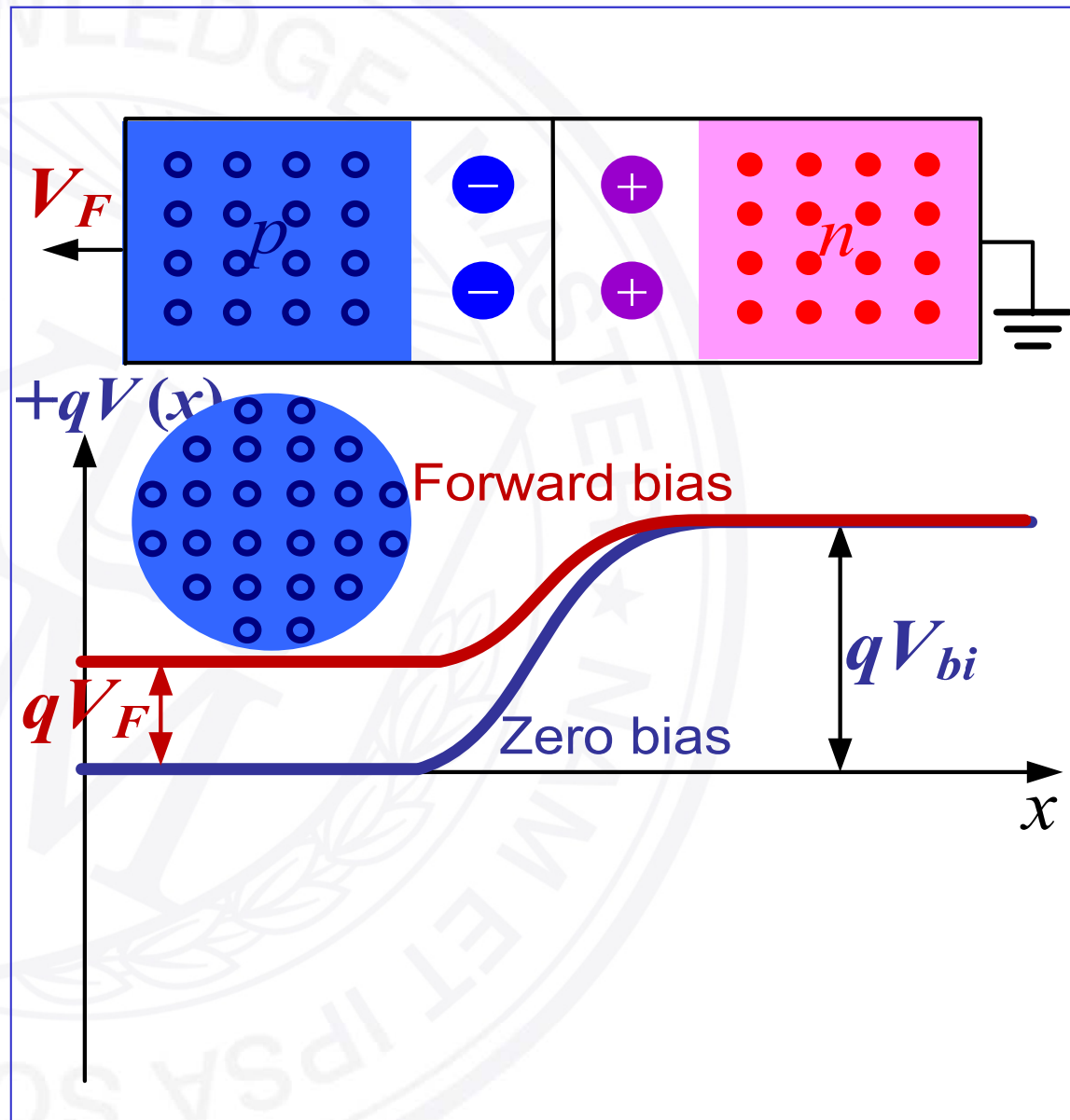
Independence Hall, Philadelphia



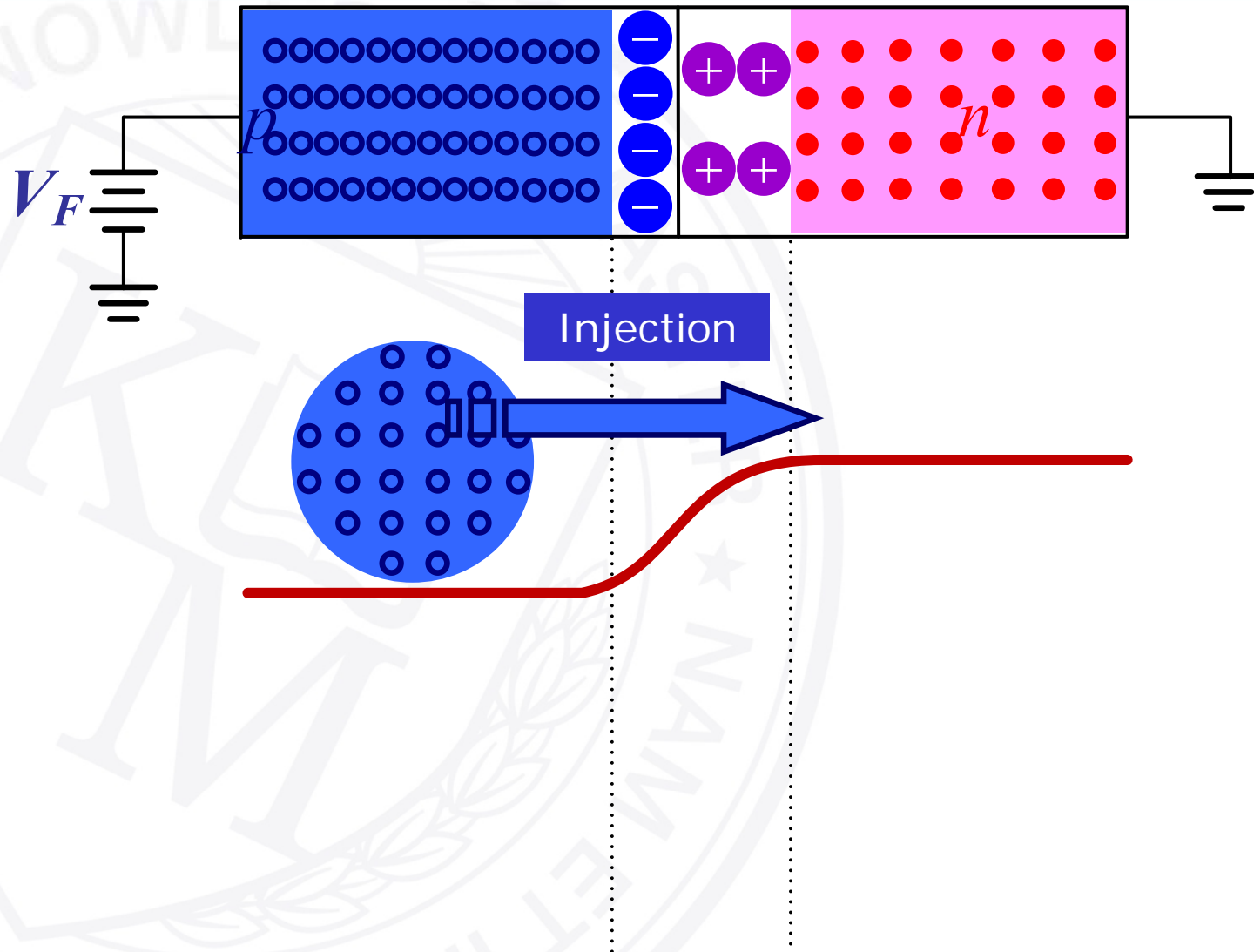
Zero Bias



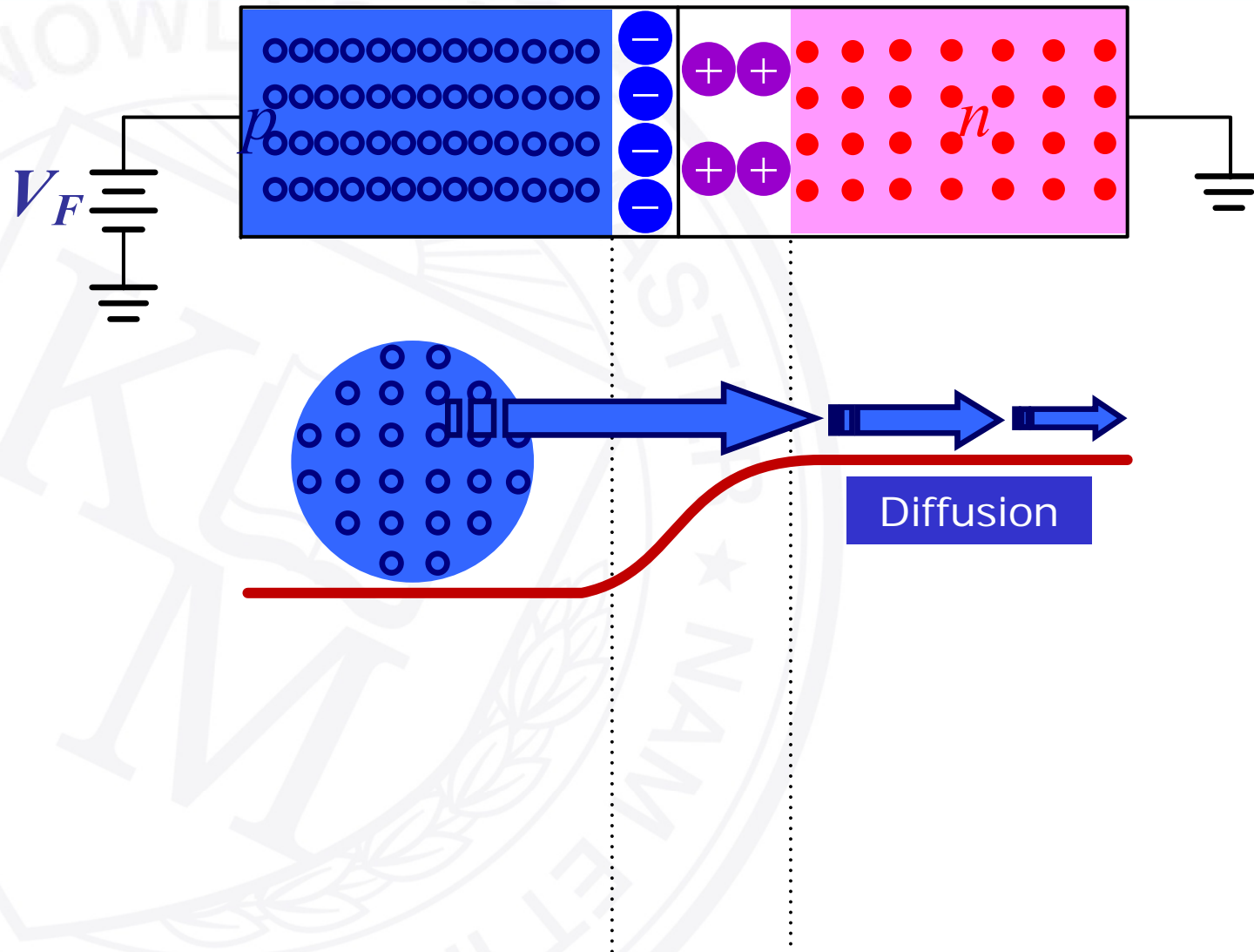
Forward Bias



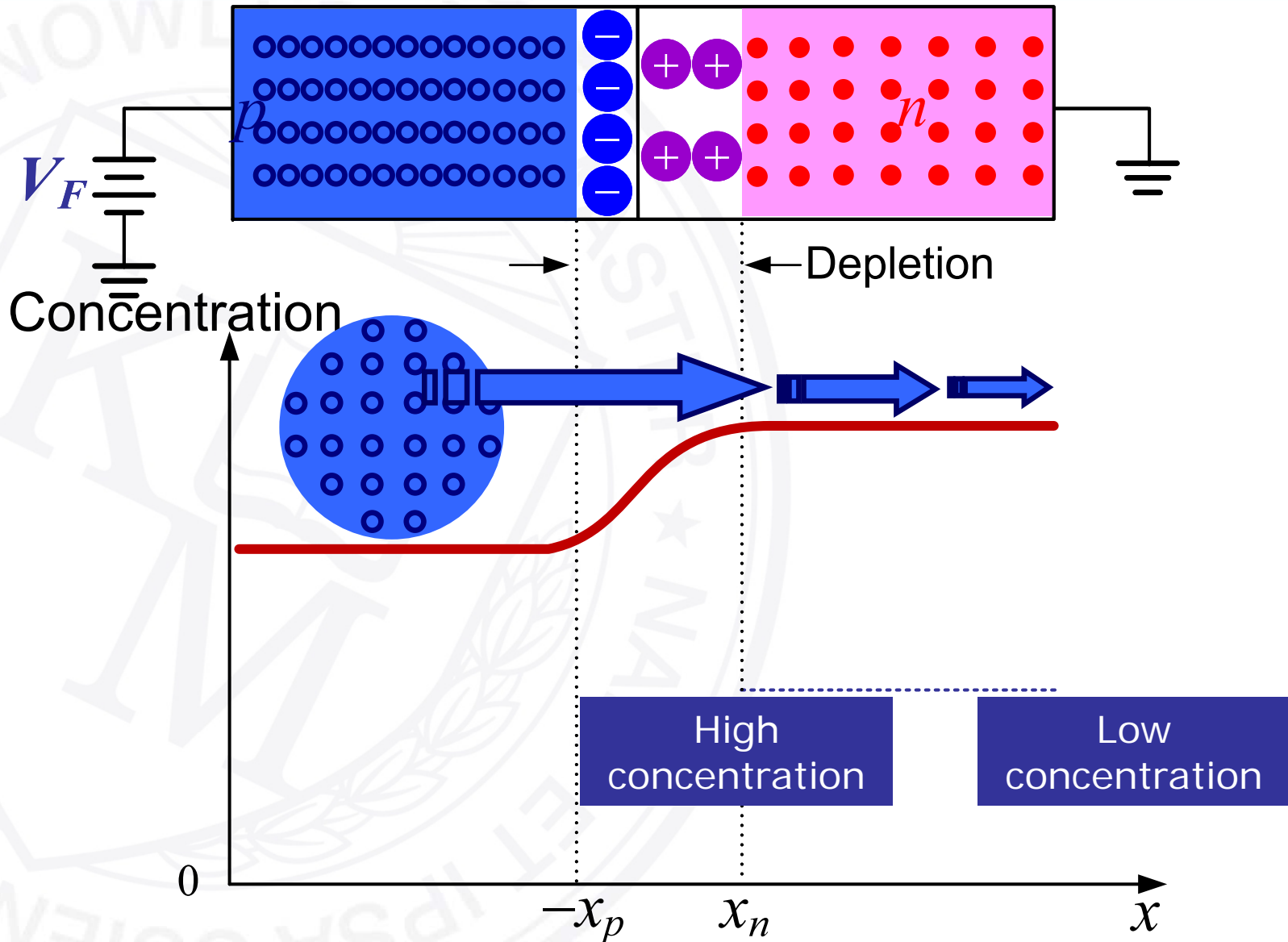
Minority Carrier Injection



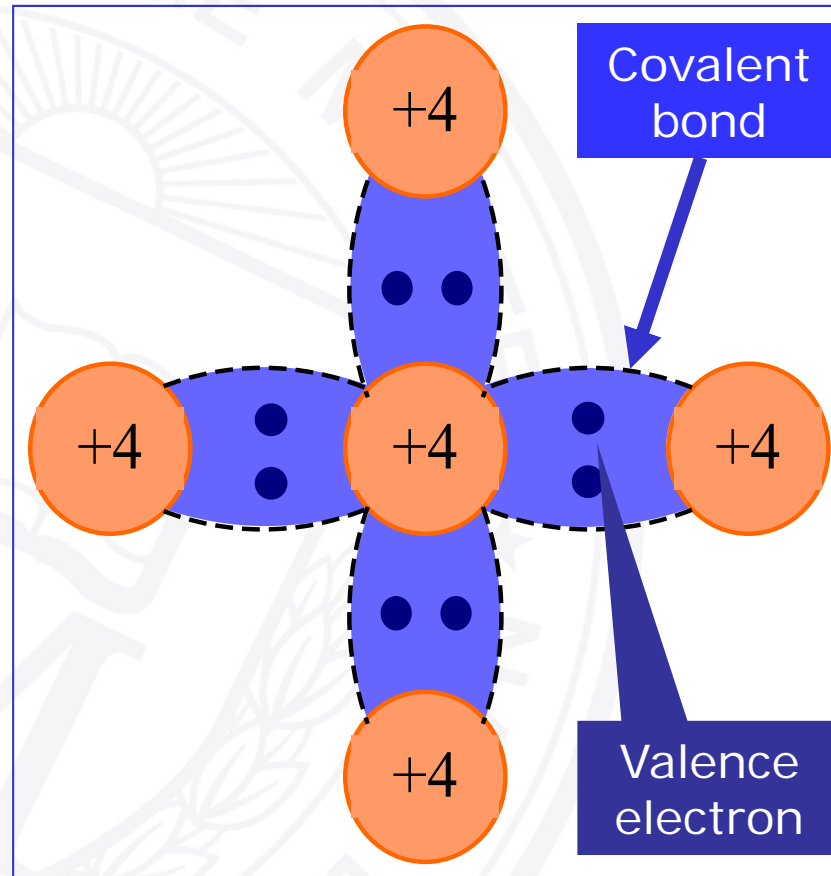
Minority Carrier Diffusion



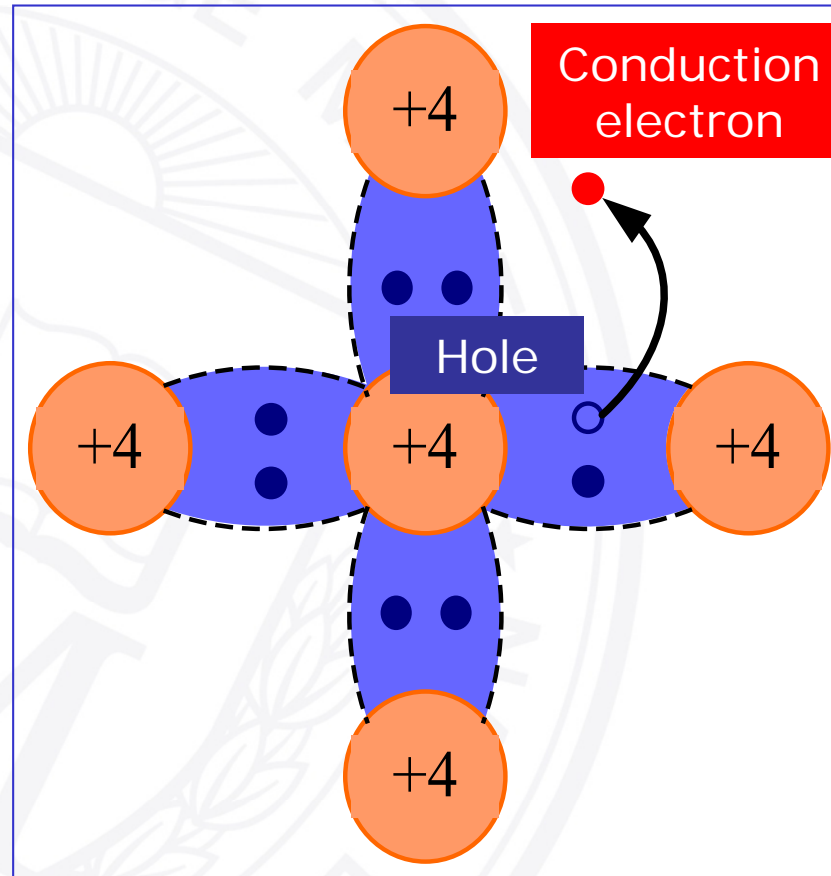
Minority Carrier Diffusion



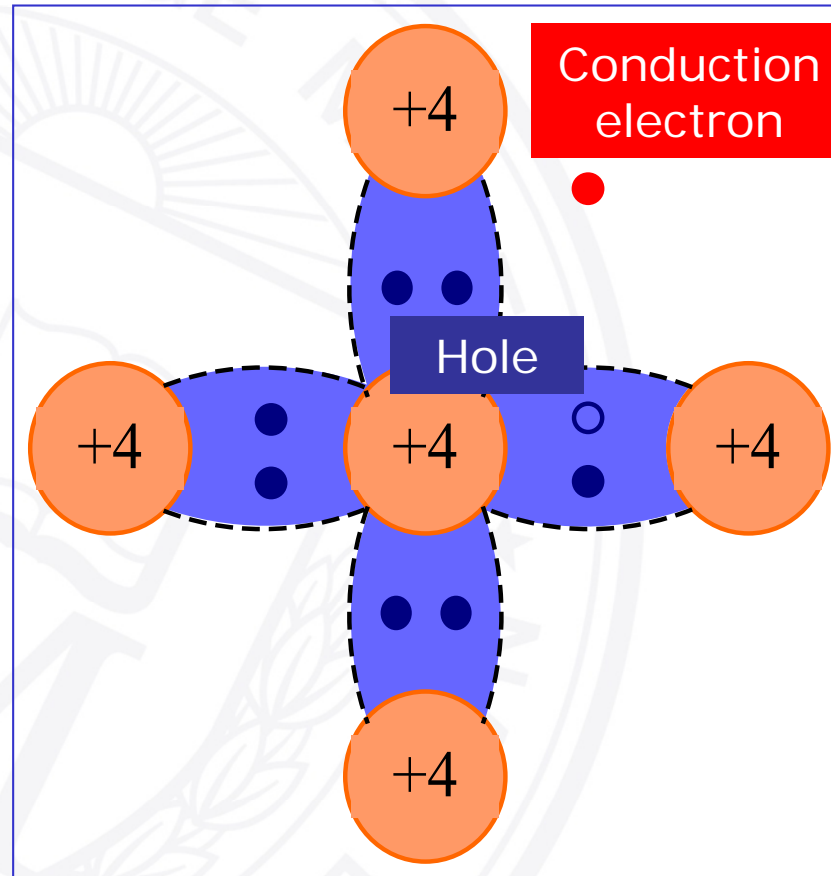
Carrier Generation



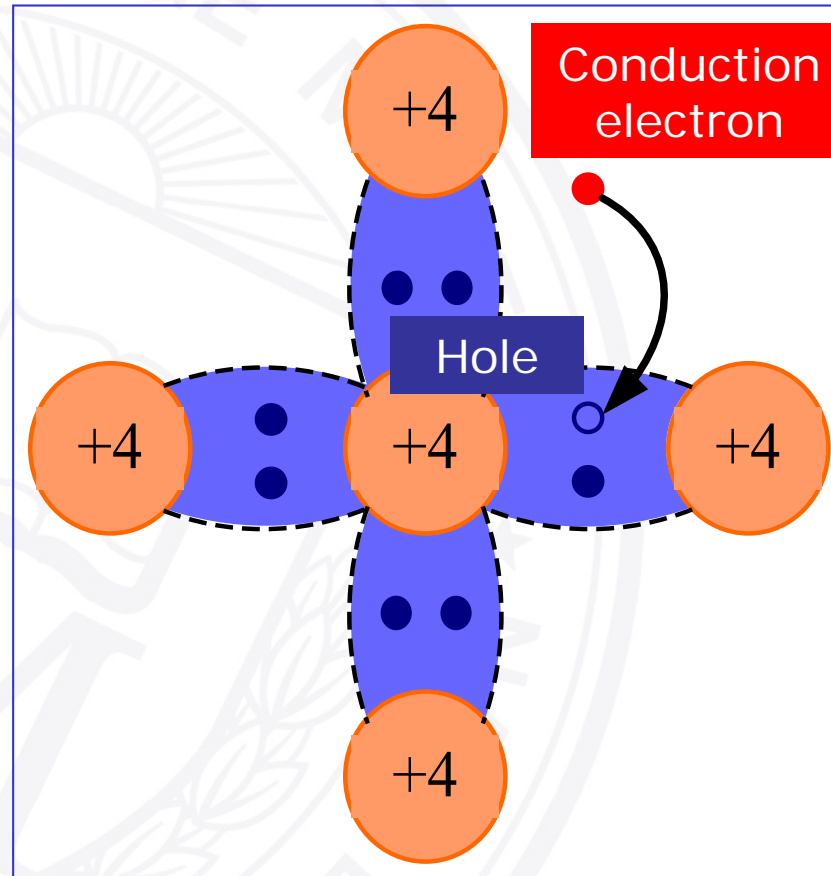
Carrier Generation



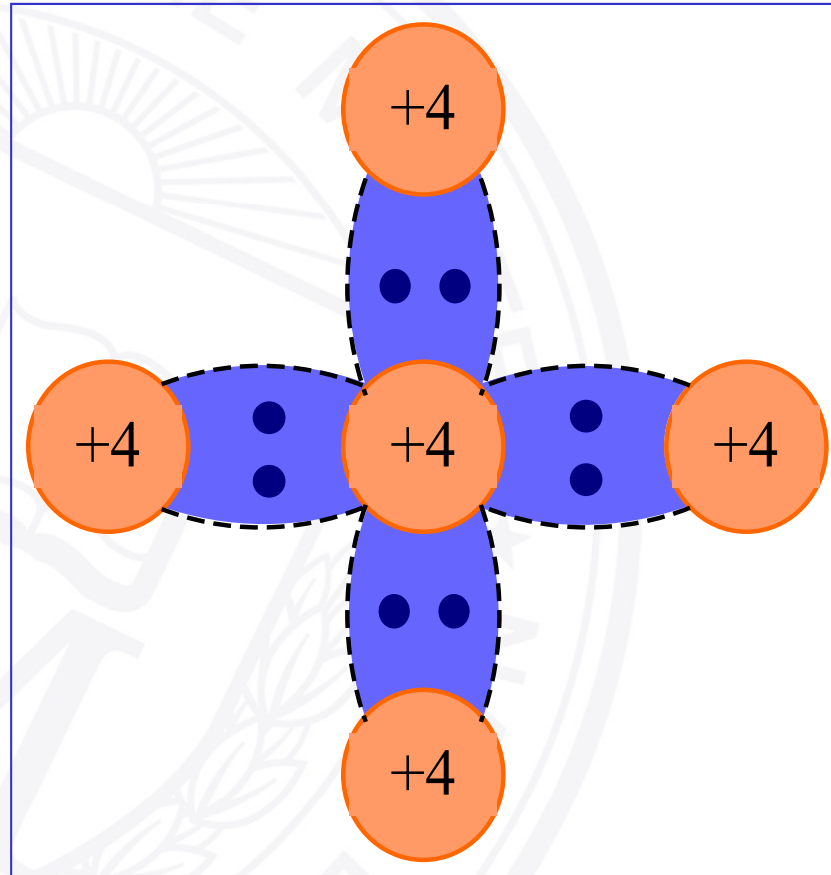
Carrier Recombination



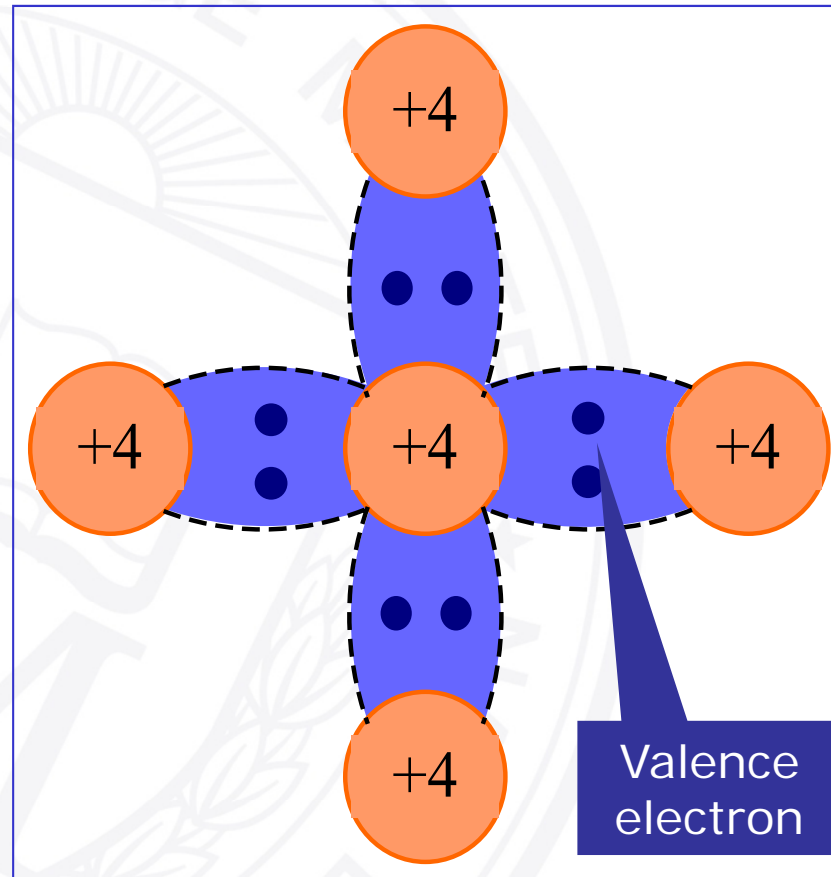
Carrier Recombination



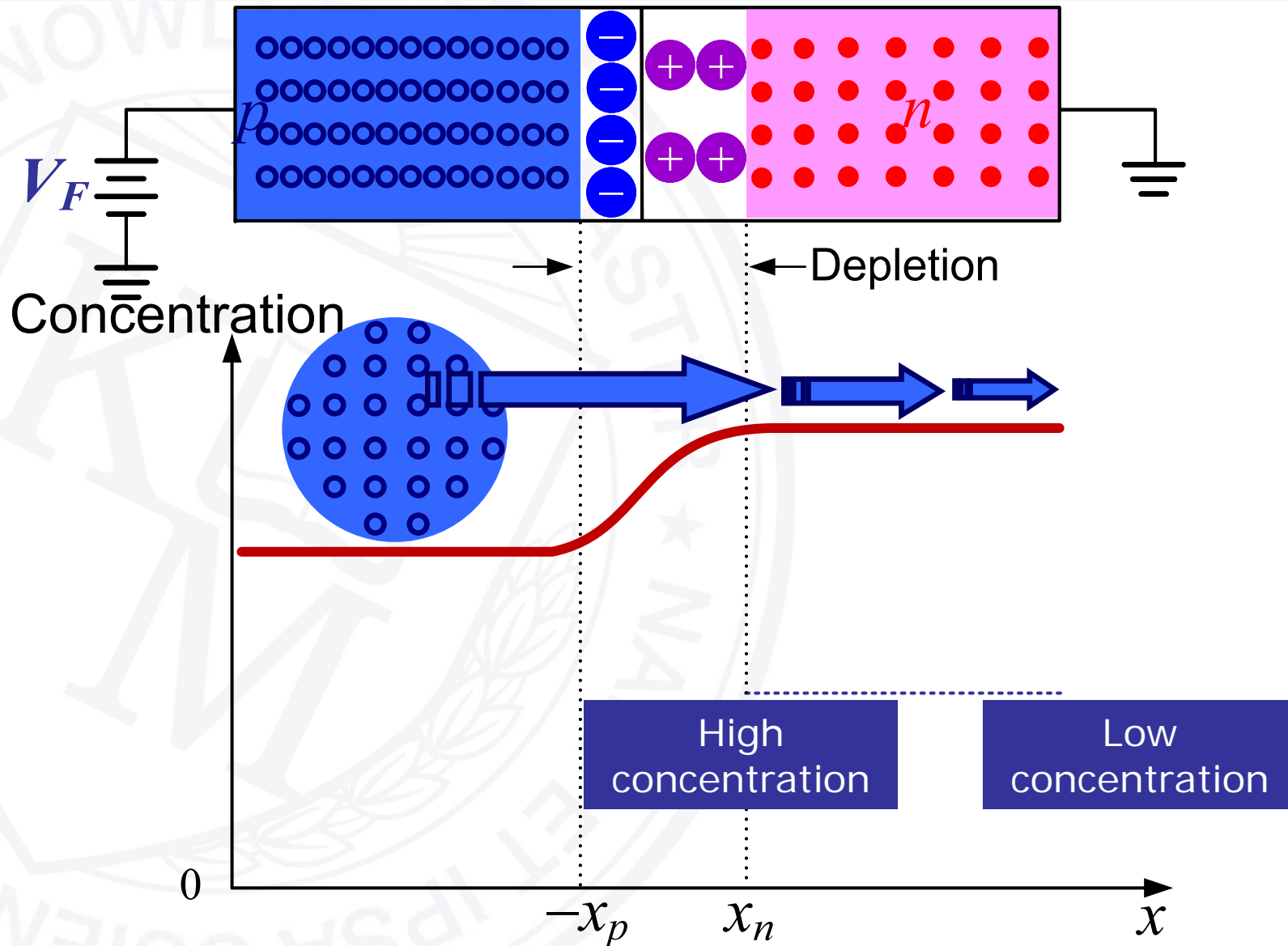
Carrier Recombination



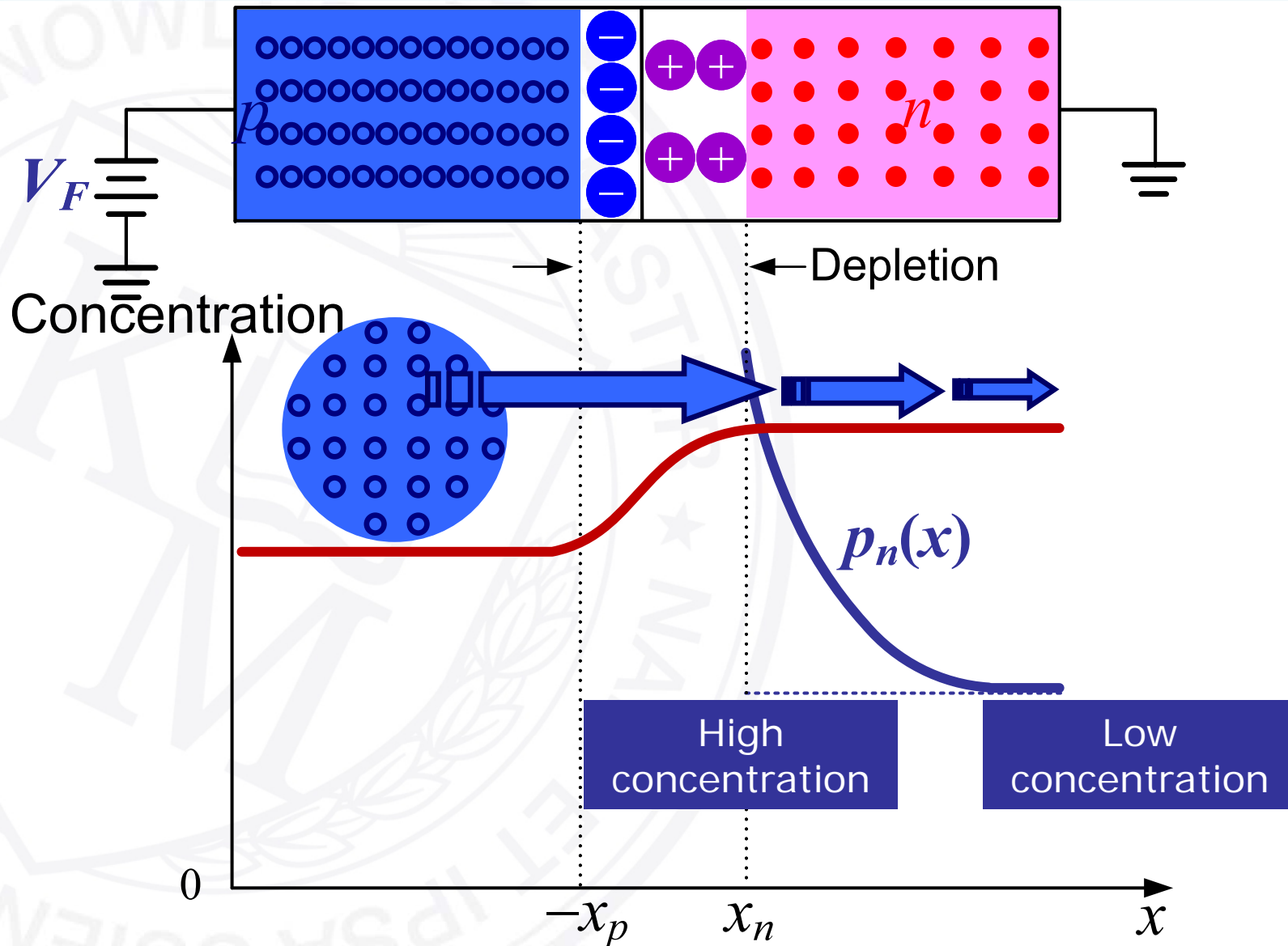
Carrier Recombination



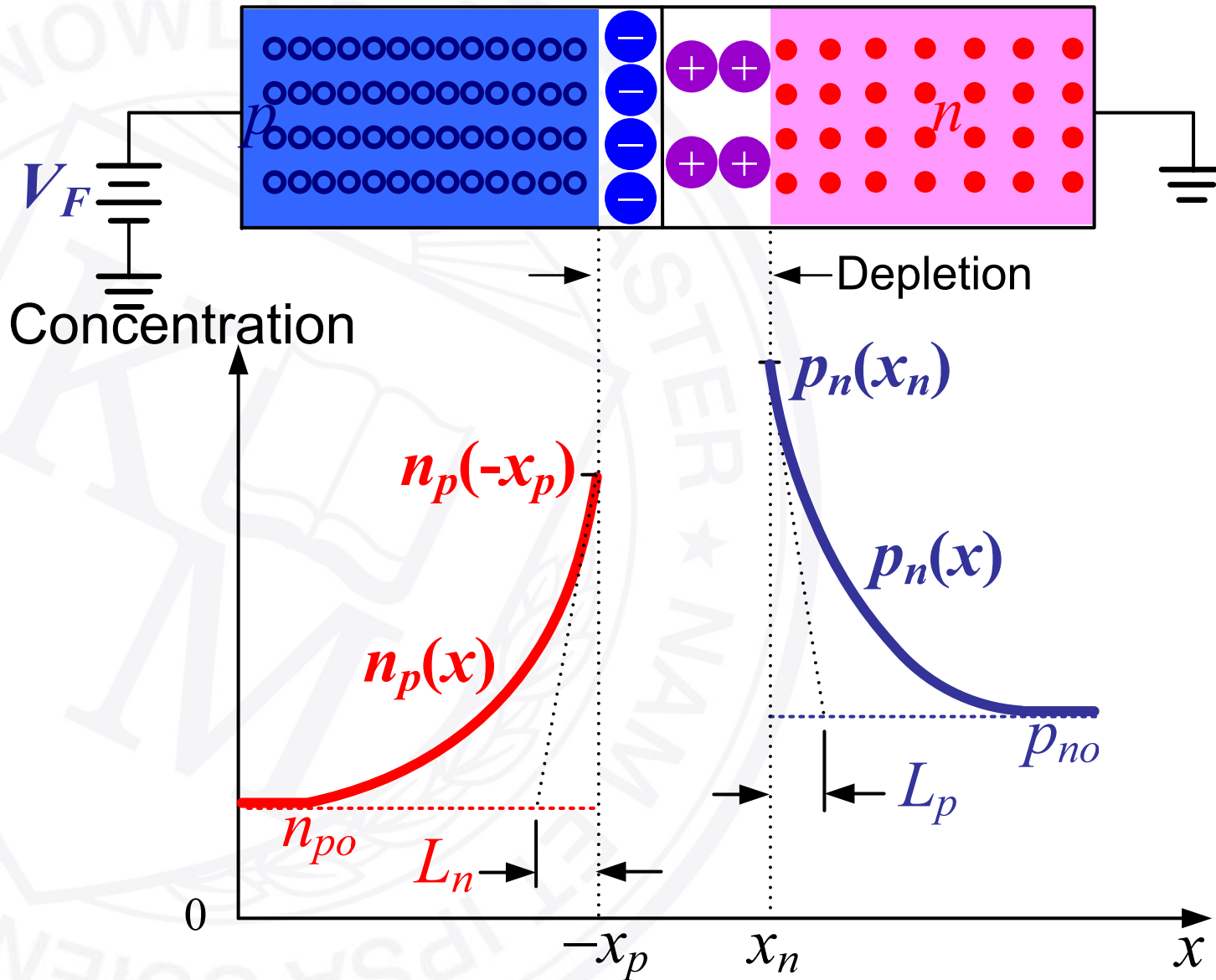
Minority Carrier Diffusion



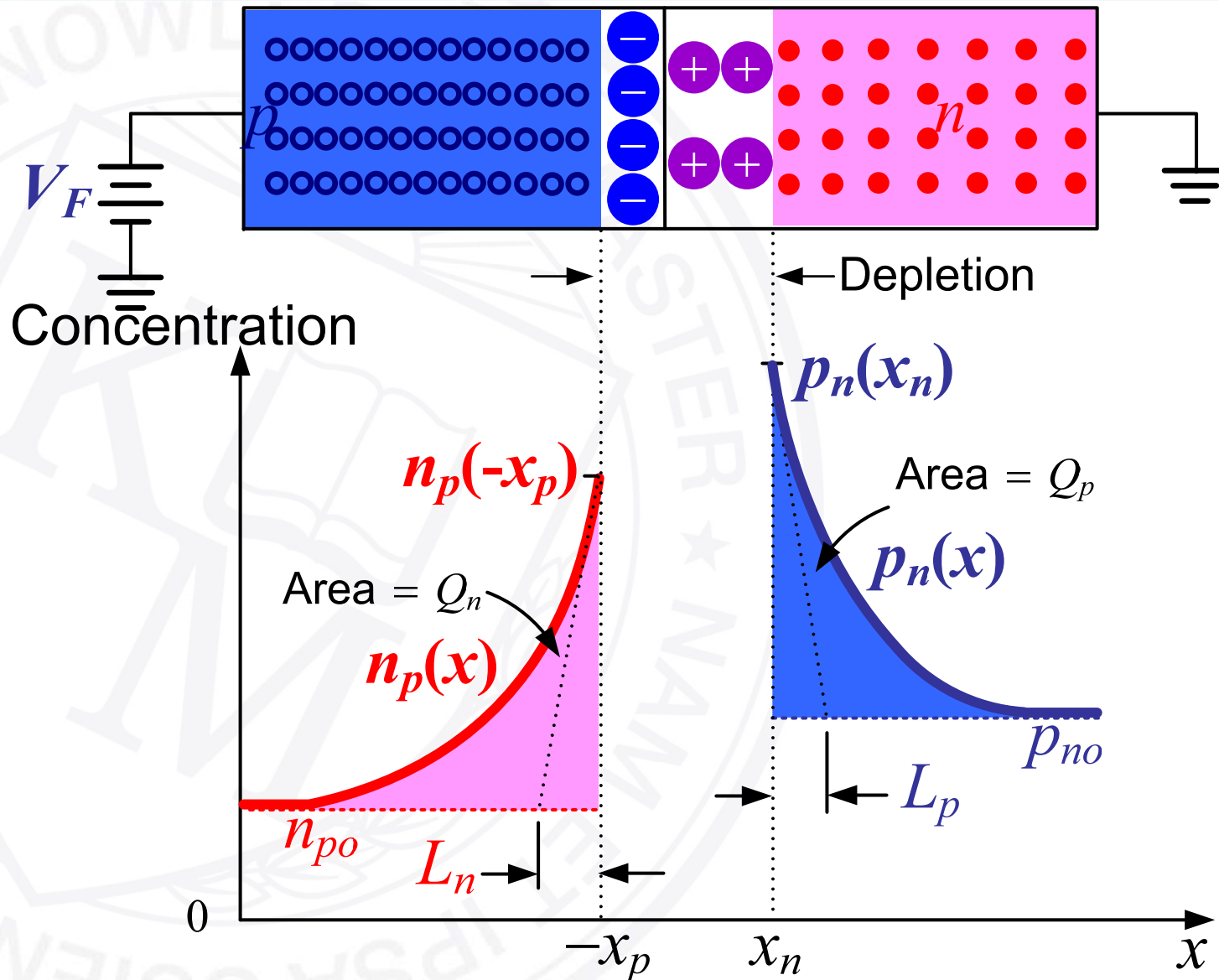
Minority Carrier Distribution



Minority Carrier



Minority-Carrier Storage Effect



Outline

Zero Bias

- Thermal equilibrium

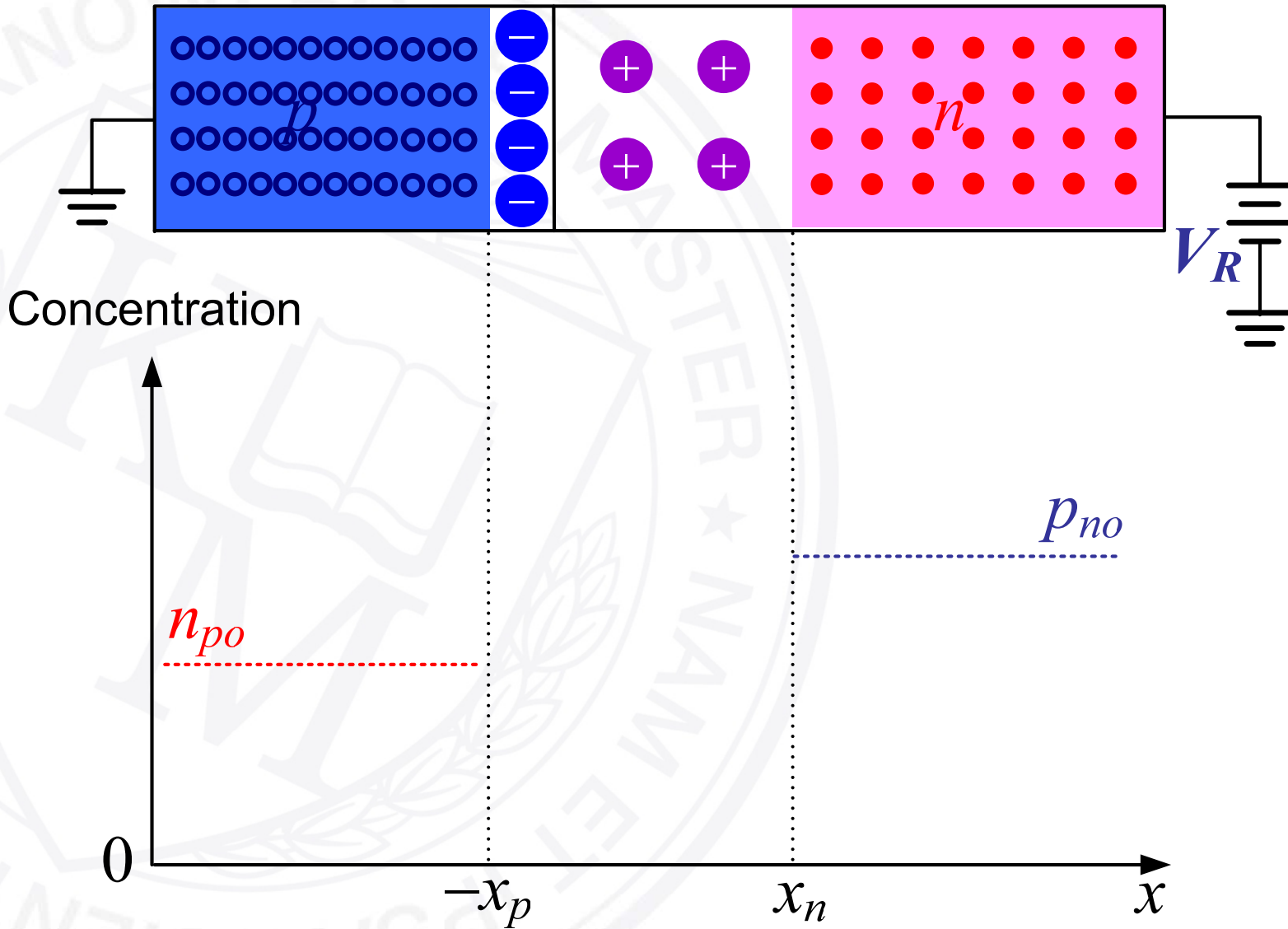
Forward Bias

- Physical meaning
- Distribution

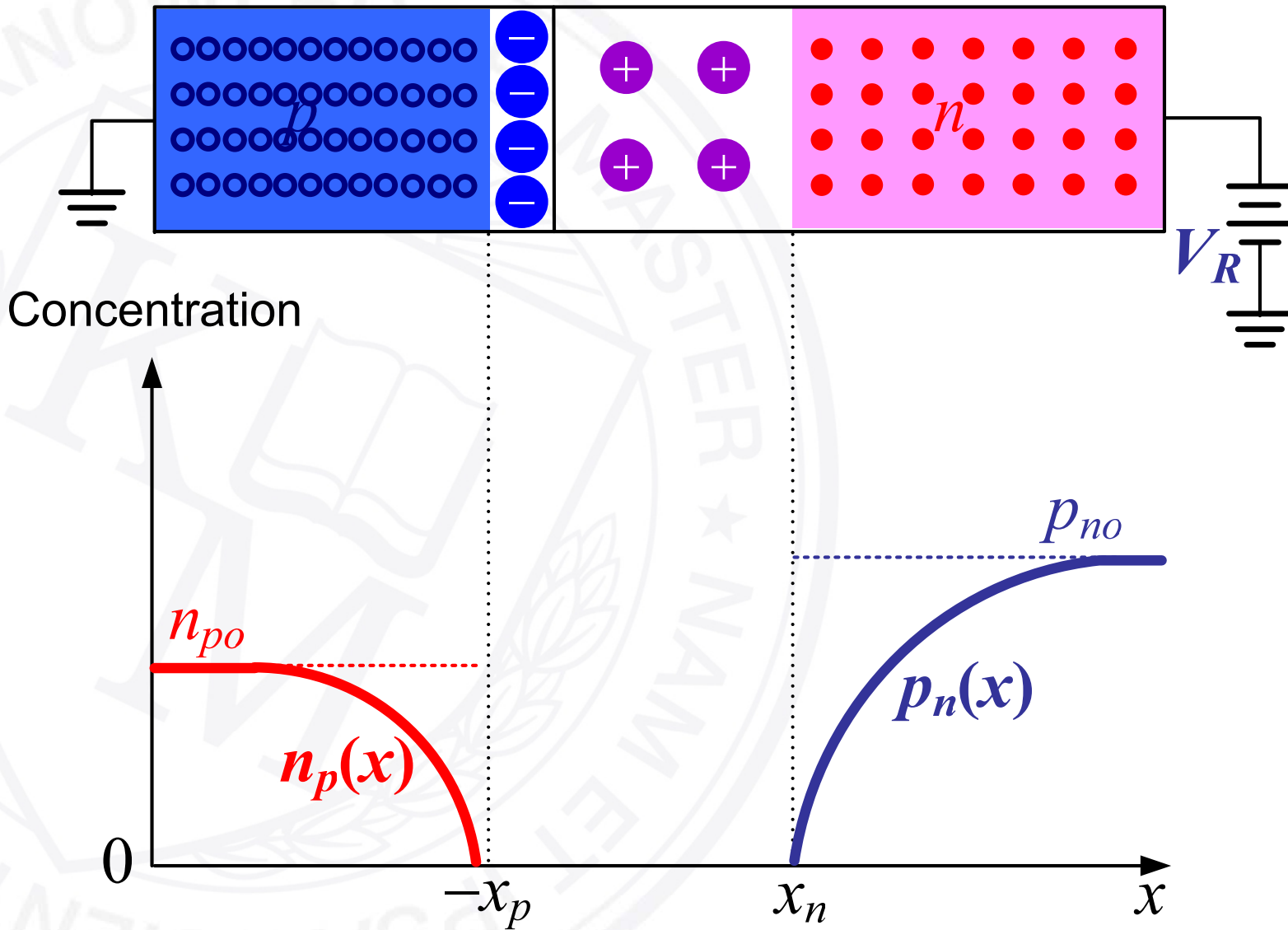
Reverse Bias

- Distribution
- Saturation current

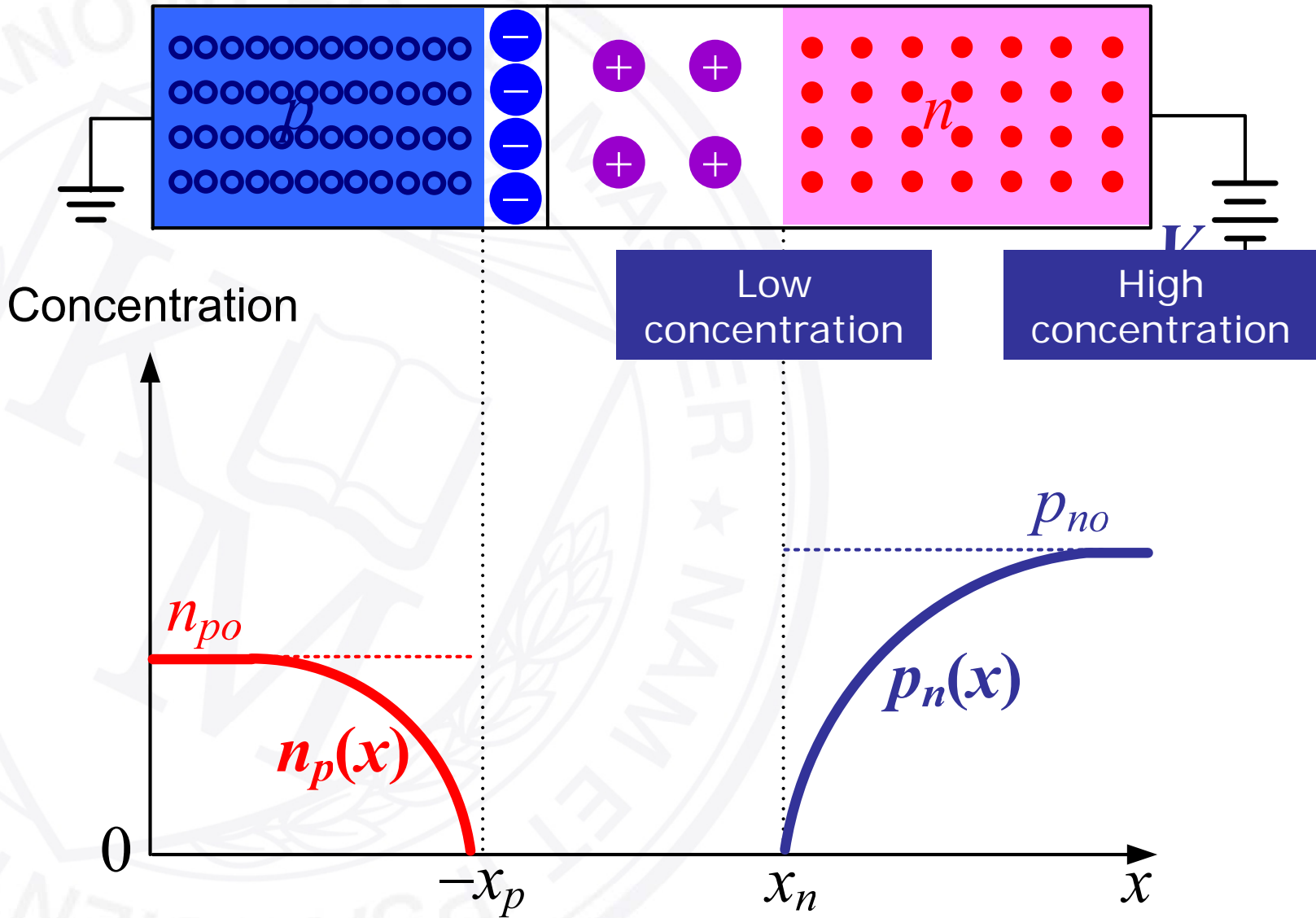
Minority Carrier (Fig.3-16b, P144)



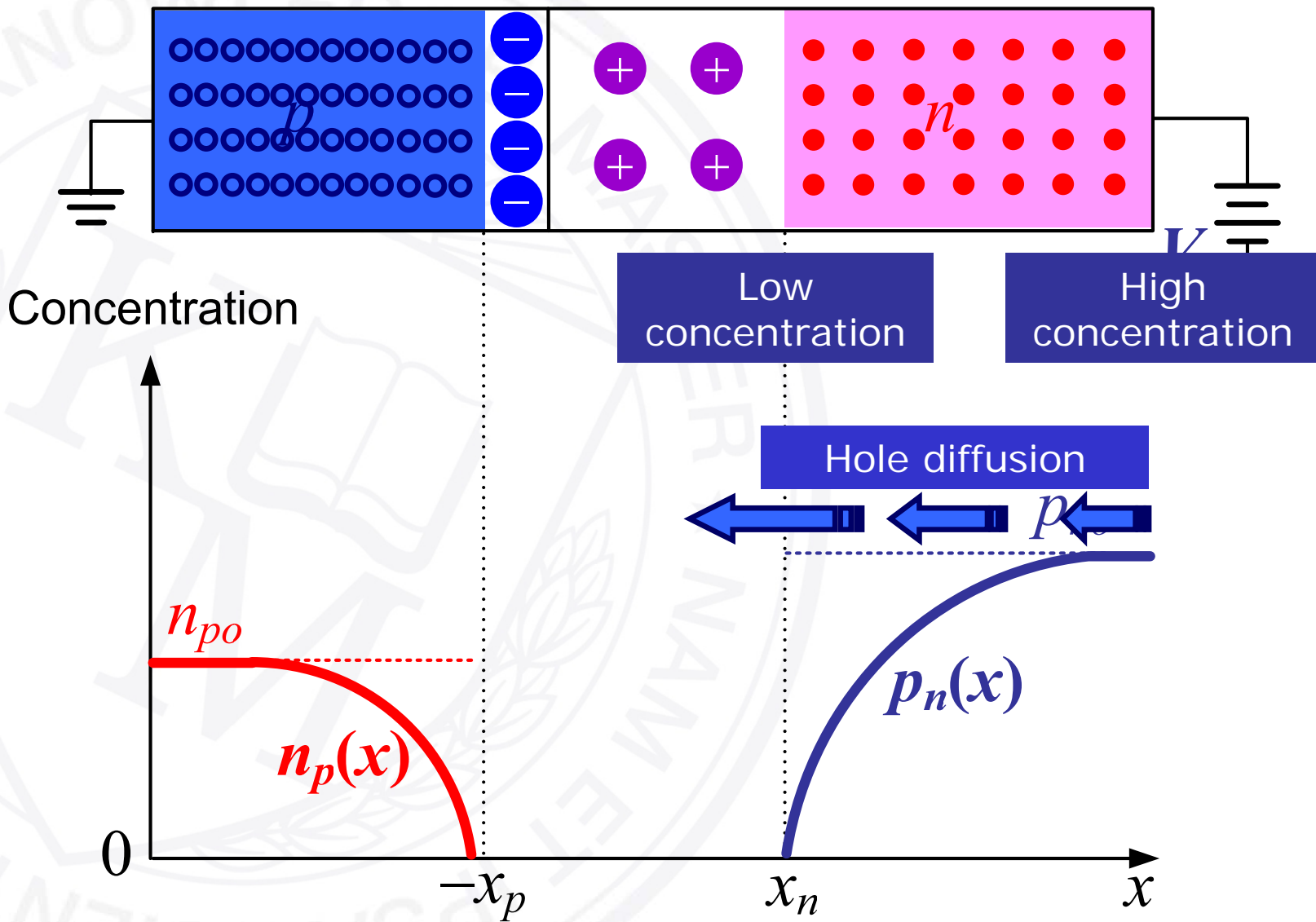
Minority Carrier (Fig.3-16b, P144)



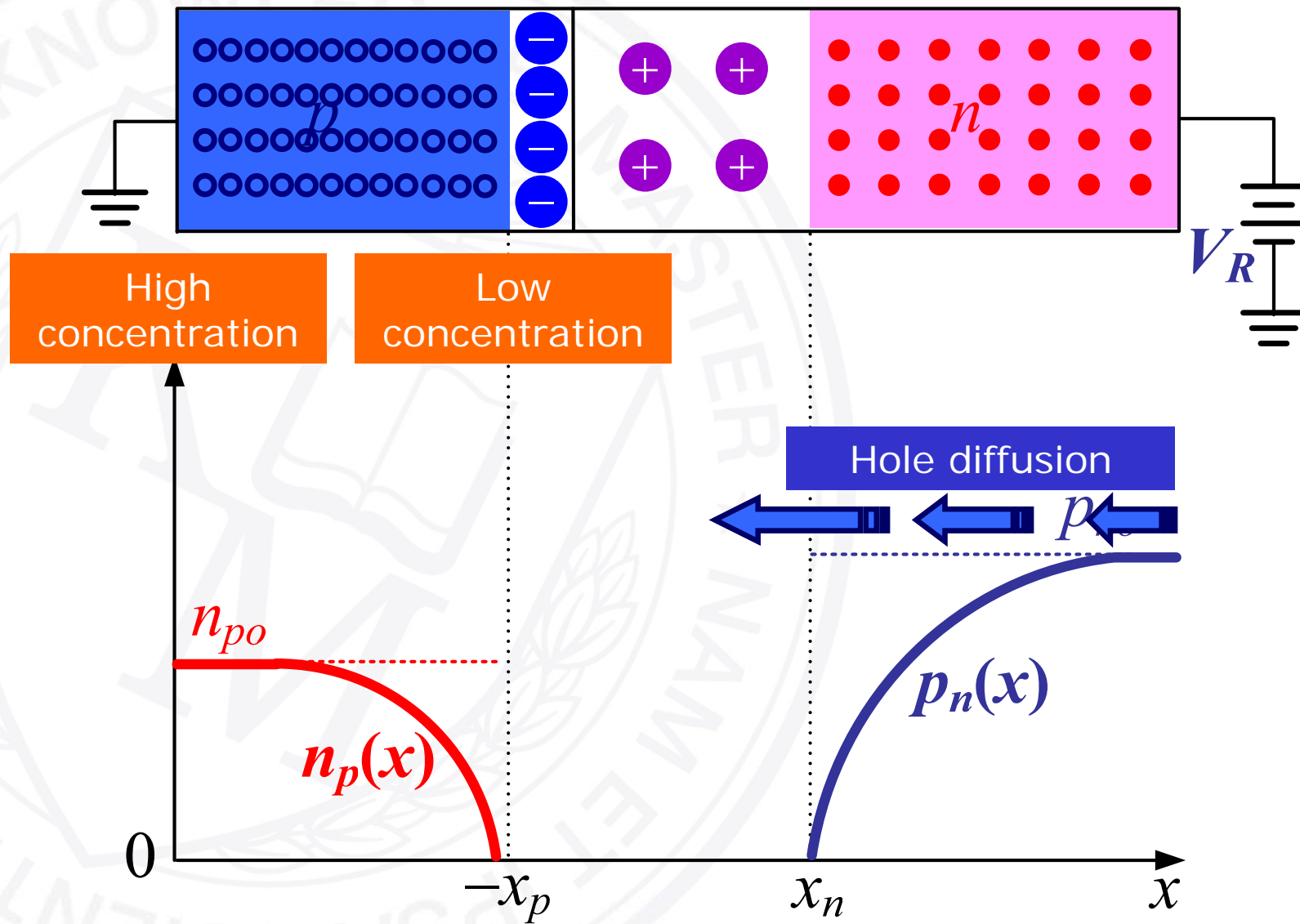
Physical Concept (Take Note)



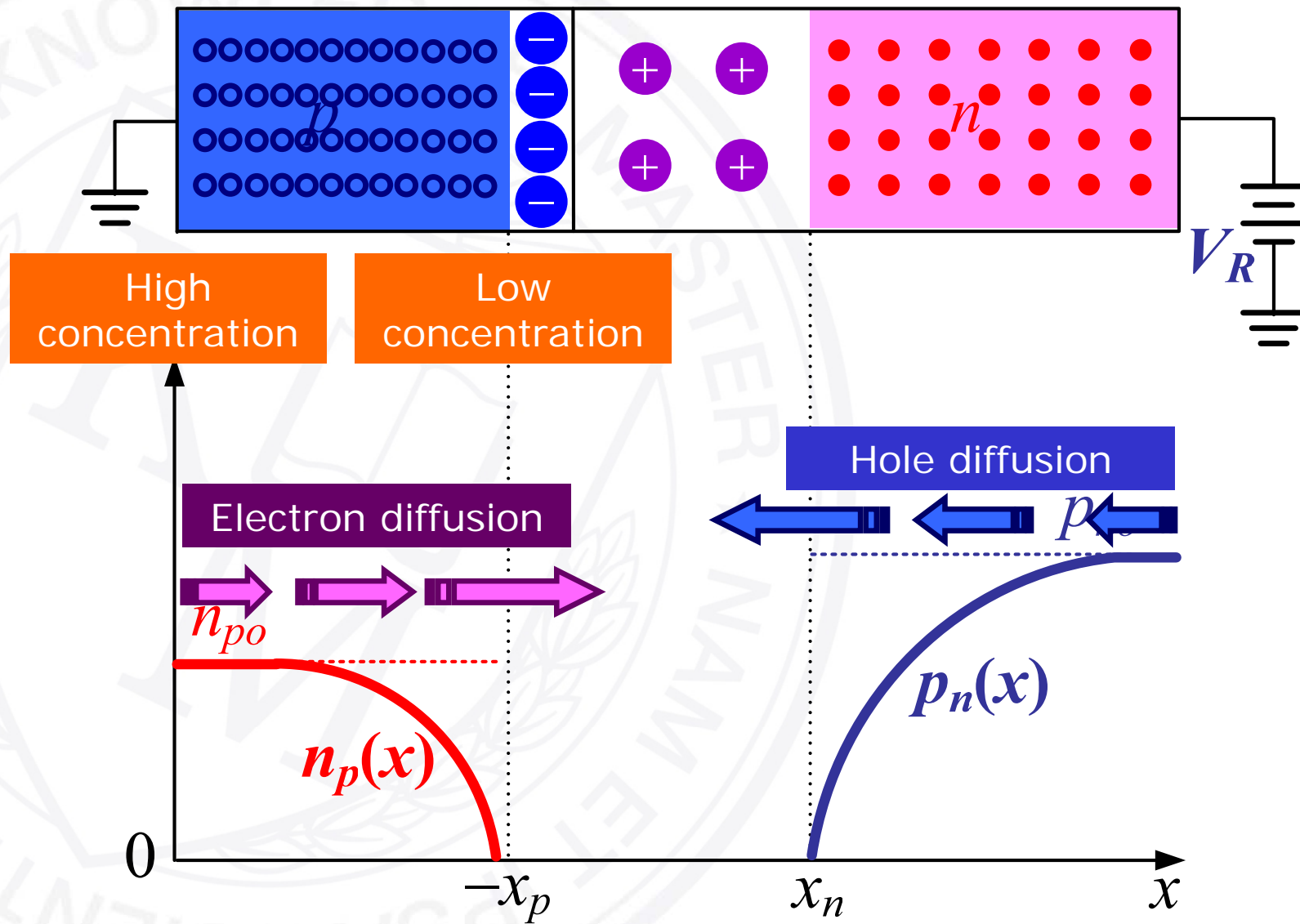
Physical Concept



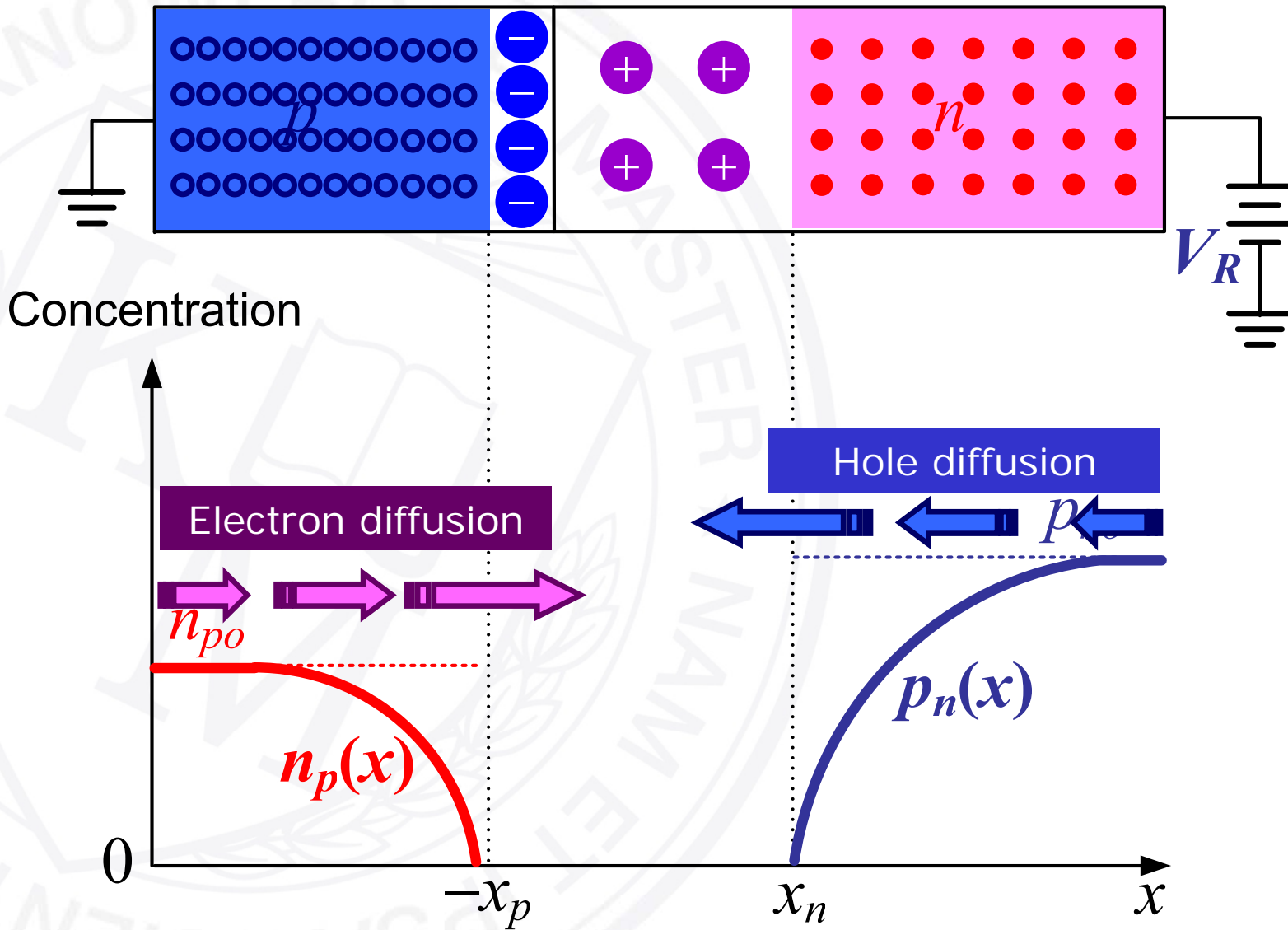
Physical Concept



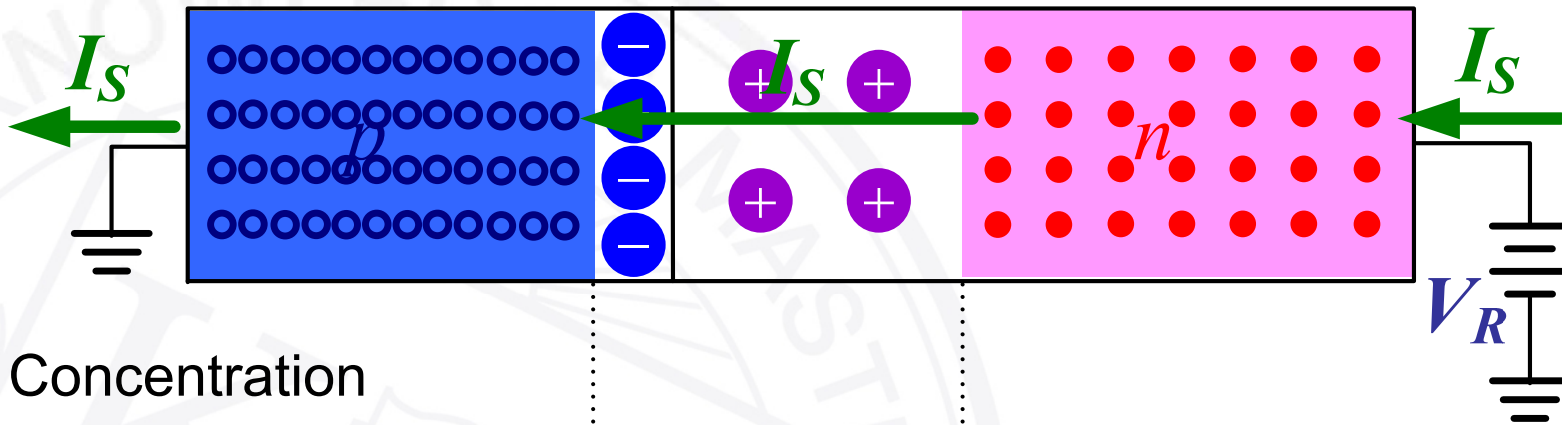
Physical Concept



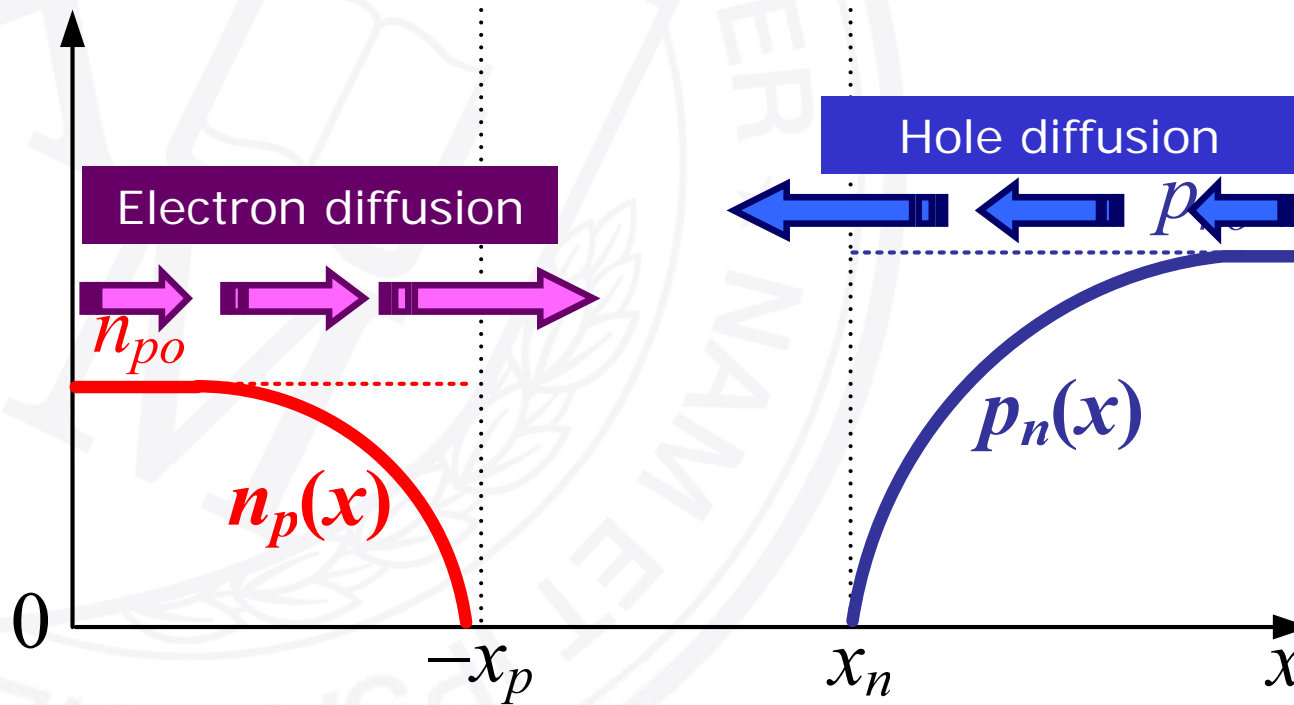
Minority Carrier Diffusion Current



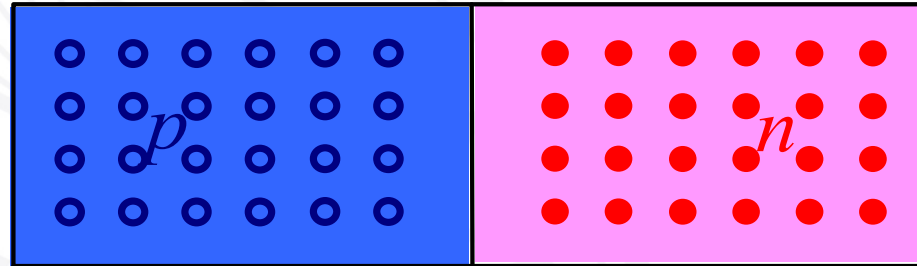
Reverse Saturation Current



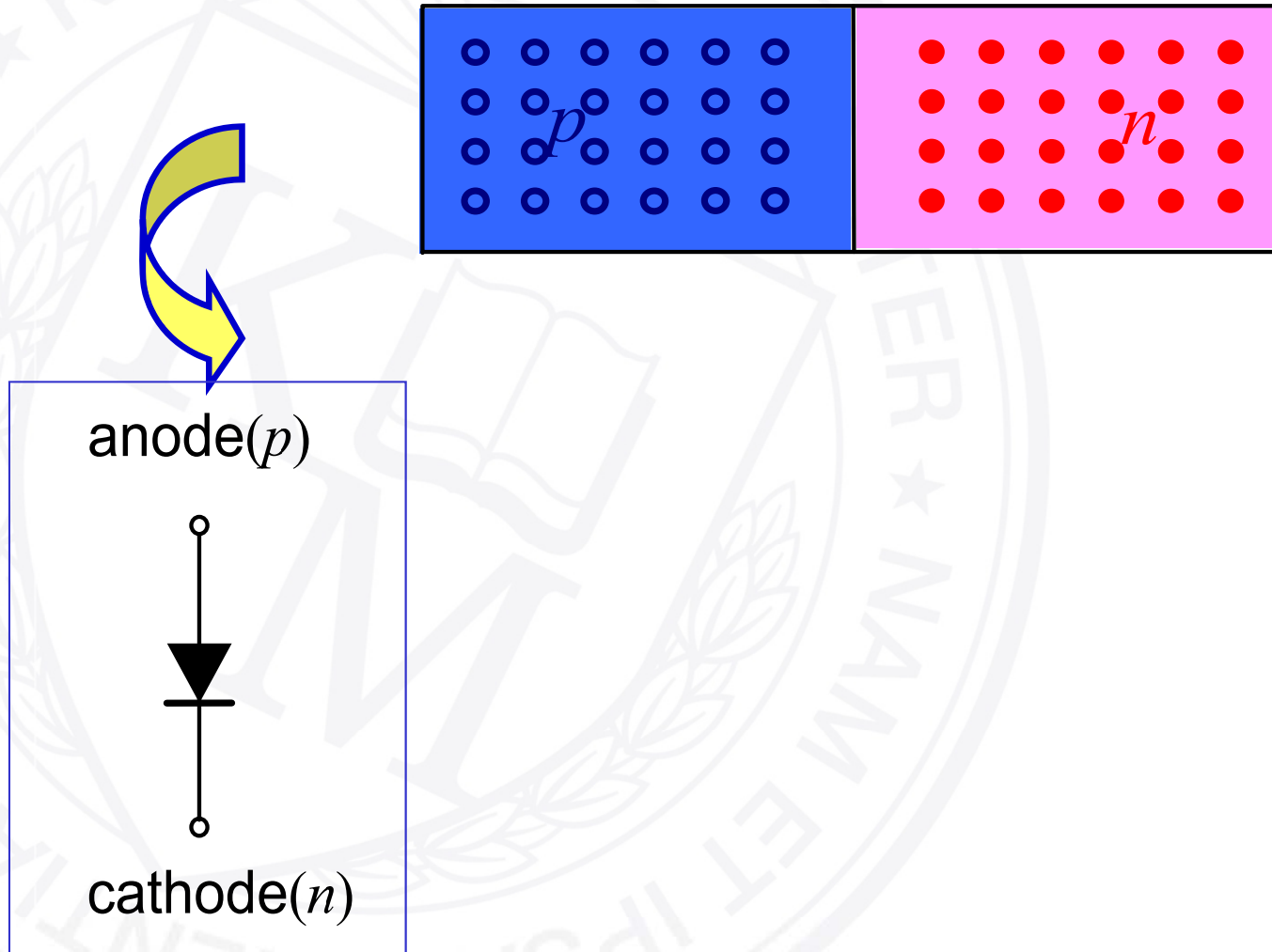
Concentration



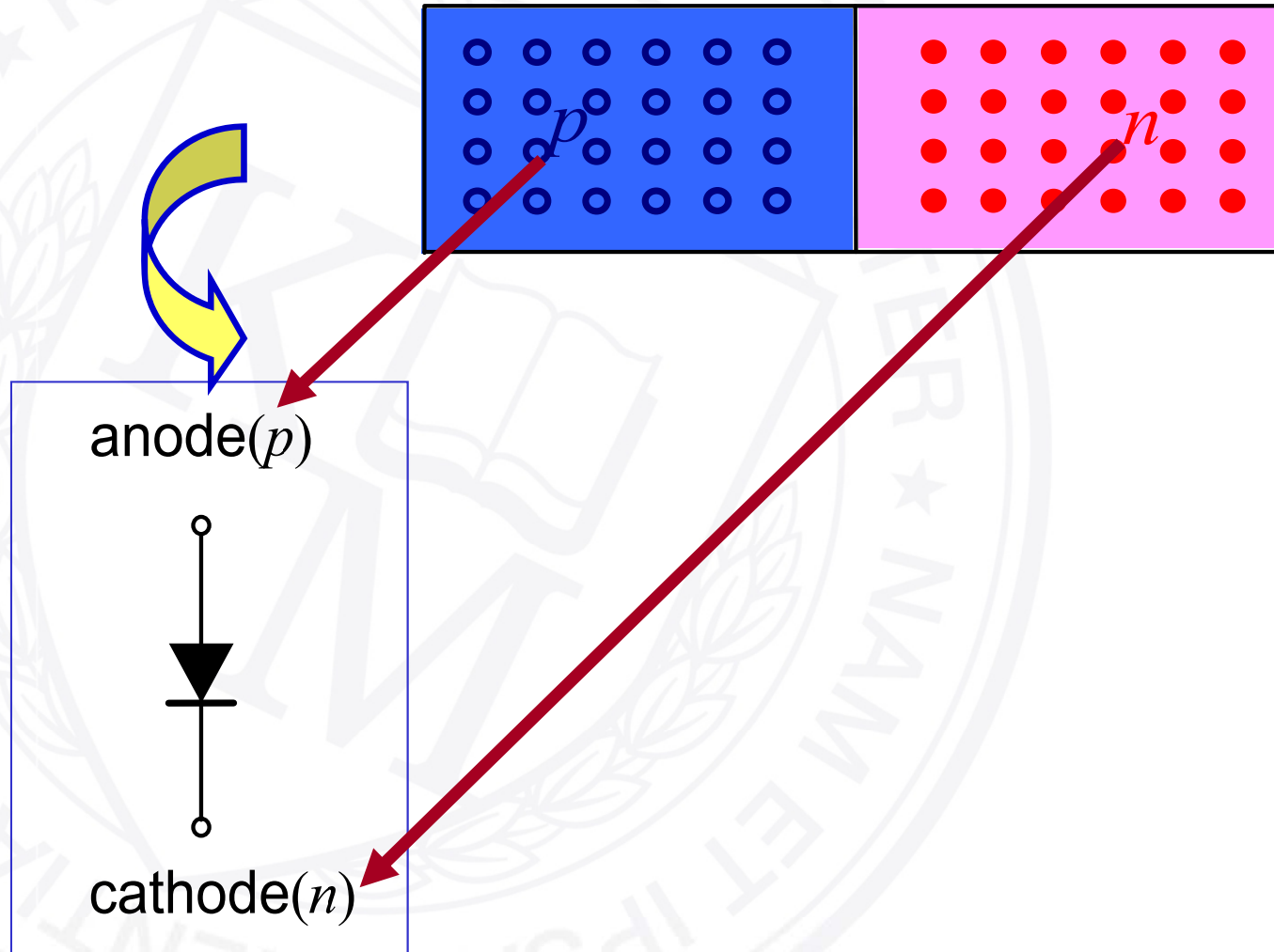
pn Junction Diode



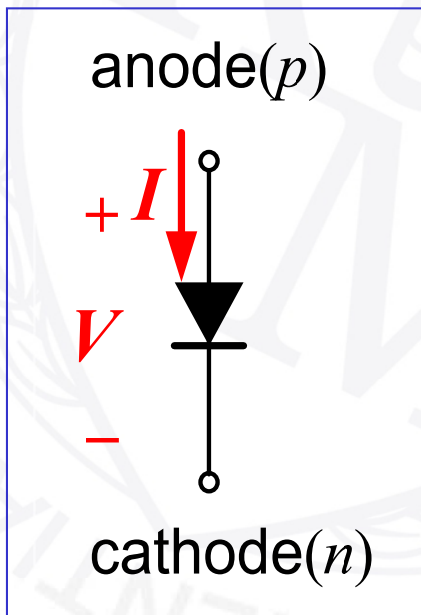
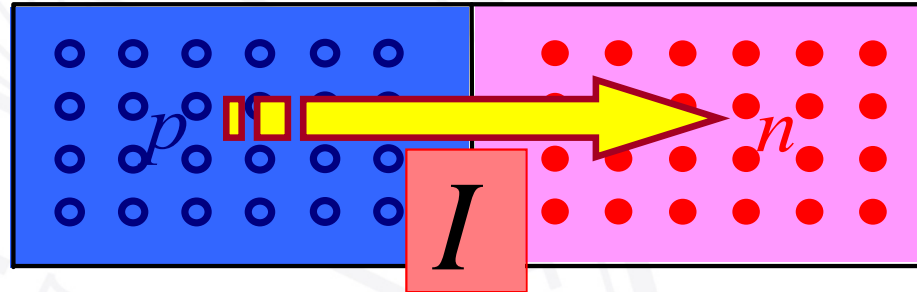
Circuit Symbol



Circuit Symbol

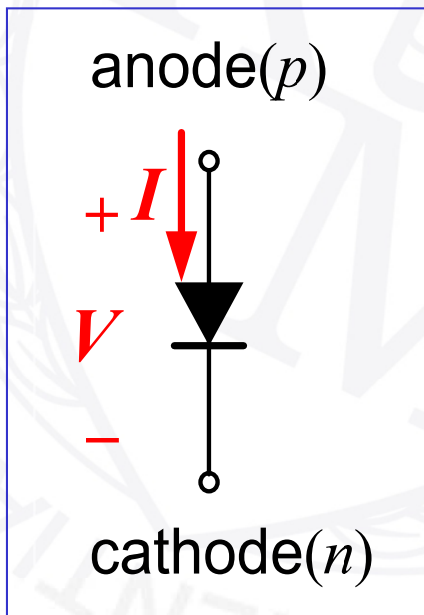


Diode Current and Voltage



Current-Voltage Characteristic

$$I = I_S (e^{V/V_T} - 1)$$

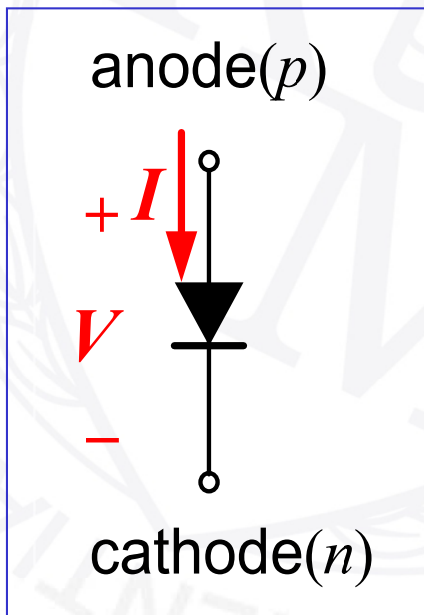


Device Parameters

Saturation current

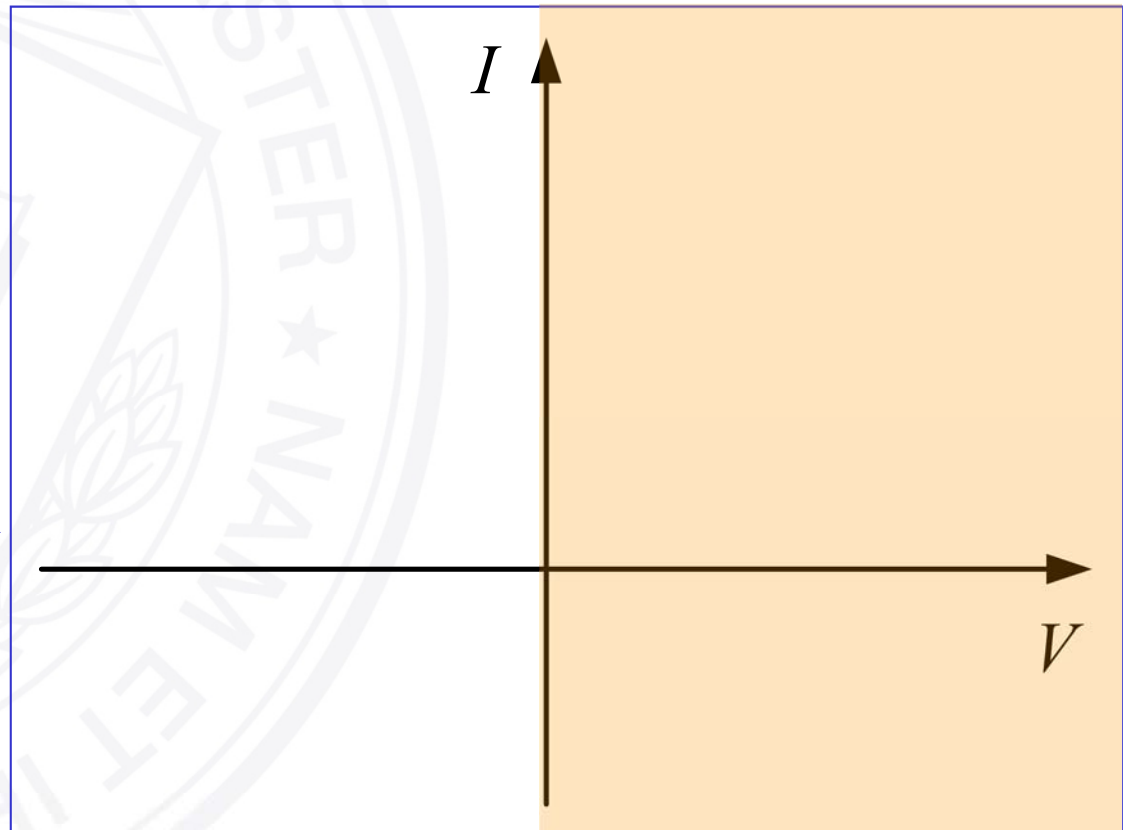
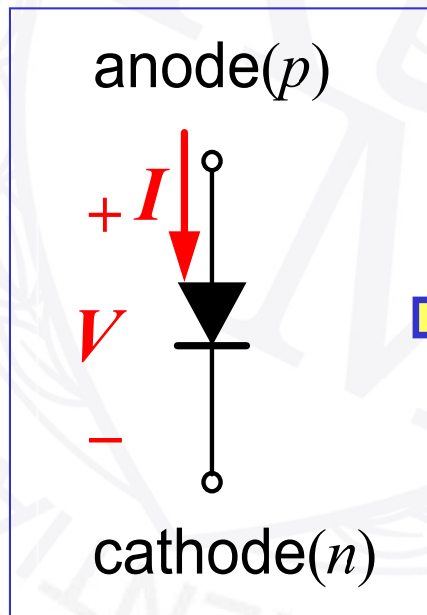
Thermal voltage

$$I = I_S (e^{V/V_T} - 1)$$



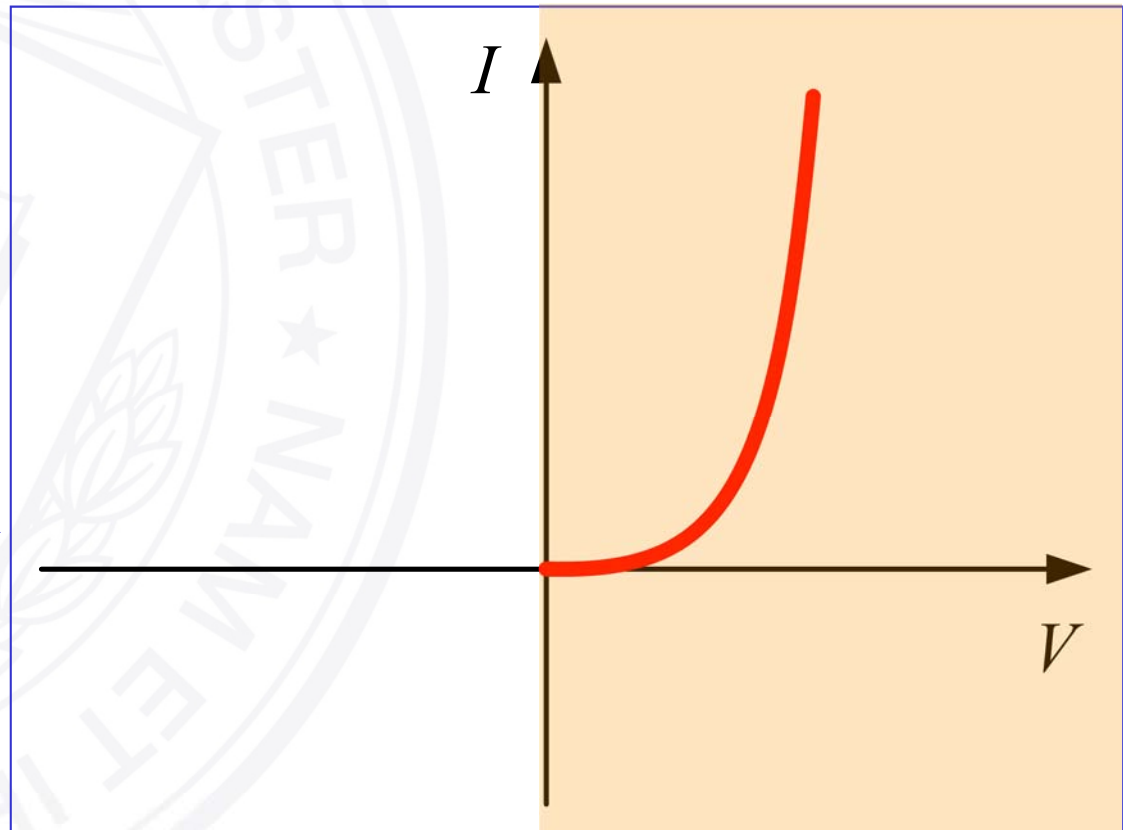
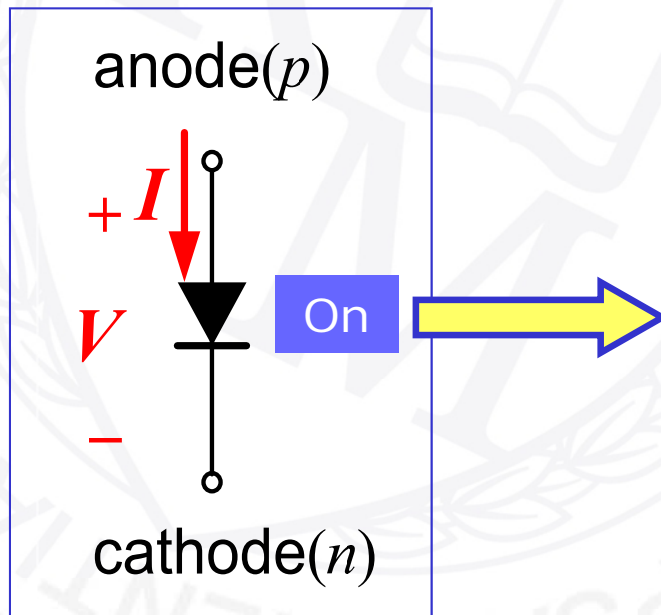
Forward Bias

$$I = I_S (e^{V/V_T} - 1)$$



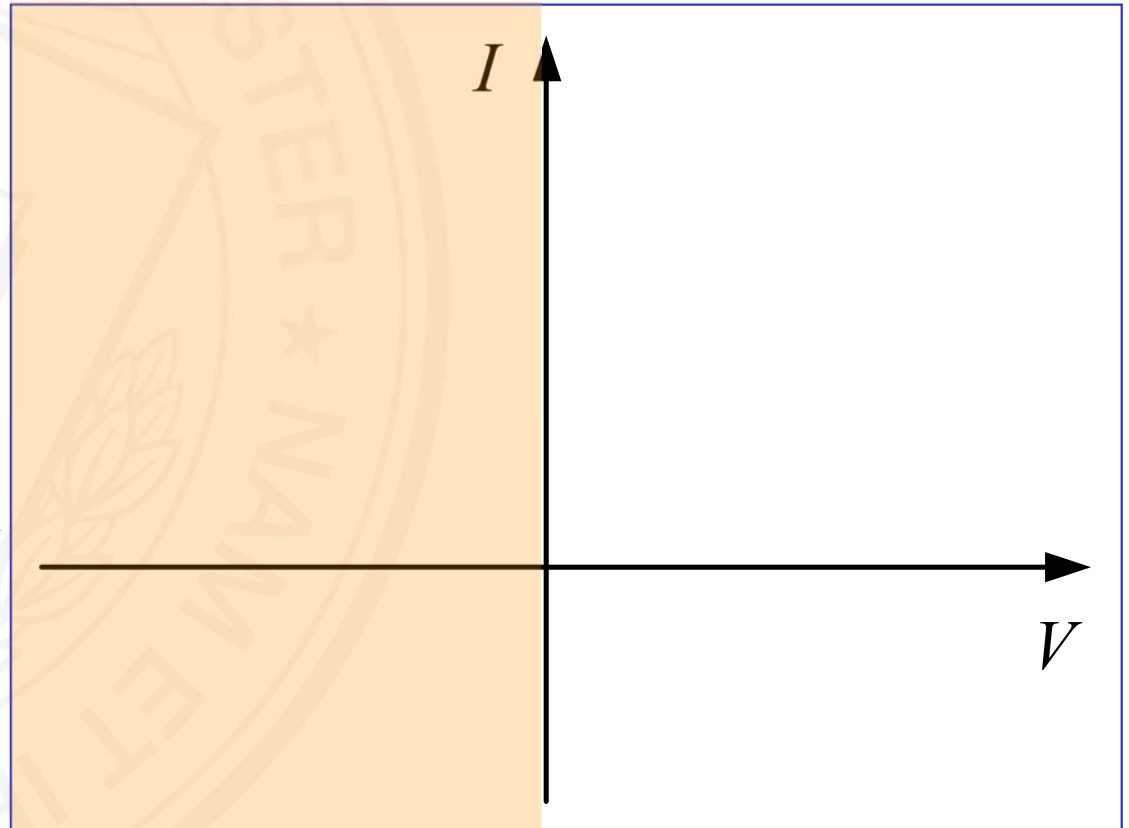
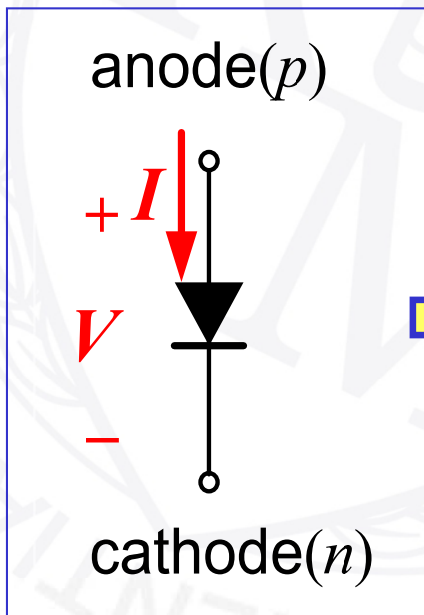
Forward Bias

$$I = I_S (e^{V/V_T} - 1)$$



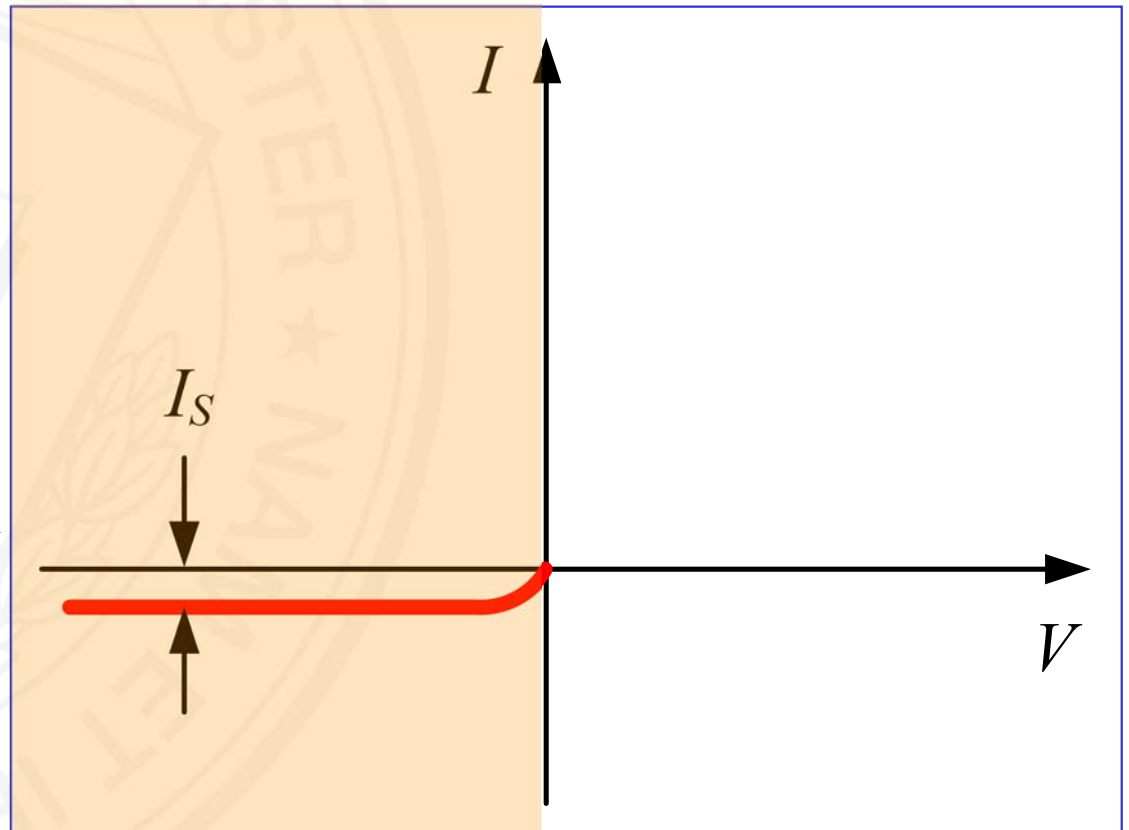
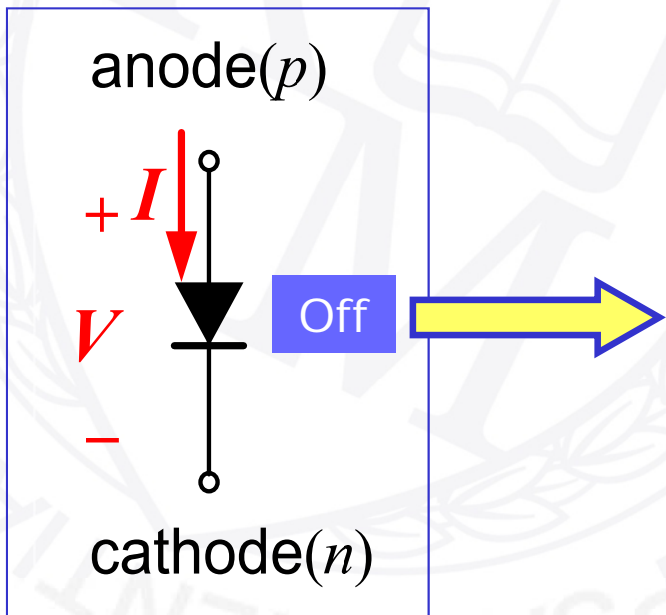
Reverse Bias

$$I = I_S (e^{V/V_T} - 1)$$



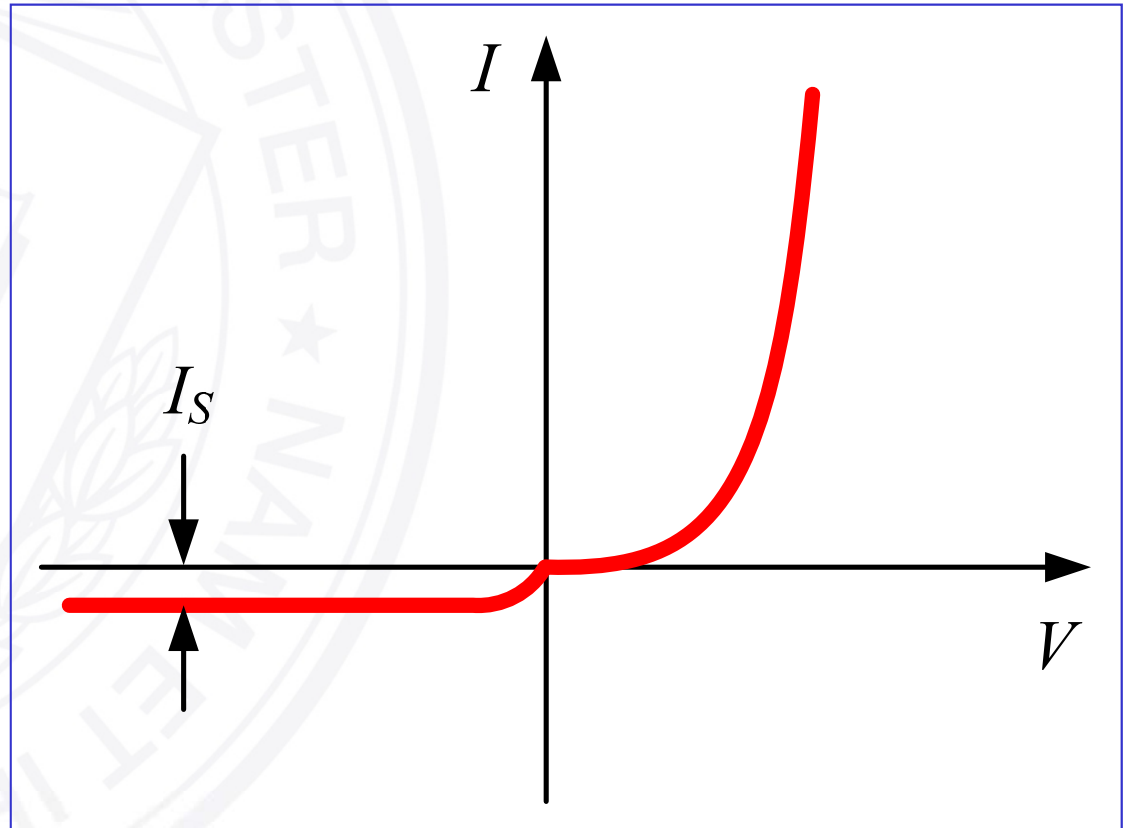
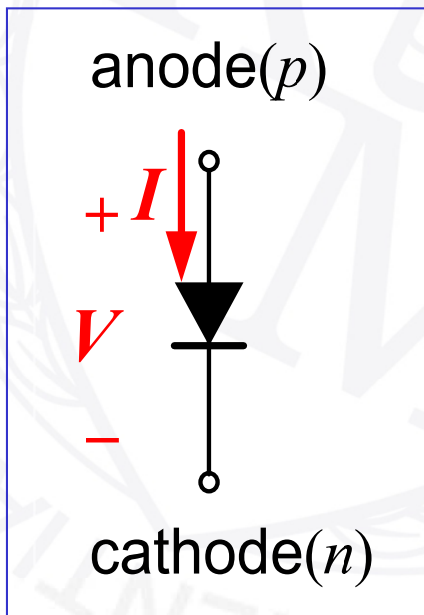
Reverse Bias

$$I = I_S (e^{V/V_T} - 1)$$



I-V Characteristic

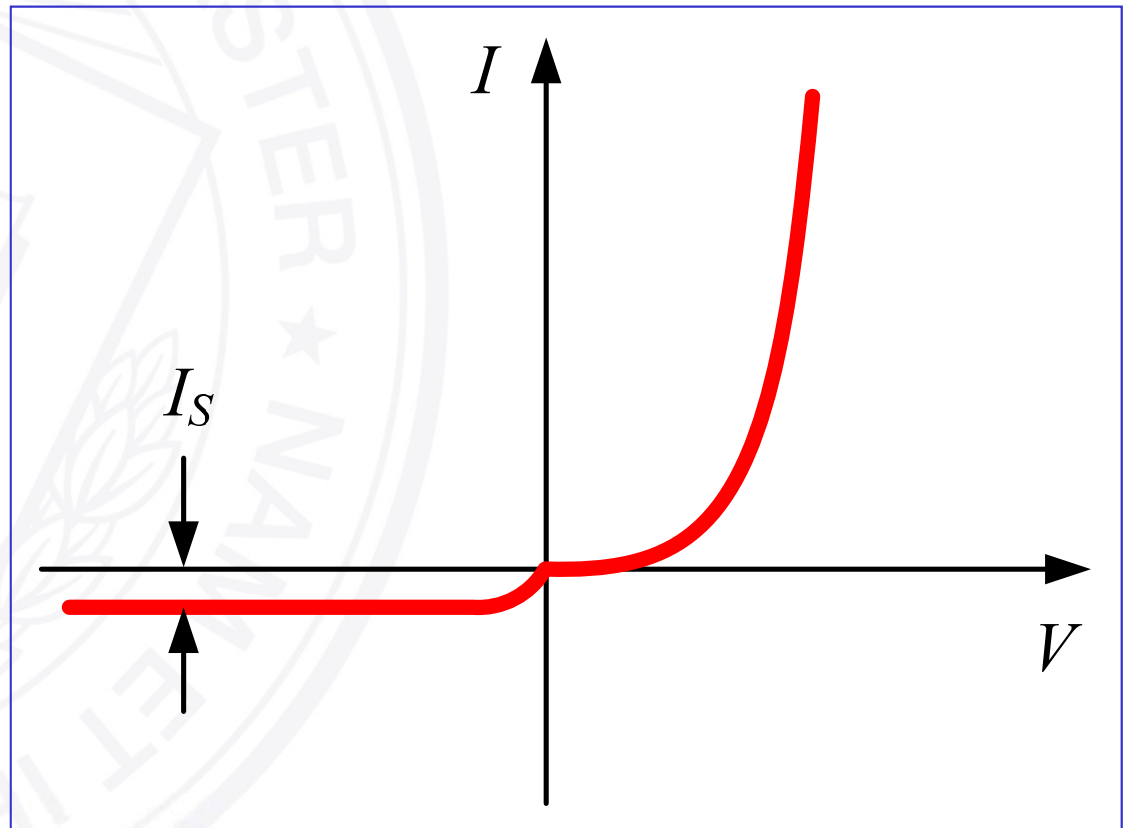
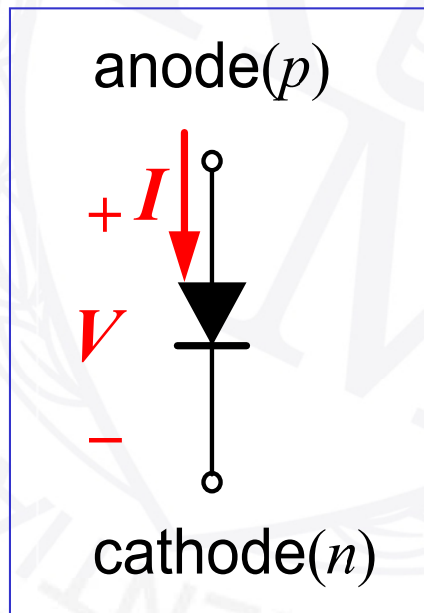
$$I = I_S (e^{V/V_T} - 1)$$



Saturation Current

$$I_S = Aqn_i^2 \left[\frac{D_p}{L_p N_D} + \frac{D_n}{L_n N_A} \right]$$

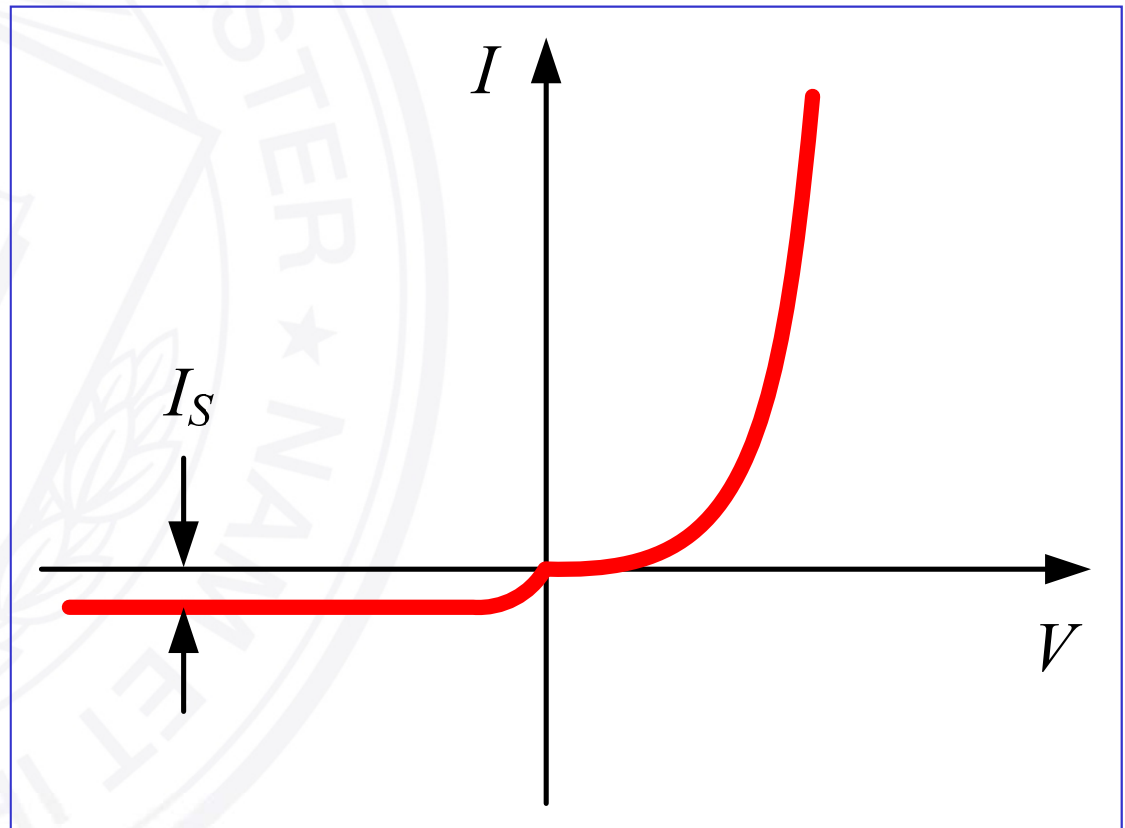
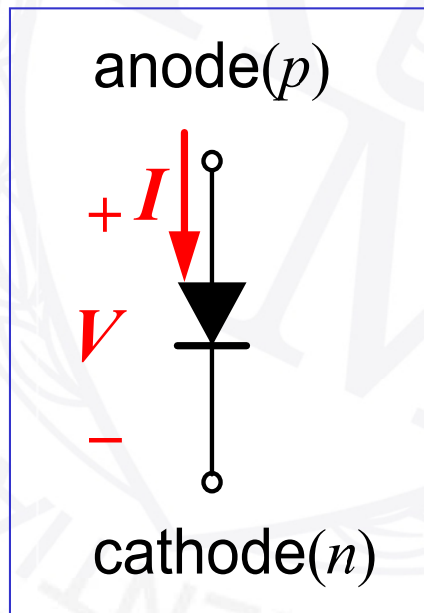
$$I = I_S (e^{V/V_T} - 1)$$



Saturation Current

$$I_S = A q n_i^2 \left[\frac{D_p}{L_p N_D} + \frac{D_n}{L_n N_A} \right]$$

$$I = I_S (e^{V/V_T} - 1)$$



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