WELCOME TO

半導體的世界

晶程所製，電晶為開

---電晶體製程概述

小哥哥小姐姐講半導體

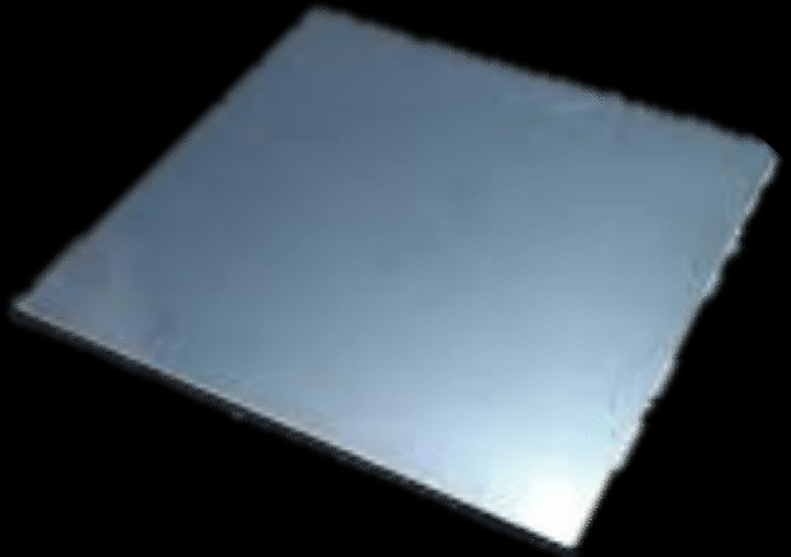
余昕芸、蔡亞庭、許書華、史千儇

甚麼是半導體？

導體？


FREE

鐵片



銅線

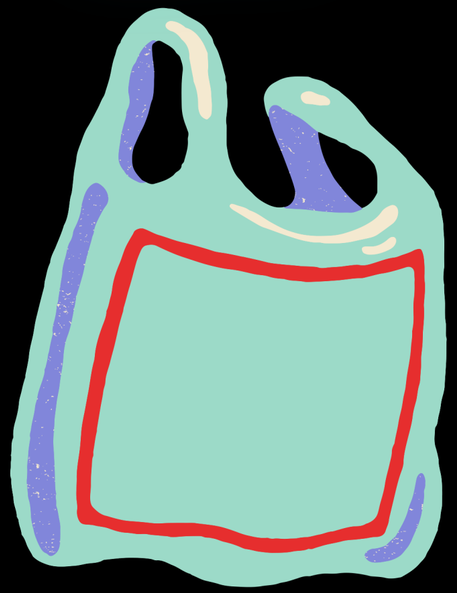
絕緣體？


Canva


Canva

玻璃

塑膠



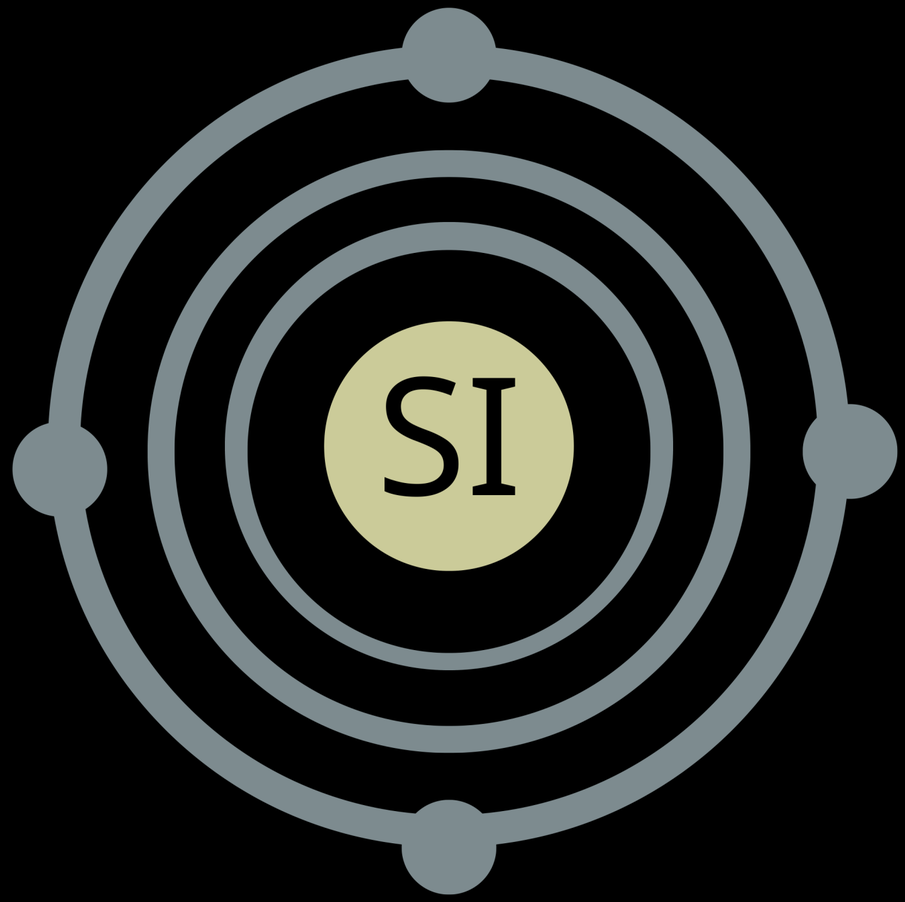
衣服

半導體？


OR

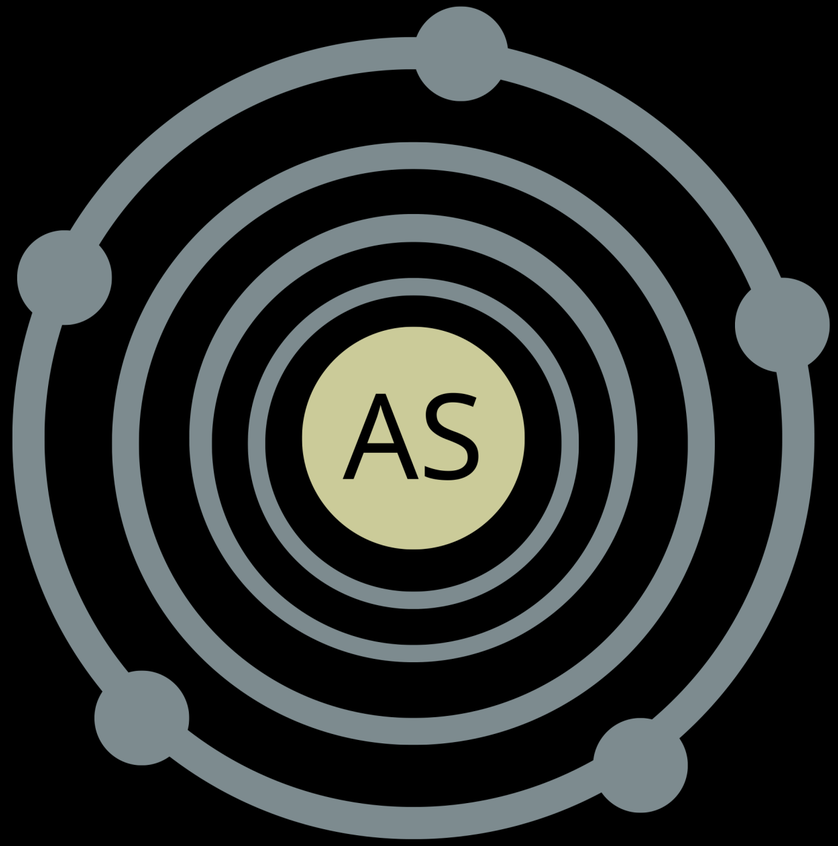

常見的半導體材料有哪些？

- 矽(SI)--4價/量多好取得

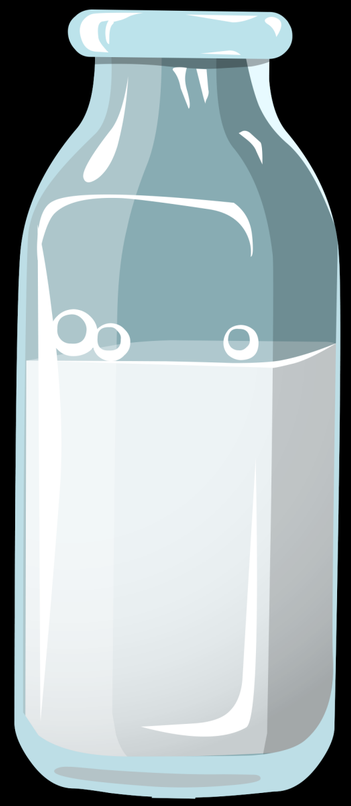

SI

- 鍺(GE)--3價
- 砷(AS)--5價

GE


AS

P型半導體
N型半導體介紹



S 矽

硼

磷

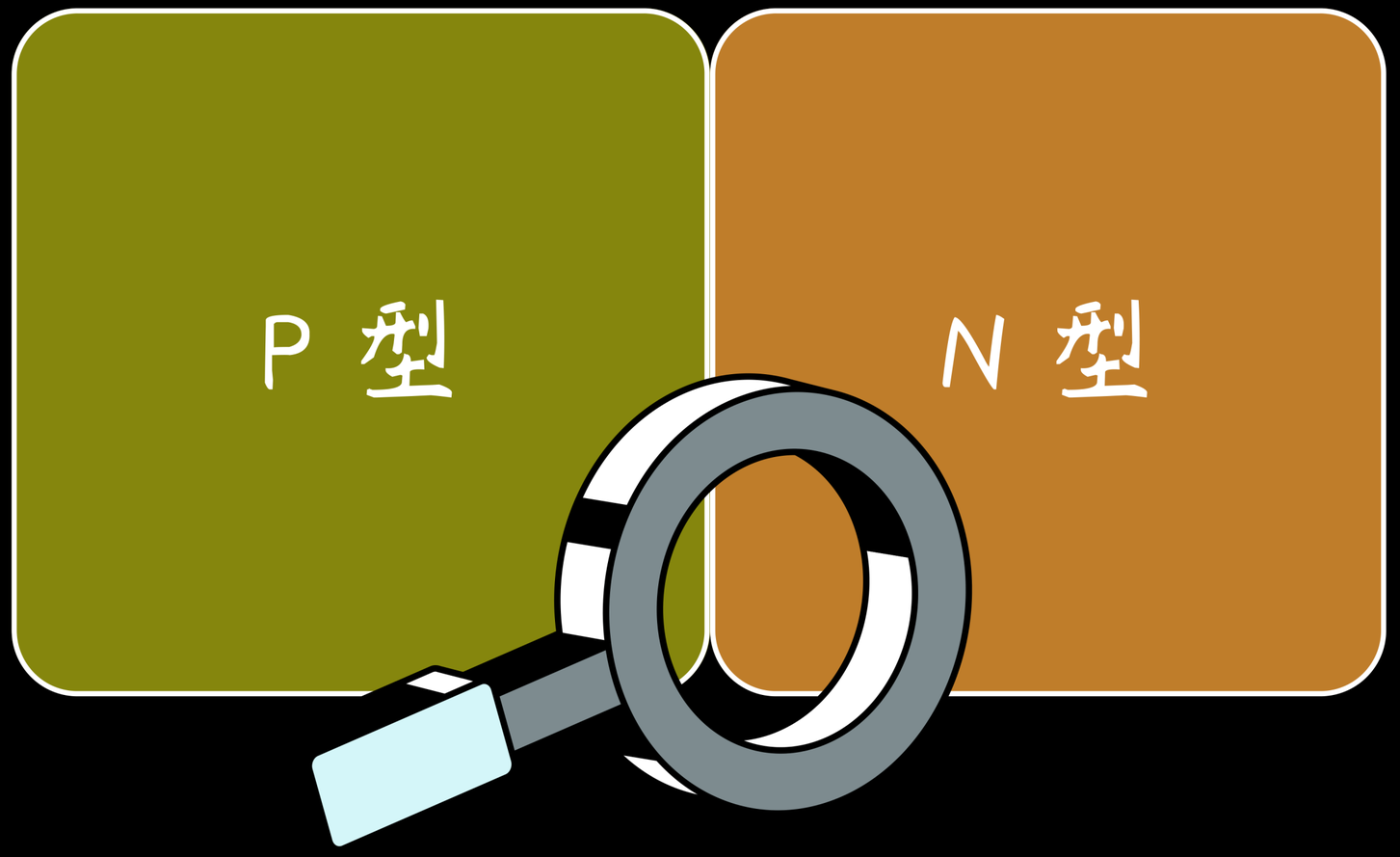
P型半導體

N型半導體

P-N接面二極體

雙極性接面電晶體

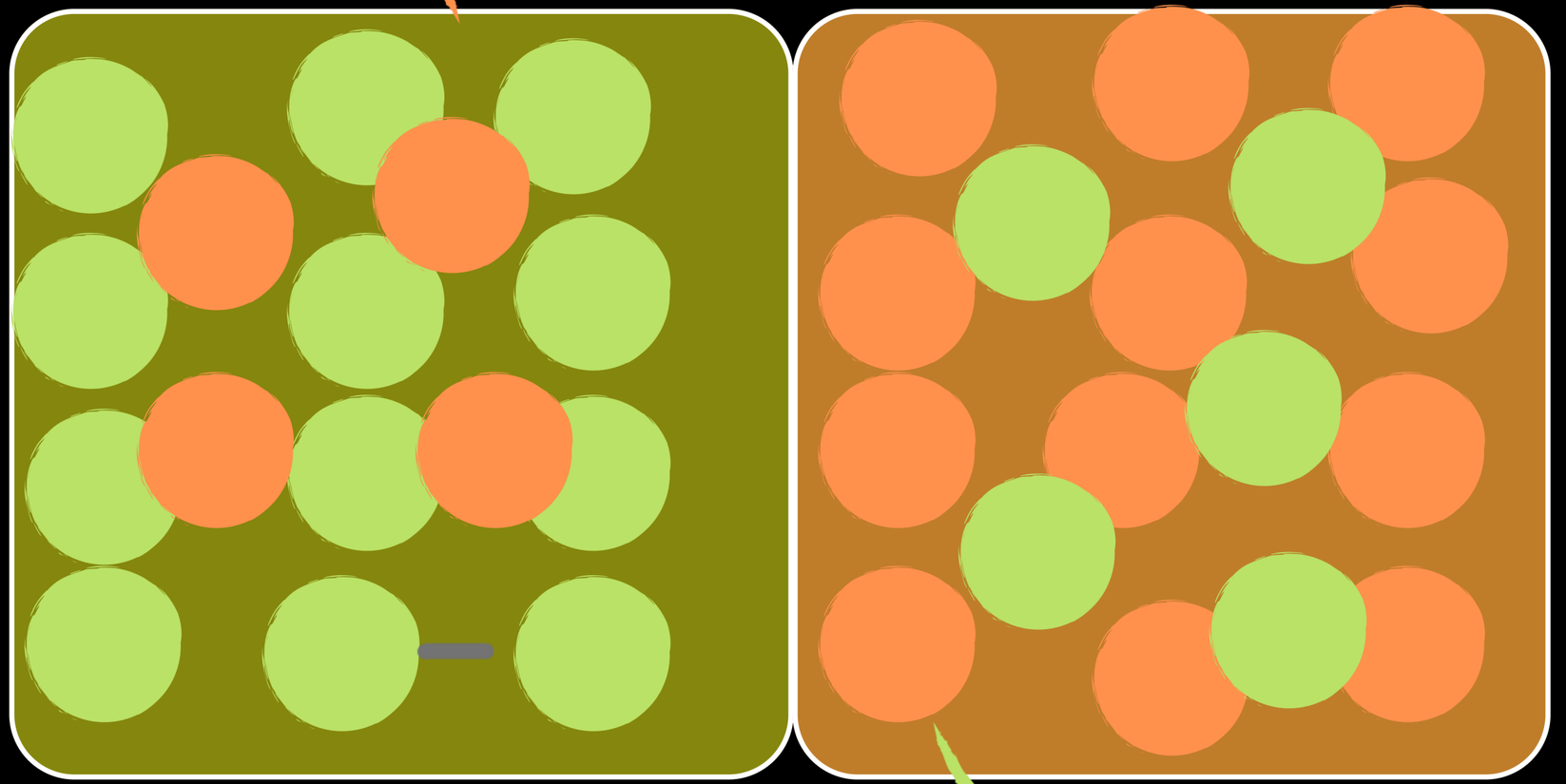
S



S

未加偏壓(不通電)

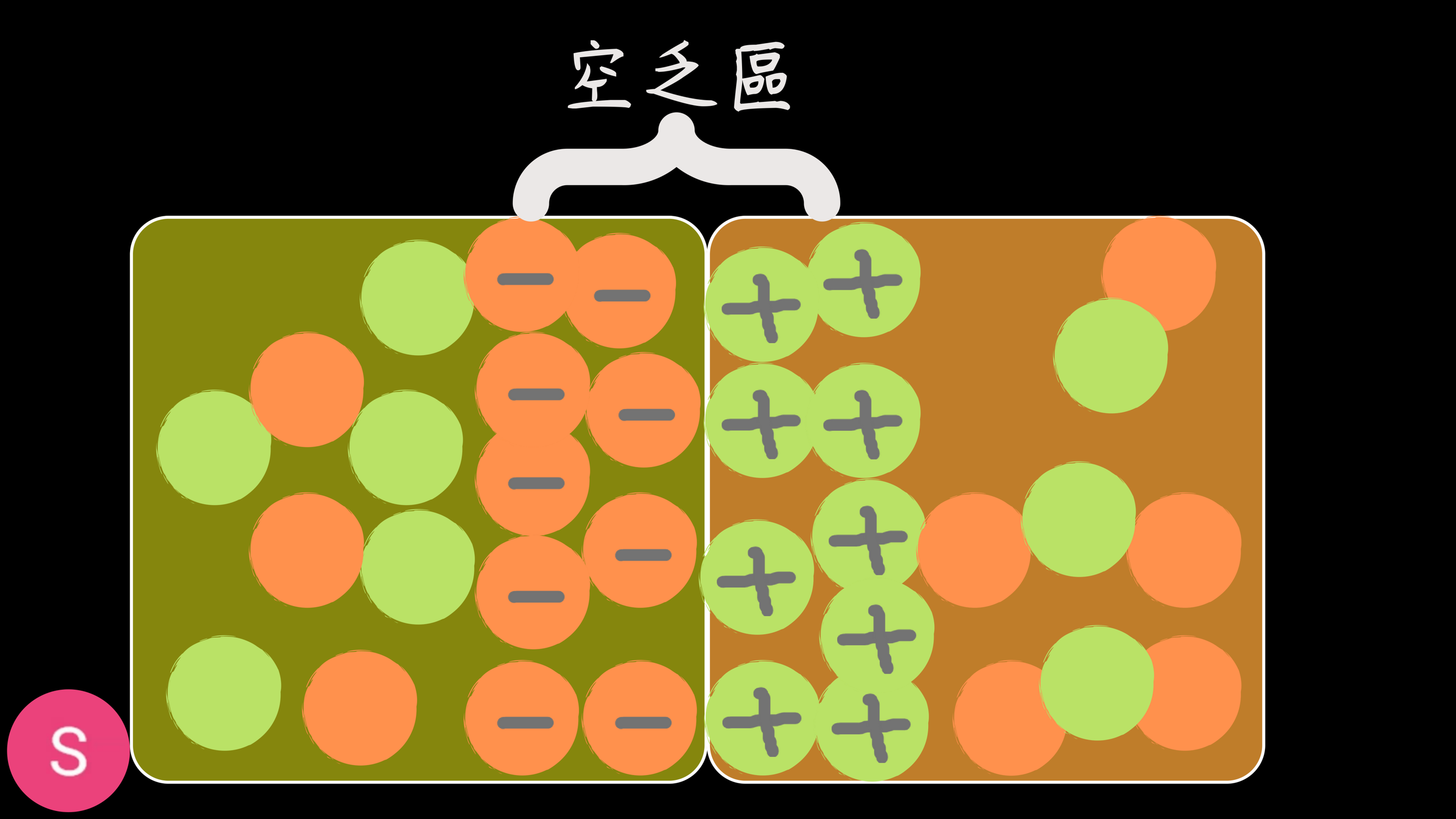
擴散電子流
(飽和電流)



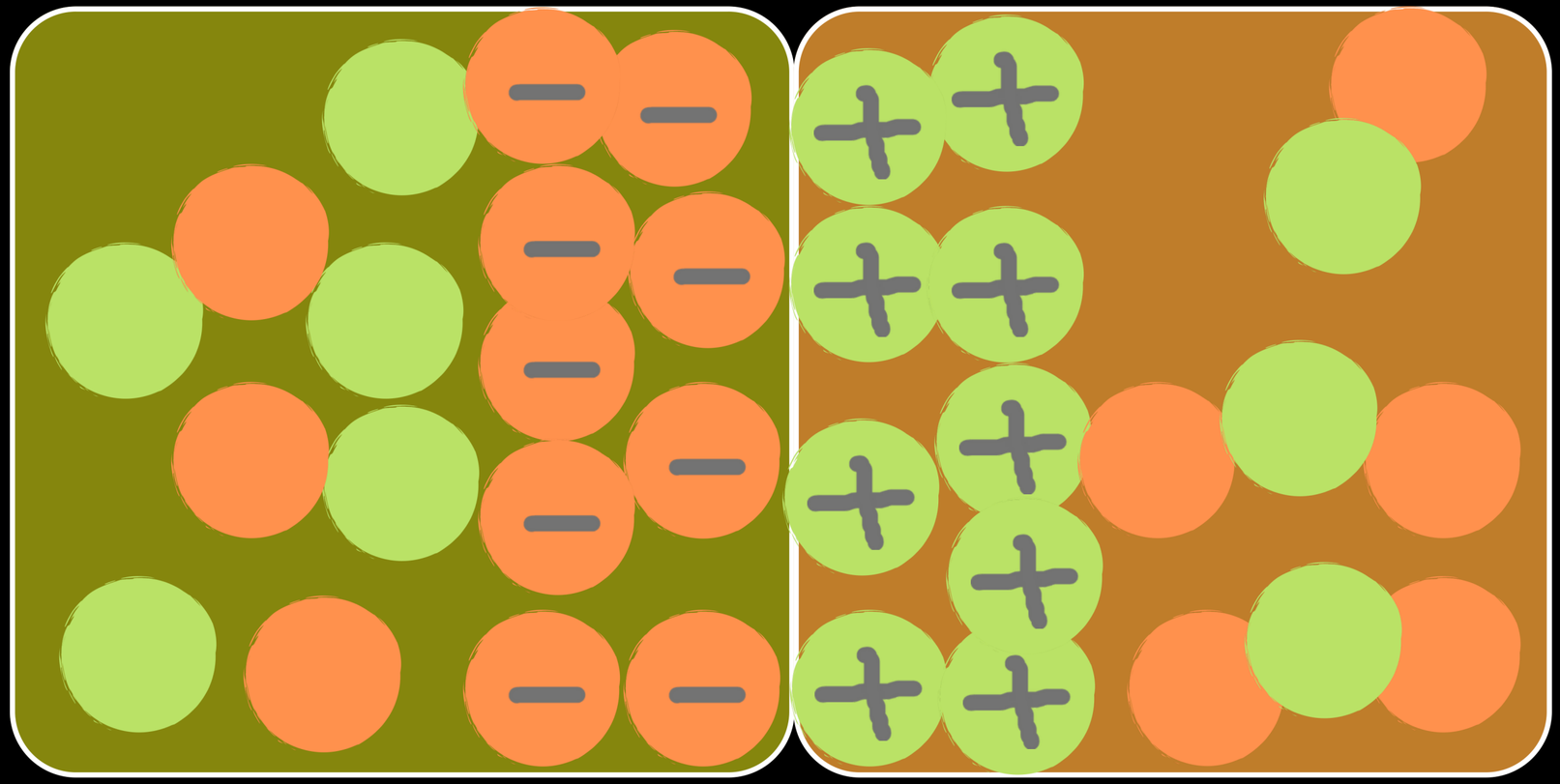
#多往少流

S

擴散電洞流


空乏區
S

飄移電流
(逆向飽和電流)

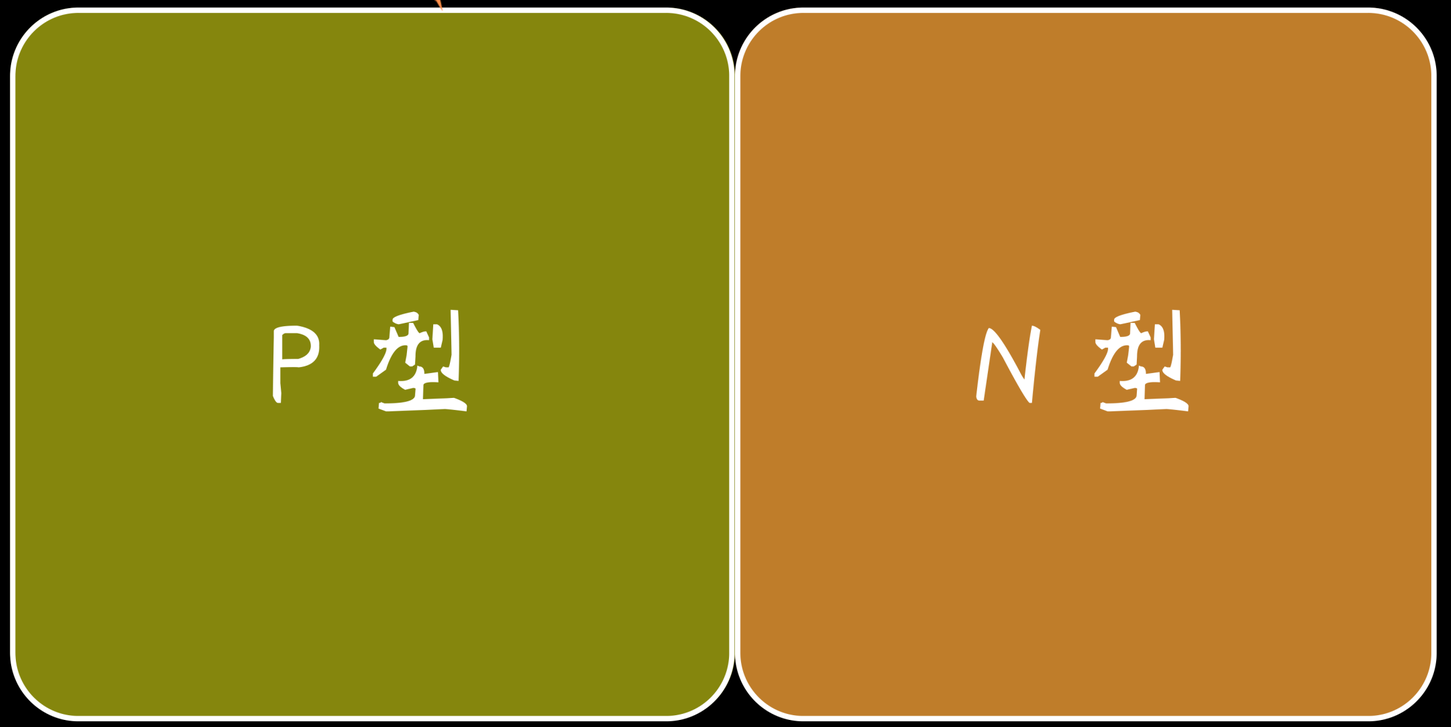


#同性相斥

飄移電子流

飄移電子流

擴散電子流(IF)



S

擴散電洞流(IF)

飄移電流
(逆向飽和電流)

飄移電子流

擴散電子流

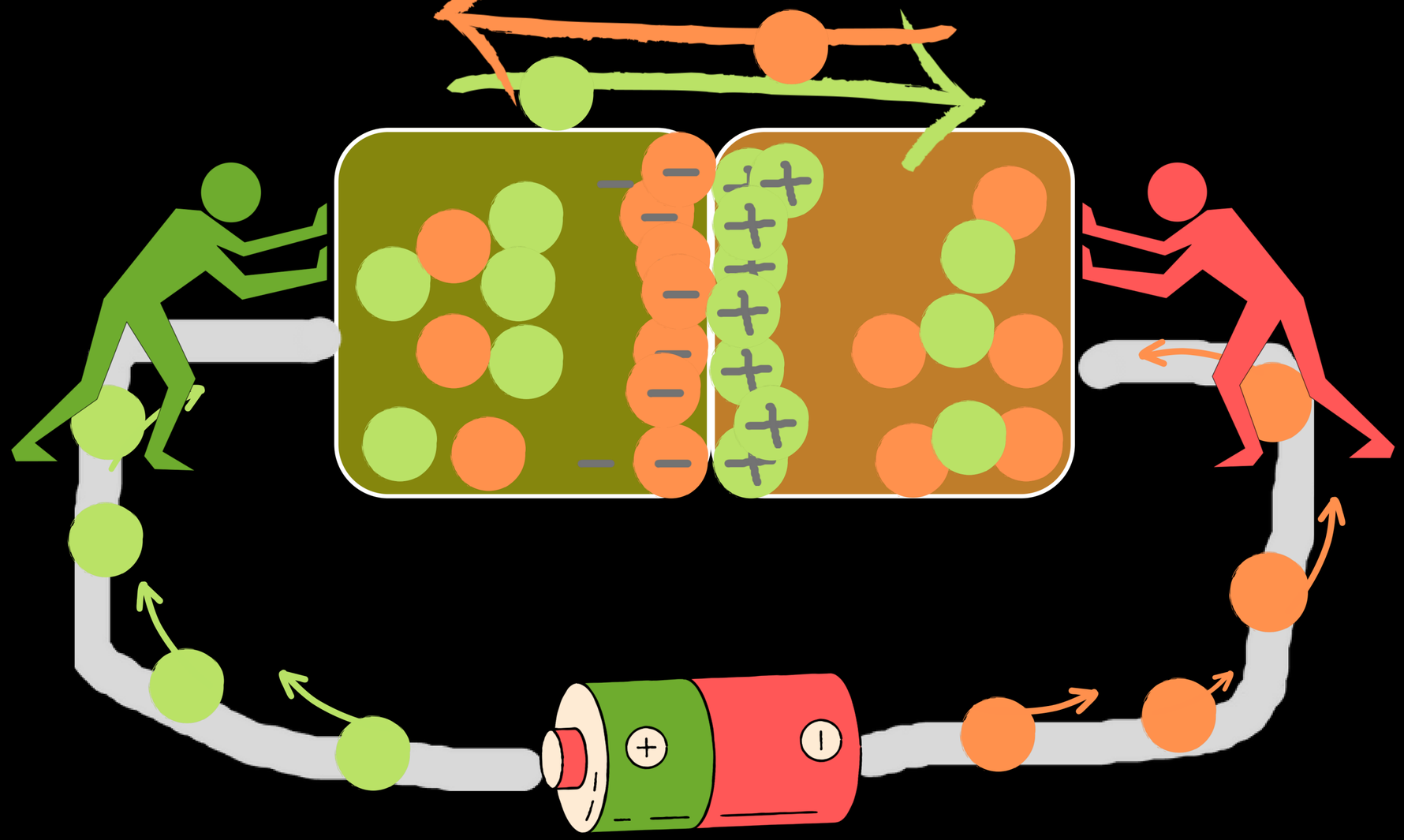
達到平衡

S

擴散電洞流

飄移電流

外加順向偏壓　形成大量擴散電洞/子流

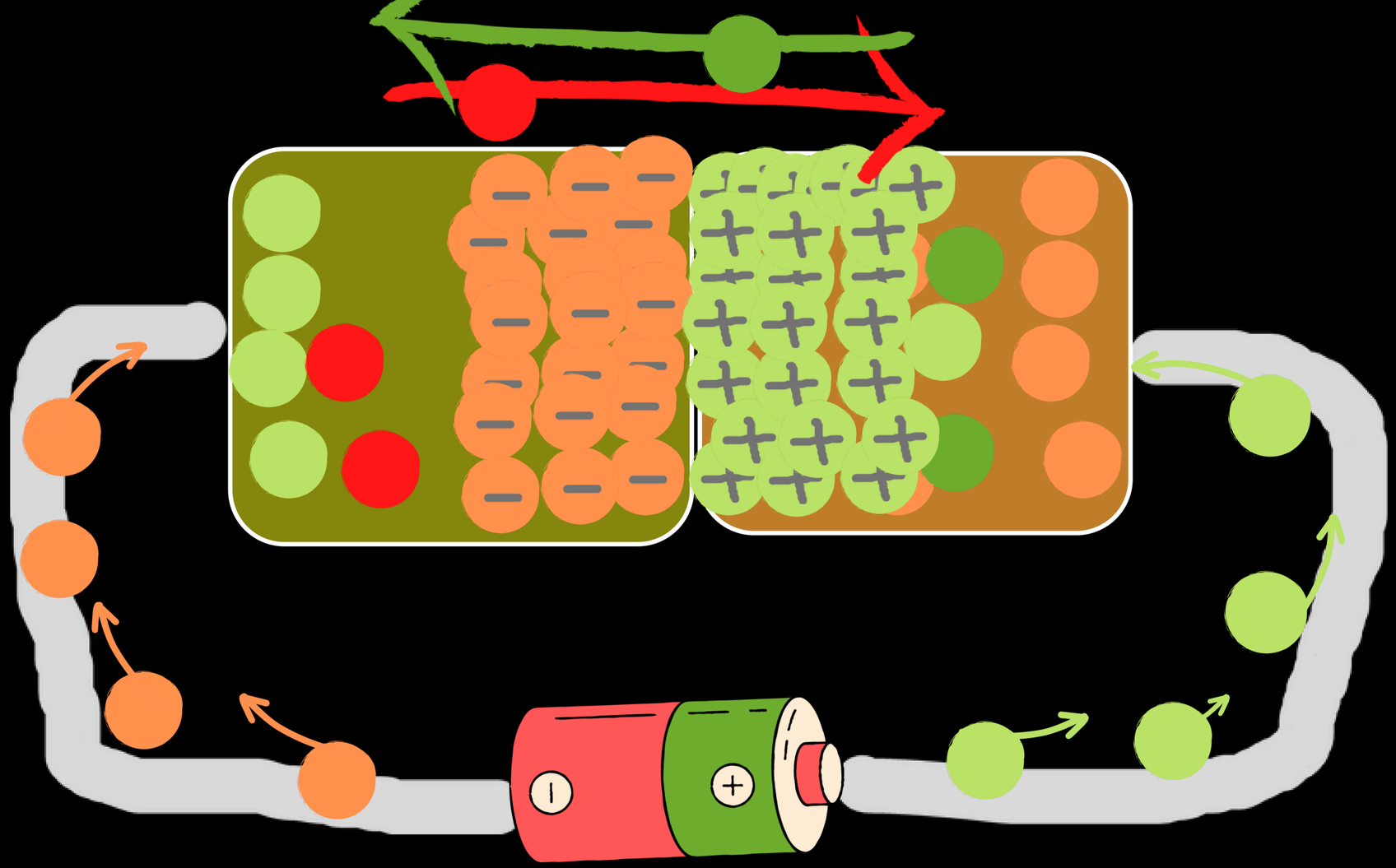


#多往少流

外加逆向偏壓

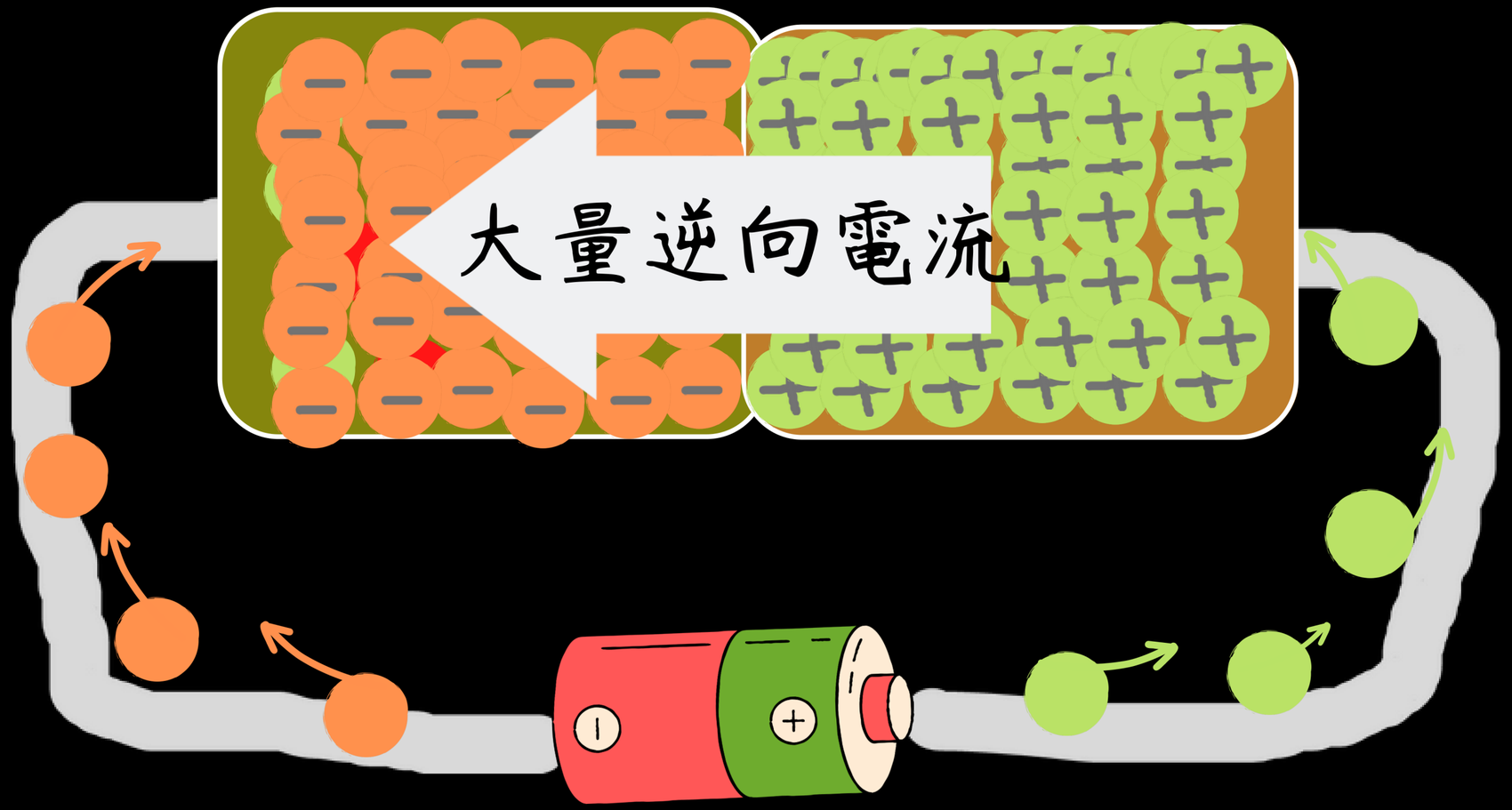
形成大量飄移電洞/子流

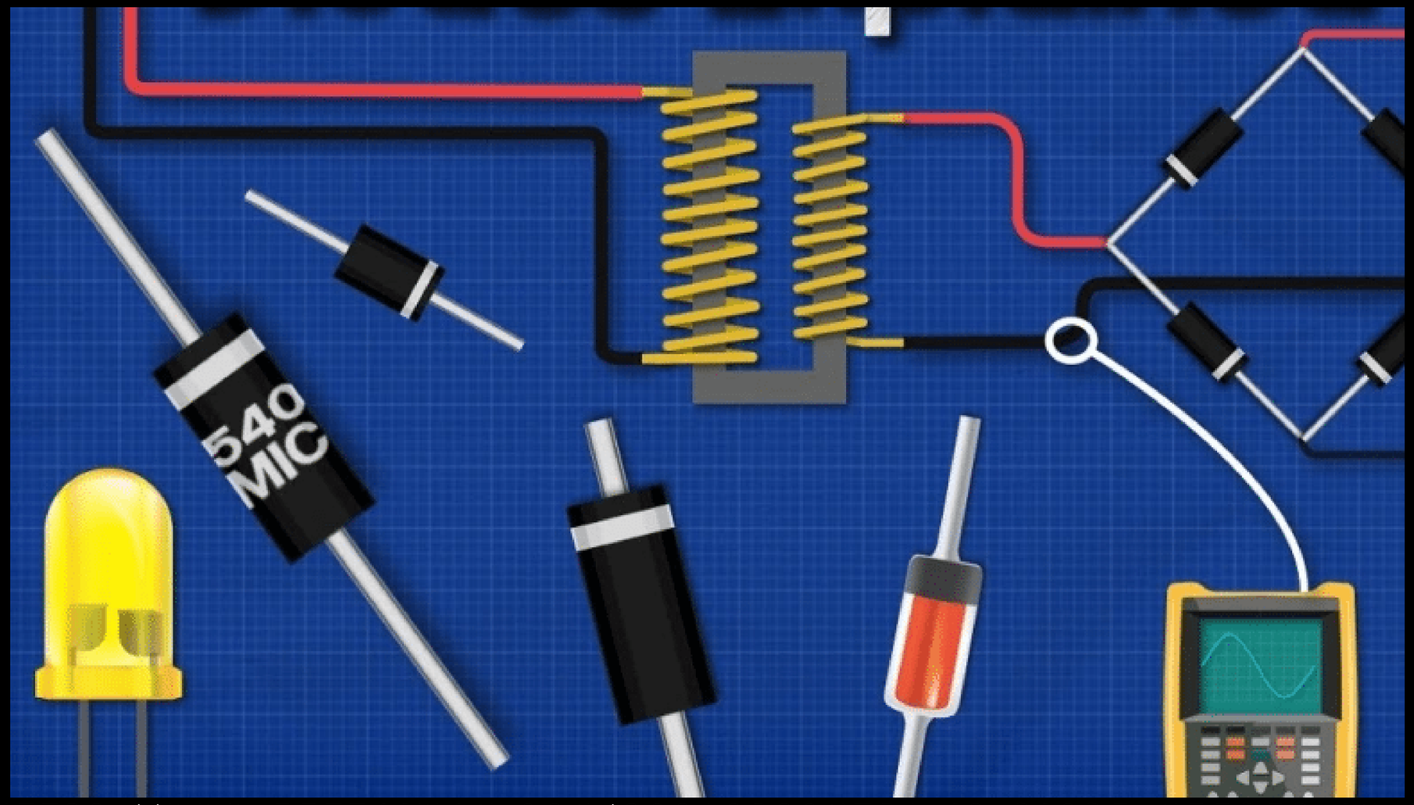
#同性相斥



外加逆向偏壓-->崩潰特性-->二極體燒毀

#同性相斥





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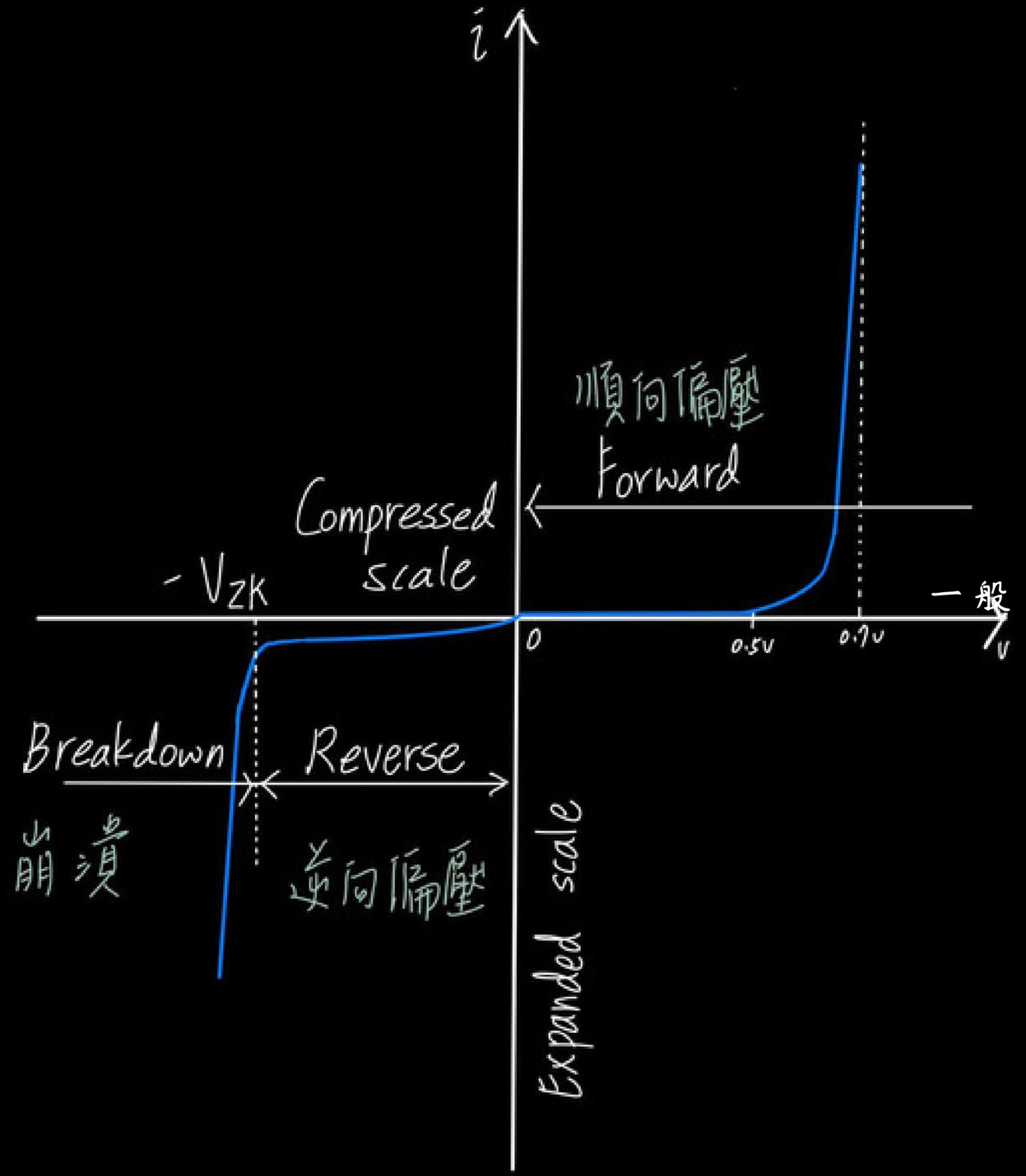
二極體是什麼?



一般

蕭特基

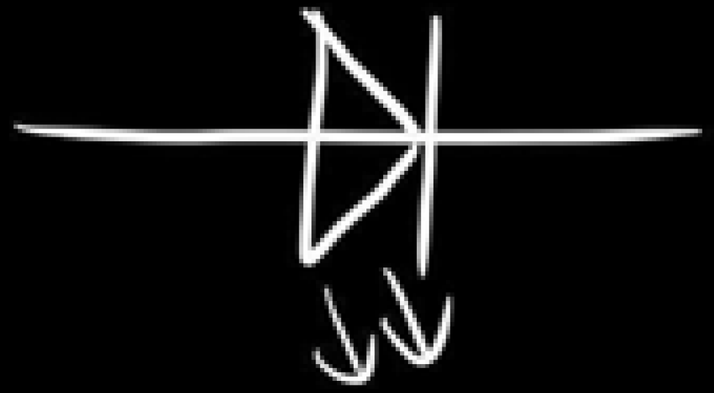
隧道

變容

齊納

光電

常見的二極體有哪些?



發光二極體

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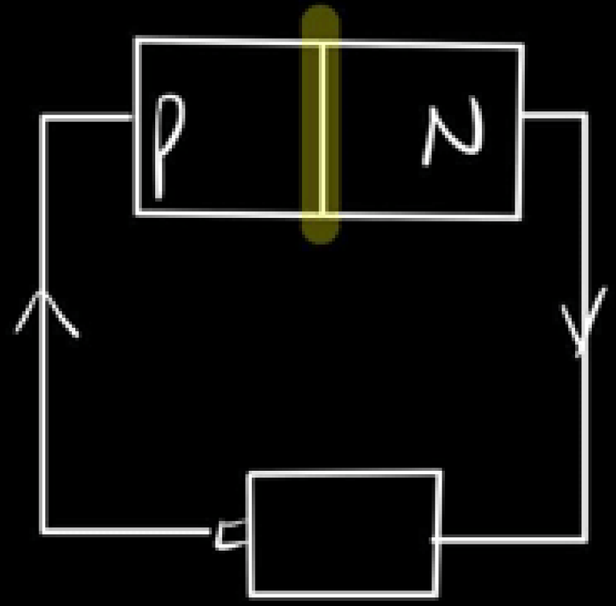
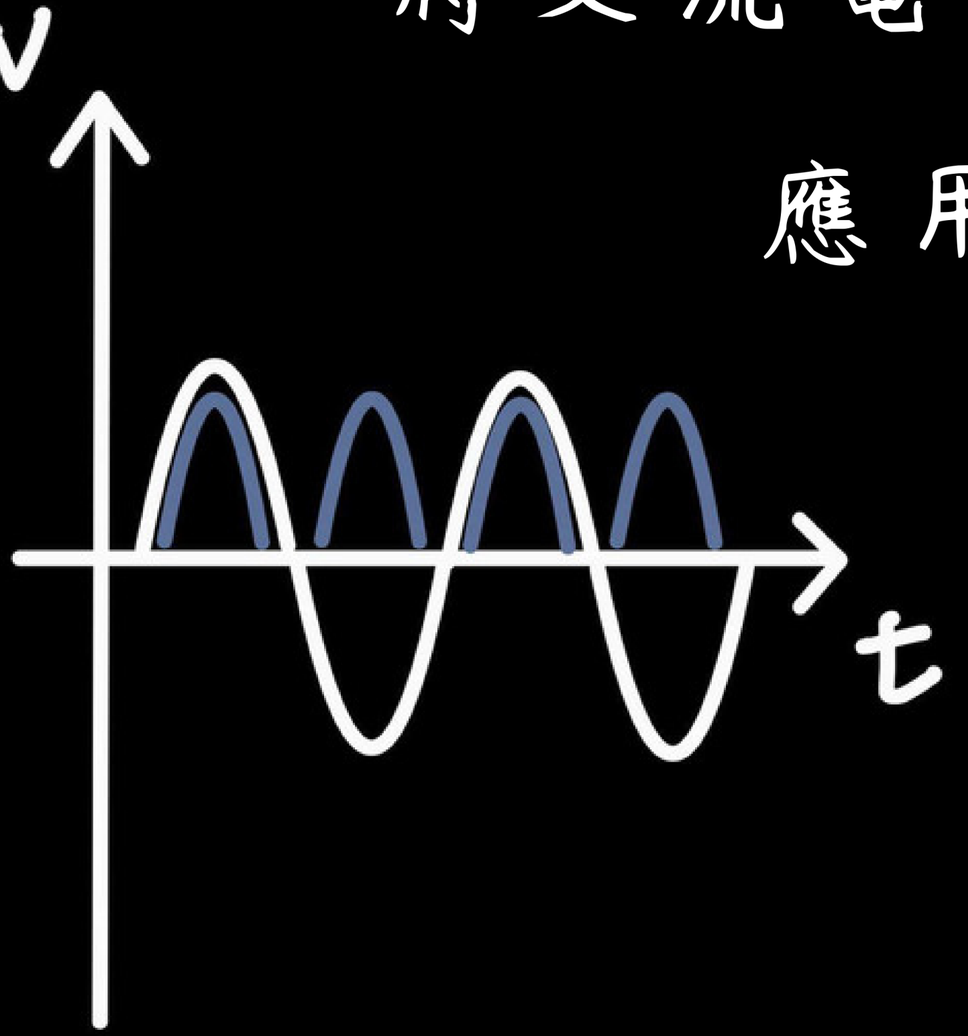
發光(PN接面)



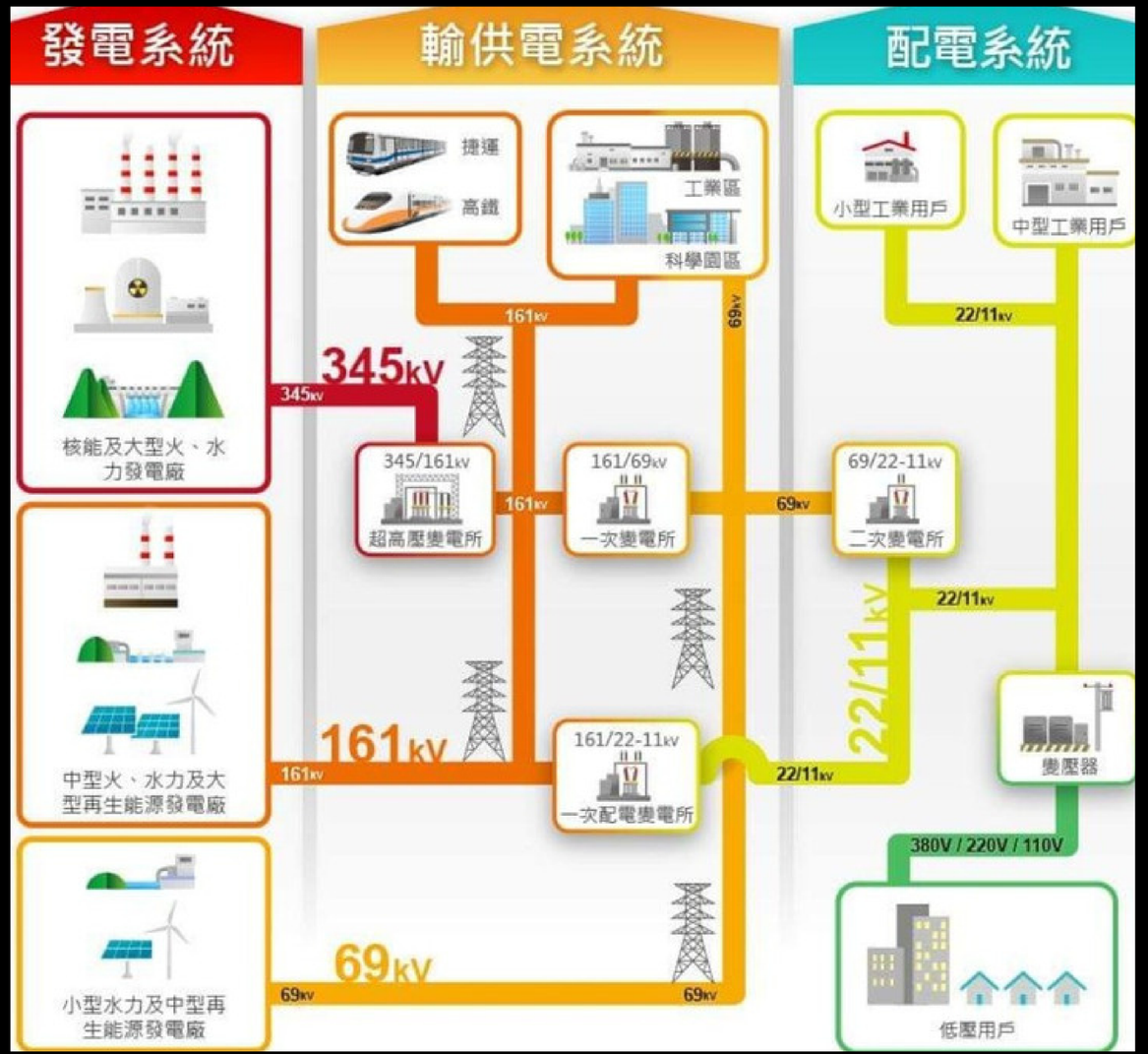
順向偏壓

整流二極體

將交流電（AC）轉為直流電（DC）



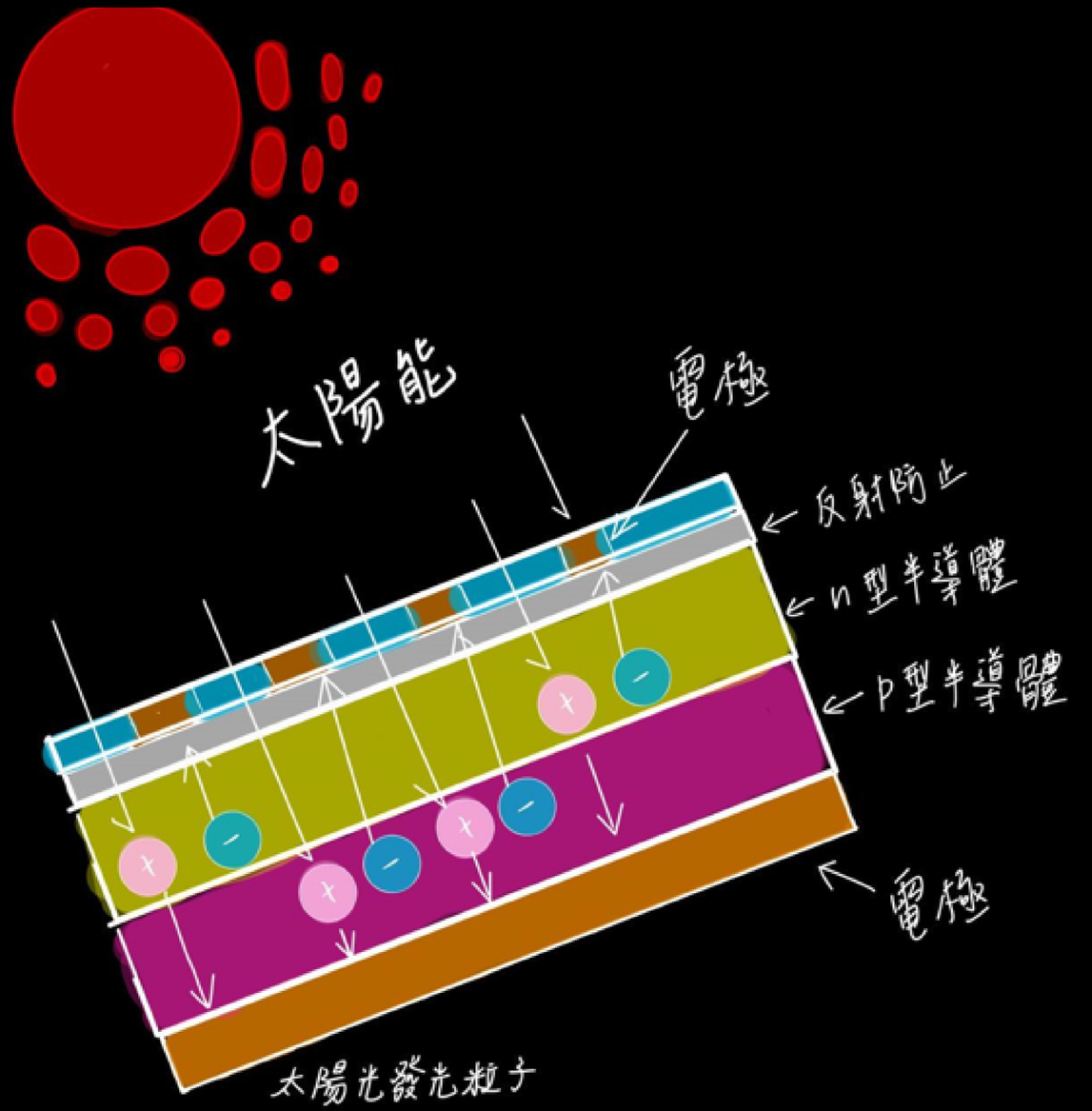
應用



來源：台灣電力公司

太陽能電池

由P型半導體和N型半導體構成，當適當光線照射到太陽能電池模組時，光能激發電子，造成電位差，配合外加的導線電路，即可產生電流



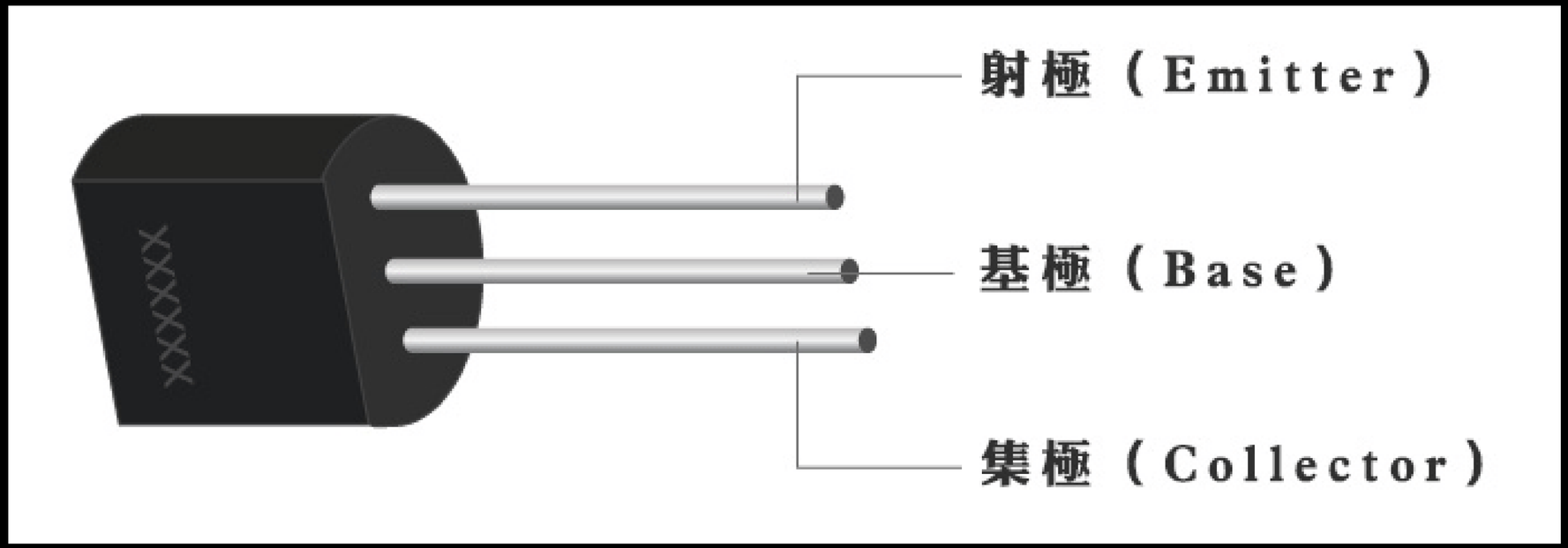
電晶體介紹

定義:電晶體是一種半導體器件，用於傳導、絕緣電流及電壓

種類:分為BJT & FET

功能:開關和放大器

簡單來說，電晶體是一種微型元件，用於控制和調節電子信號的流動。



電晶體管有三個端子：

基極（BASE）

集極（COLLECTOR）

射極（EMITTER）

雙極性接面電晶體(BJT)

功能:放大器、開關

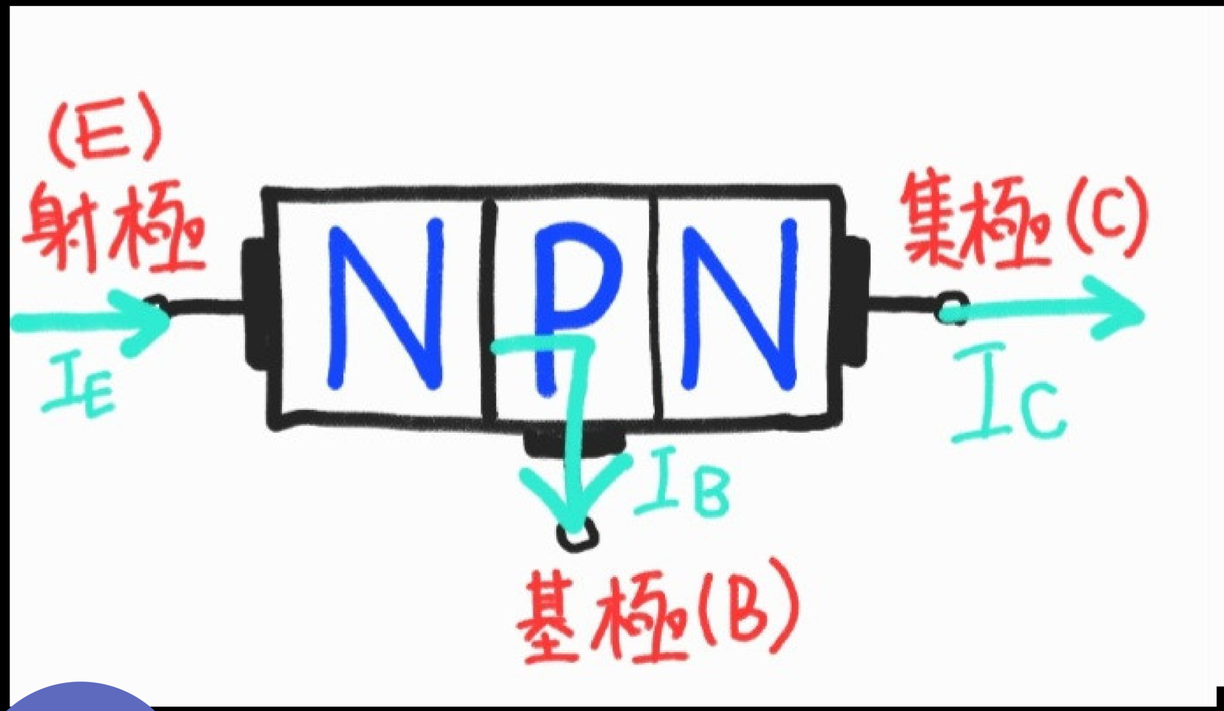
組成:P-N接面二極體+N/P型半導體

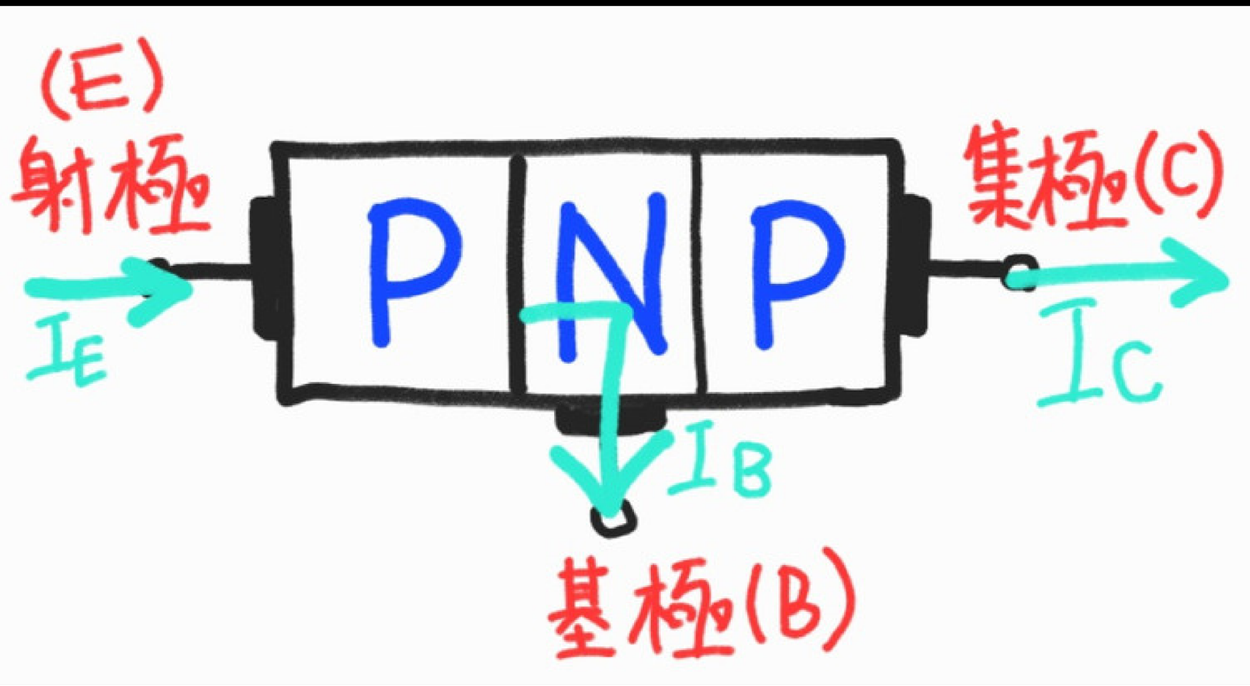
種類:分為NPN & PNP

NPN & PNP 比較

PNP:P型為射極，P型的多數載子為電洞

NPN:N型為射極，N型的多數載子為電子

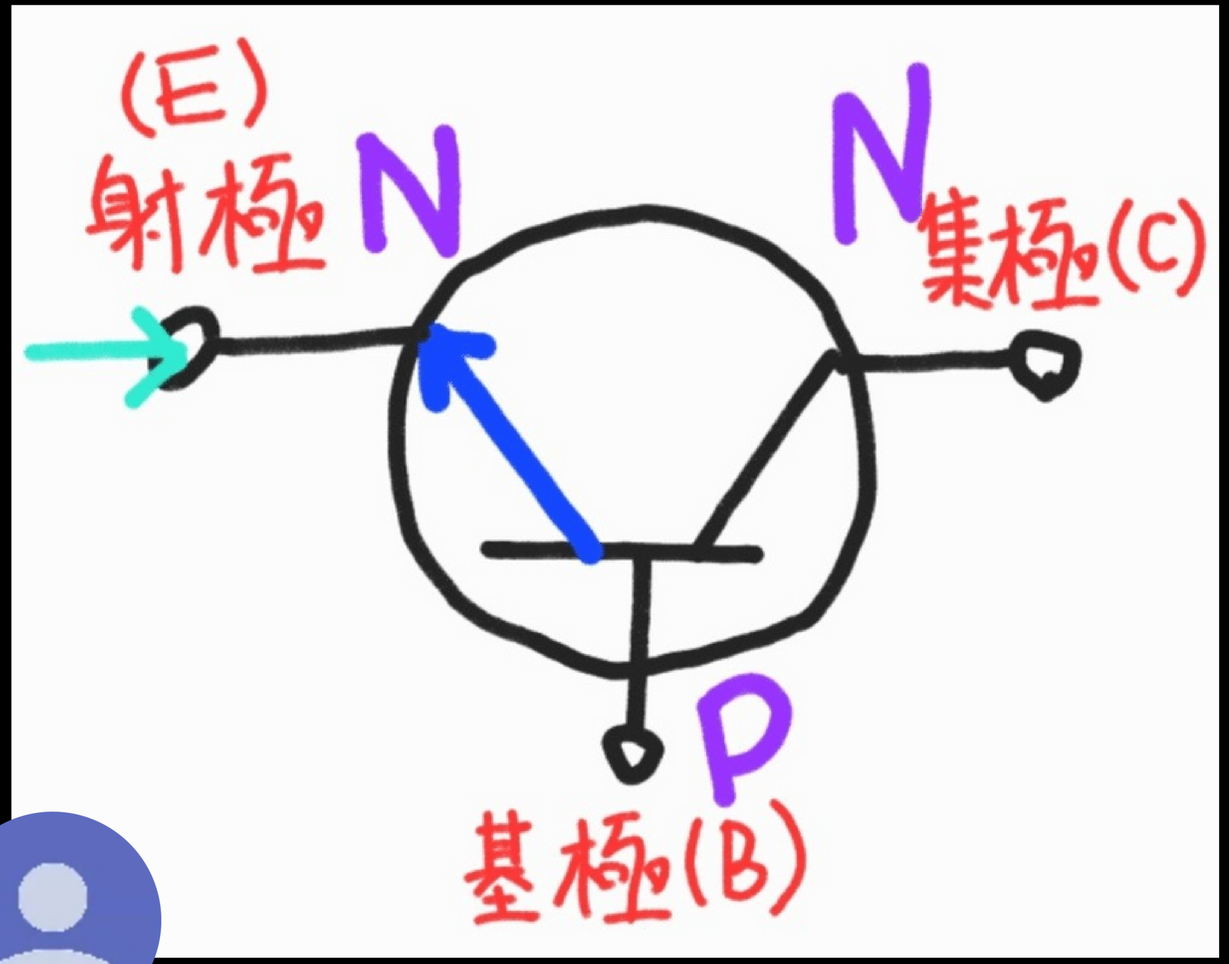




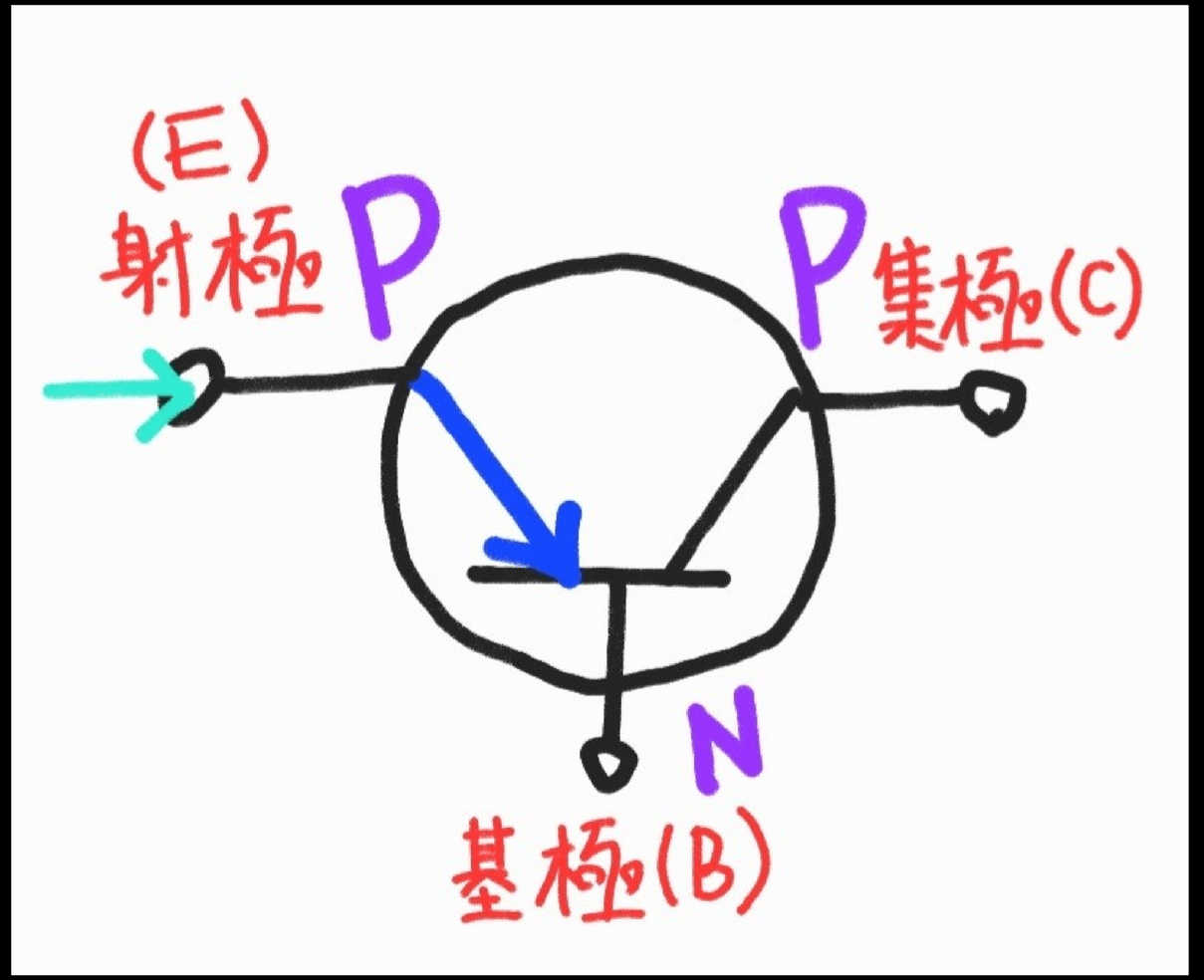
$$I_E = I_B + I_C$$

符號

NPN

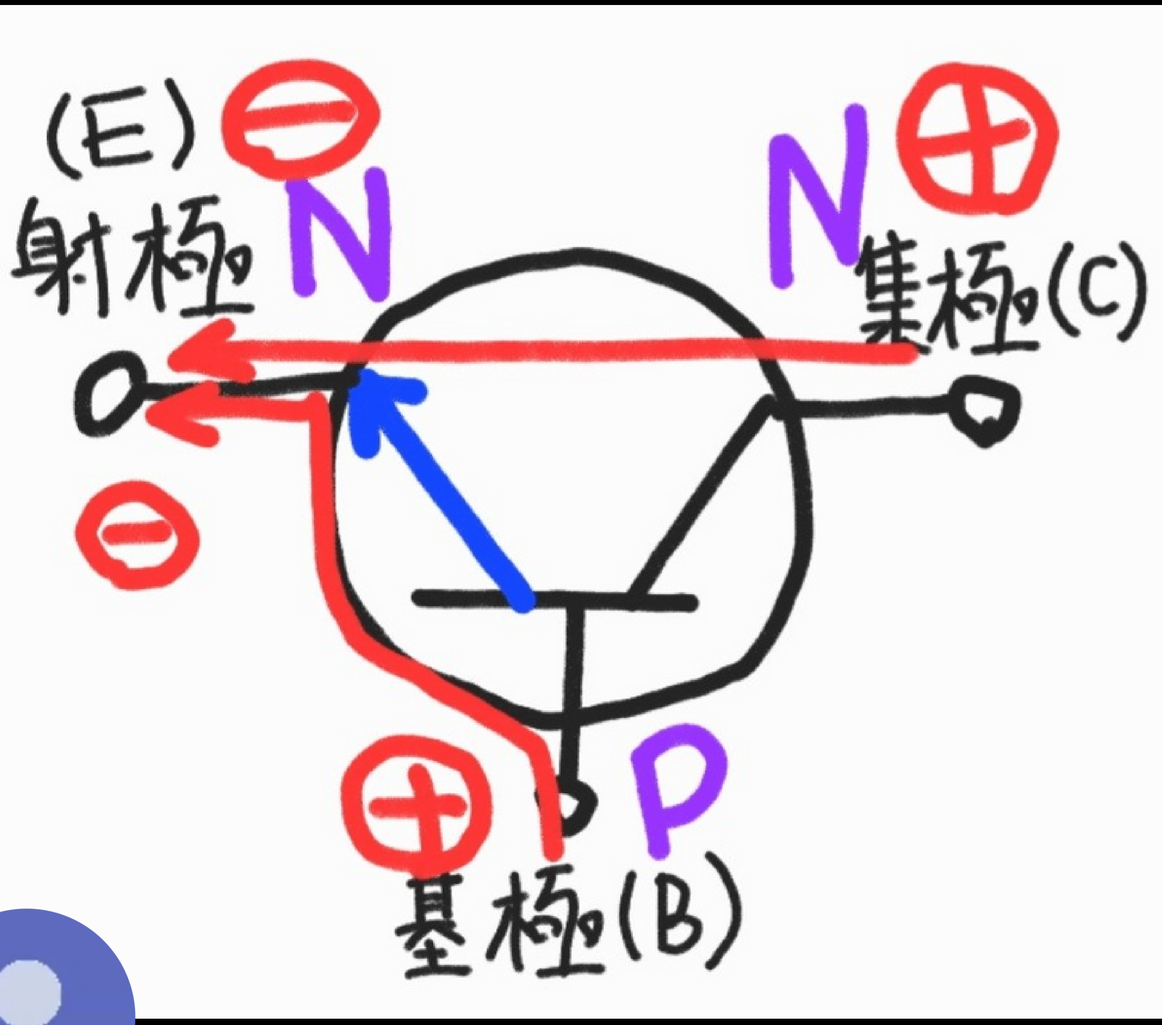


PNP

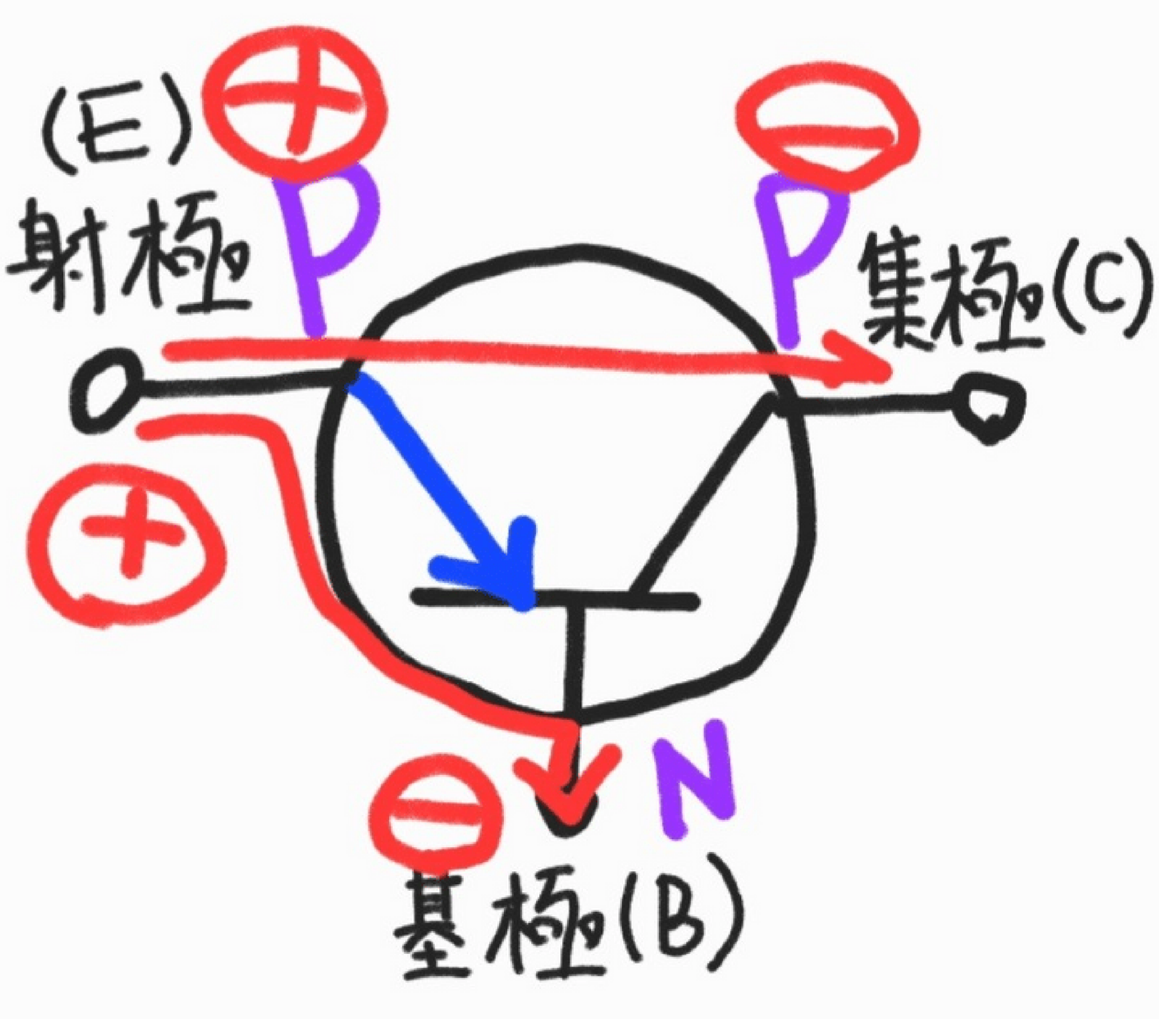


符號

NPN



PNP



電場效應電晶體(FET)

接腳介紹:

SOURSE(S)源極:發射多數載子，多數載子的來源

GATE(G)閘極:控制多數載子通過的數量

DRAIN(D)汲極:收集發射過來的多數載子、提供多數載子流出

分類:

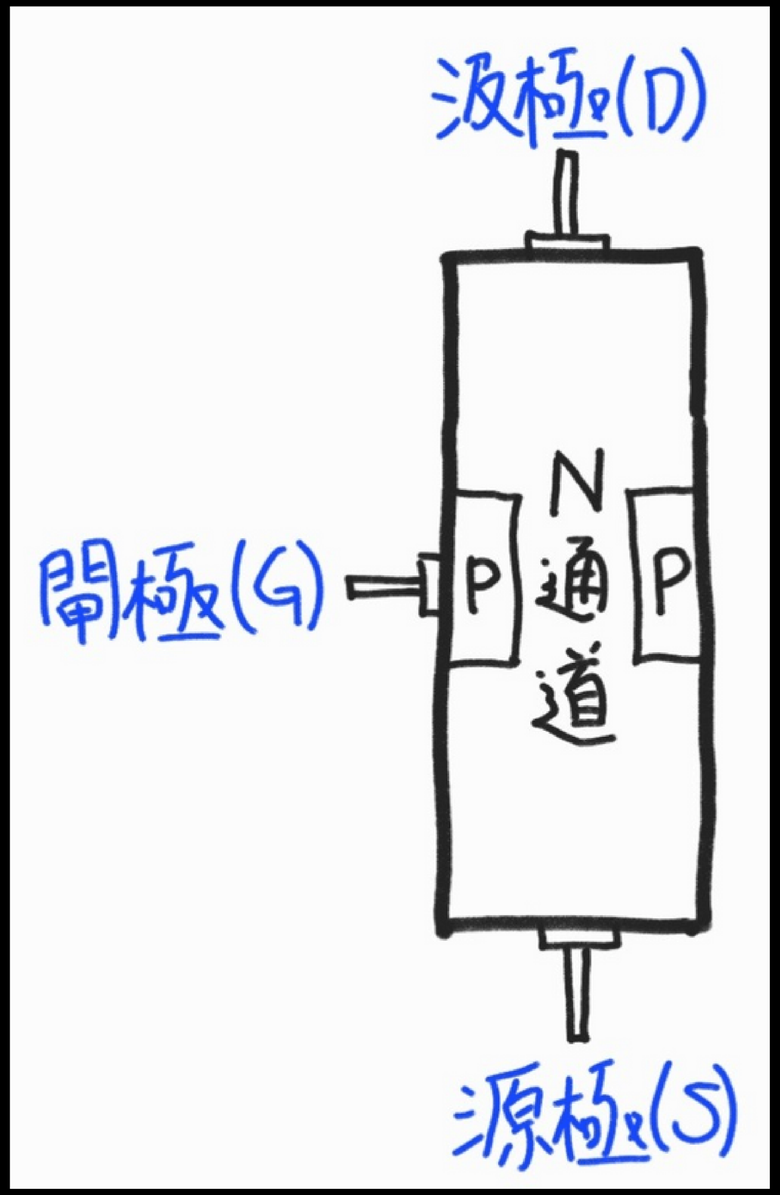
1.JFET(接面場效電晶體): 分為P通道和N通道

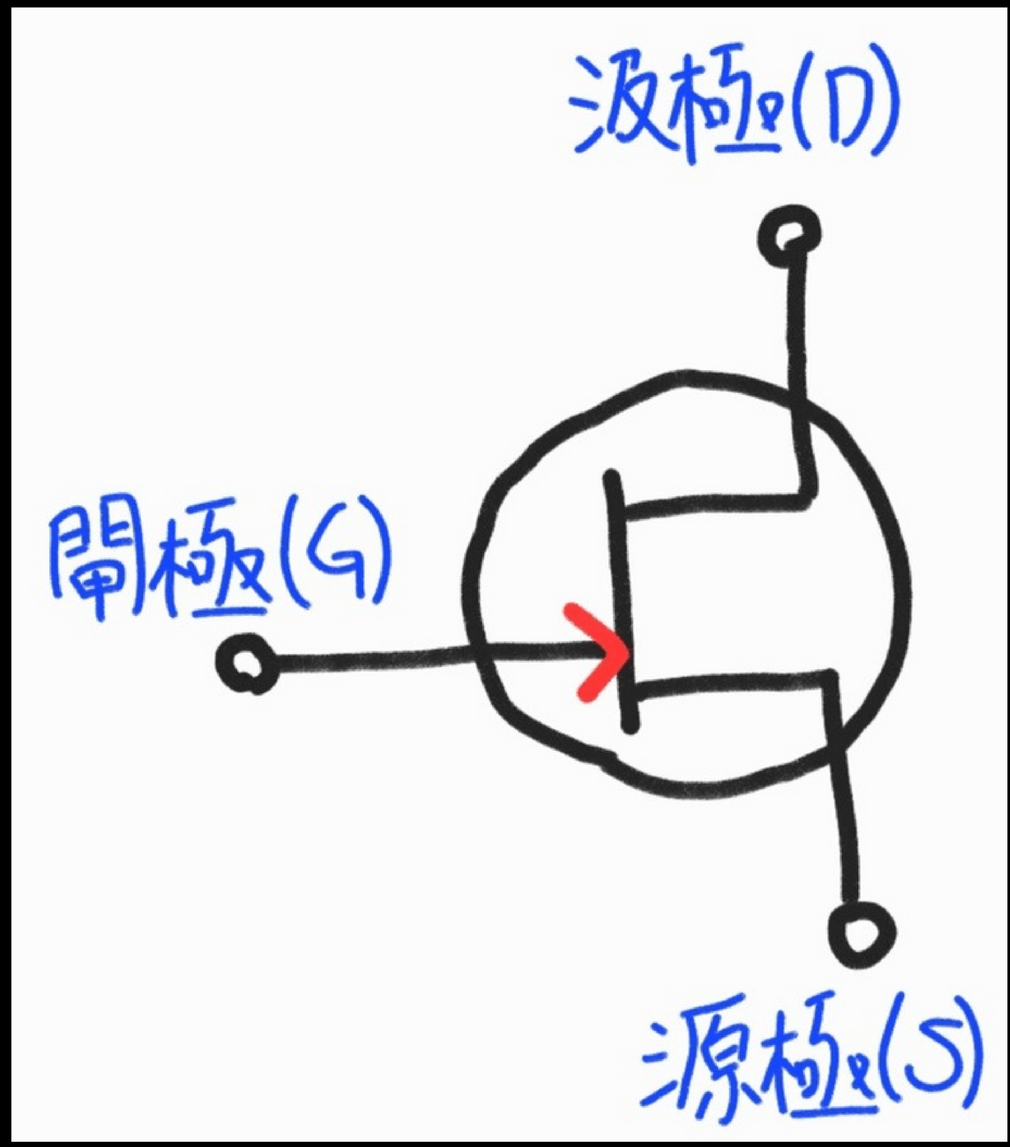
2.MOSFET(金屬氧化物半導體場效電晶體)

(1) D-MOSFET(空泛型):分為P通道和N通道

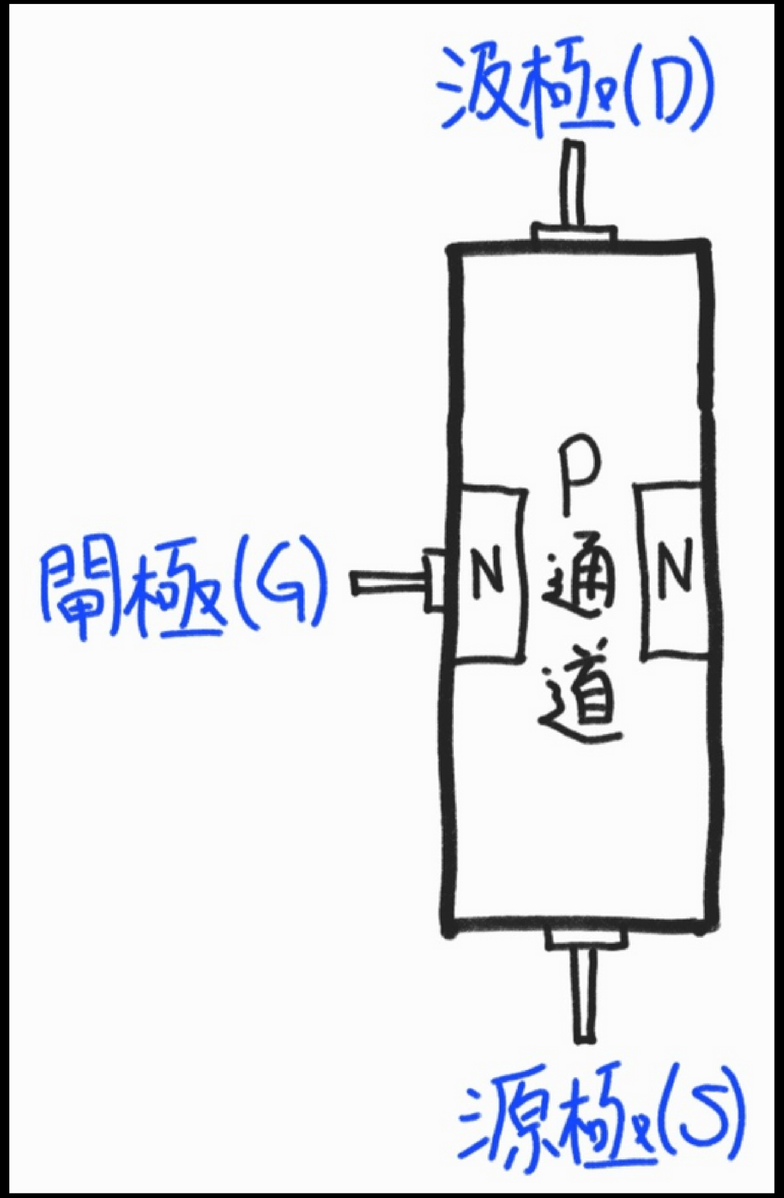
(2) E-MOSFET(增強型):分為P通道和N通道

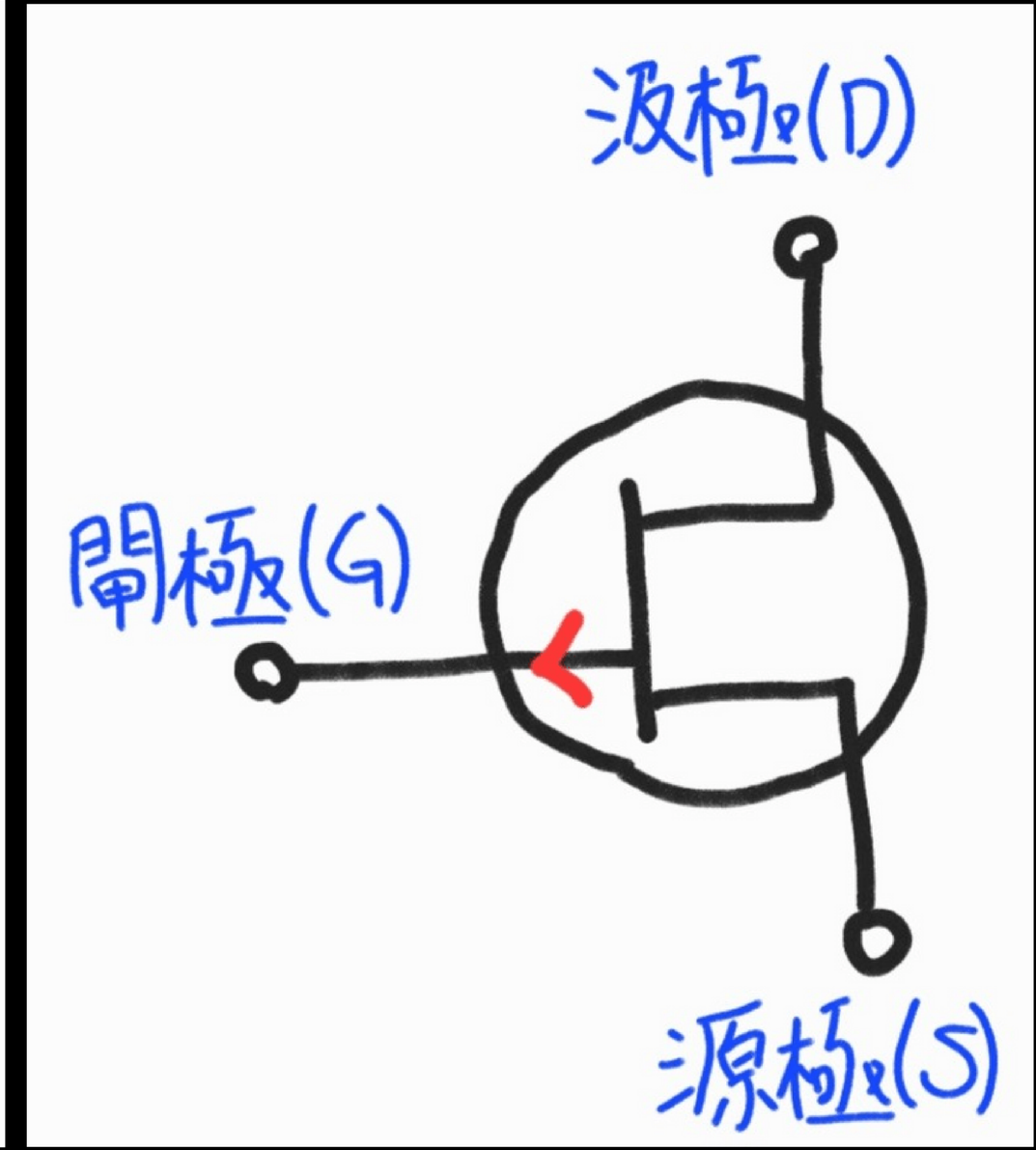
NCH JFET



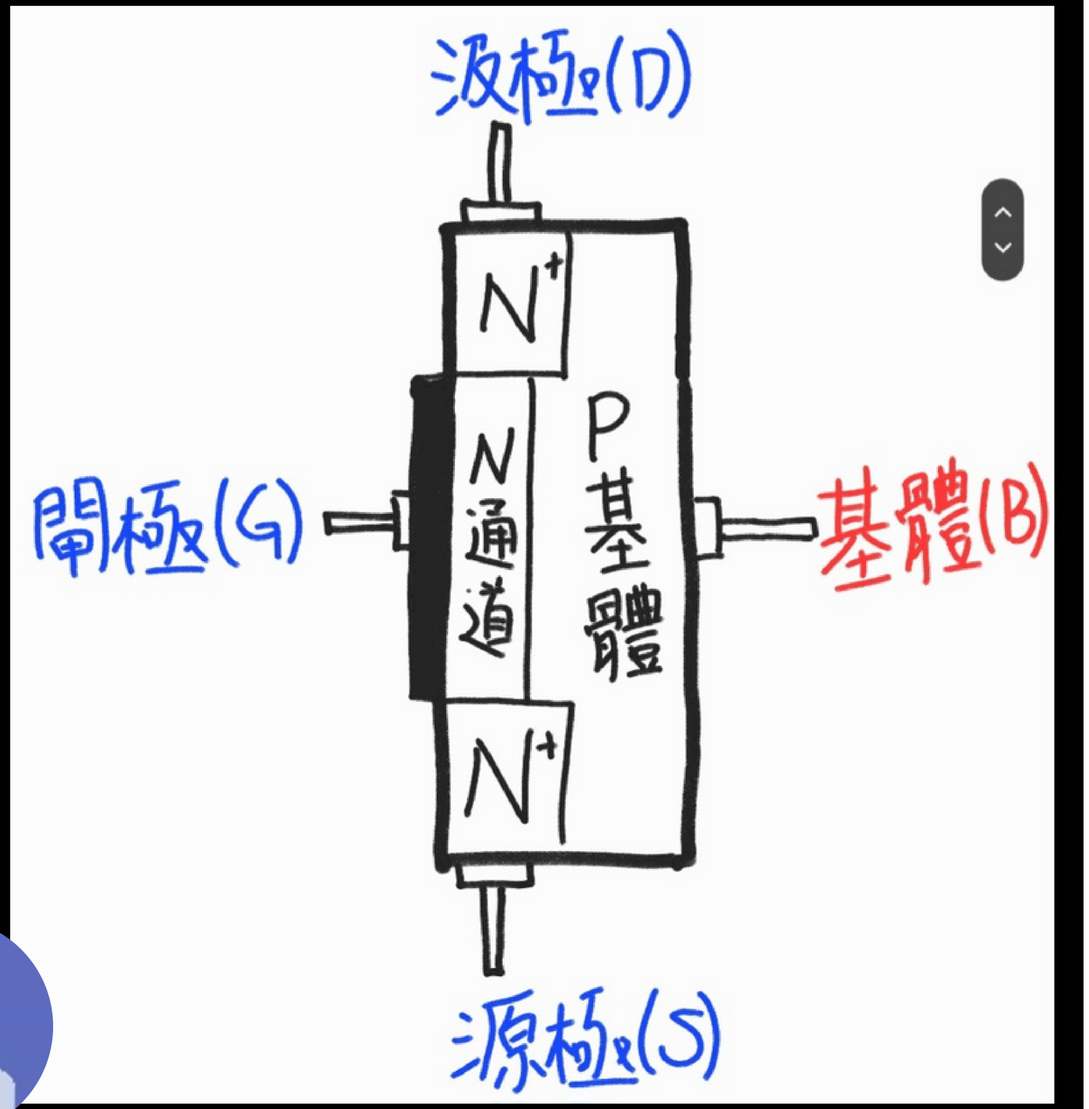


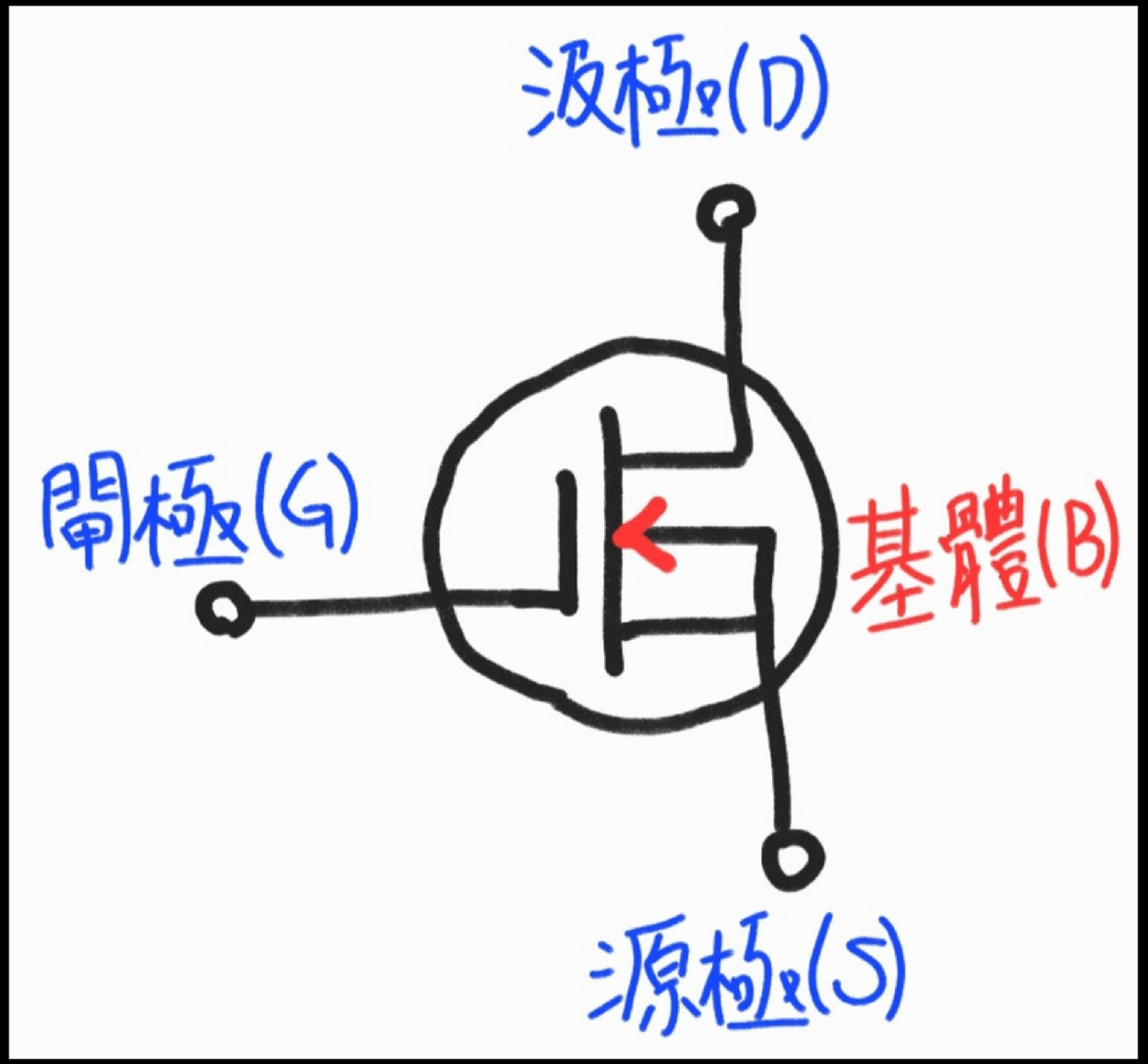
PCH JFET



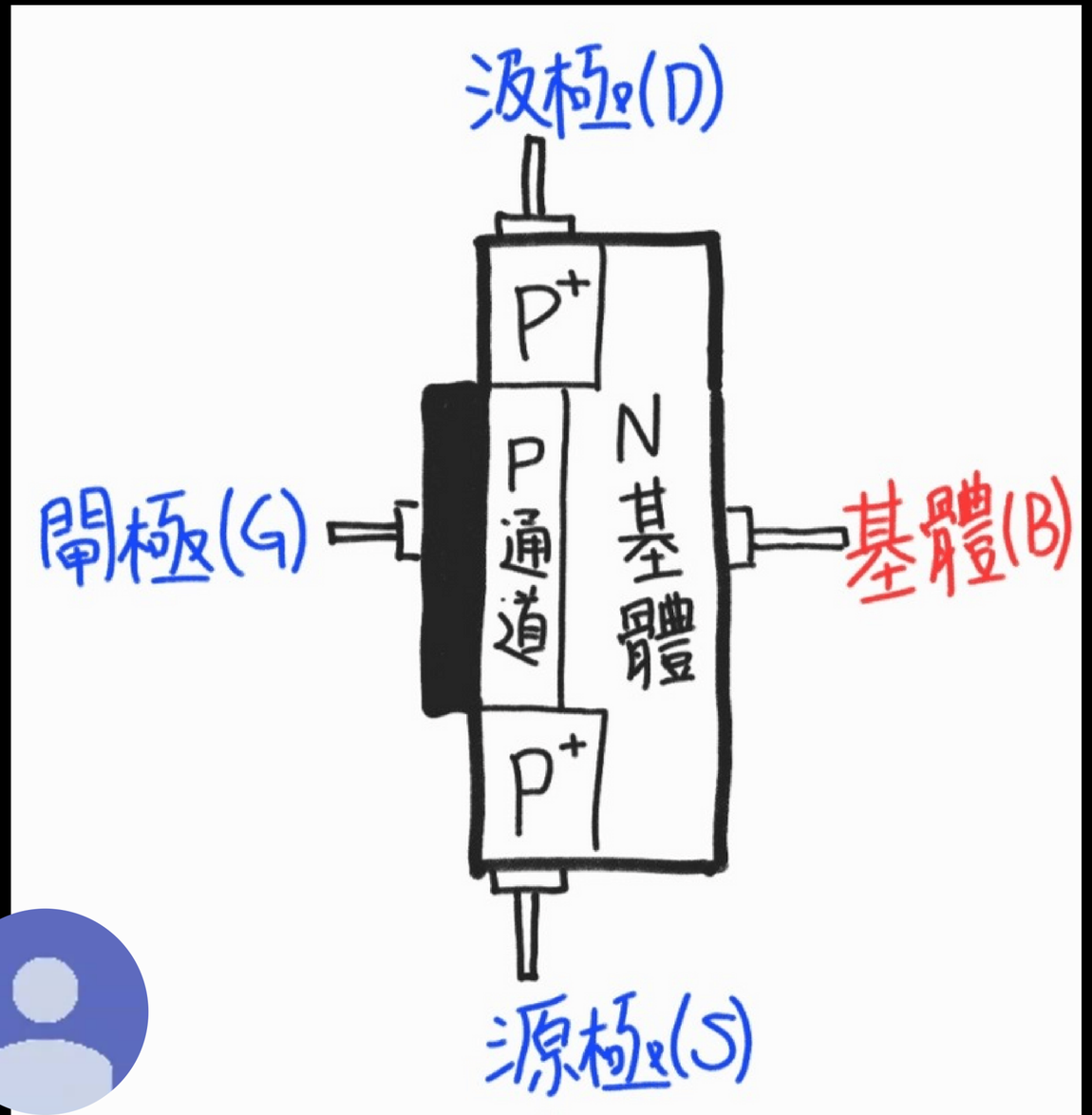


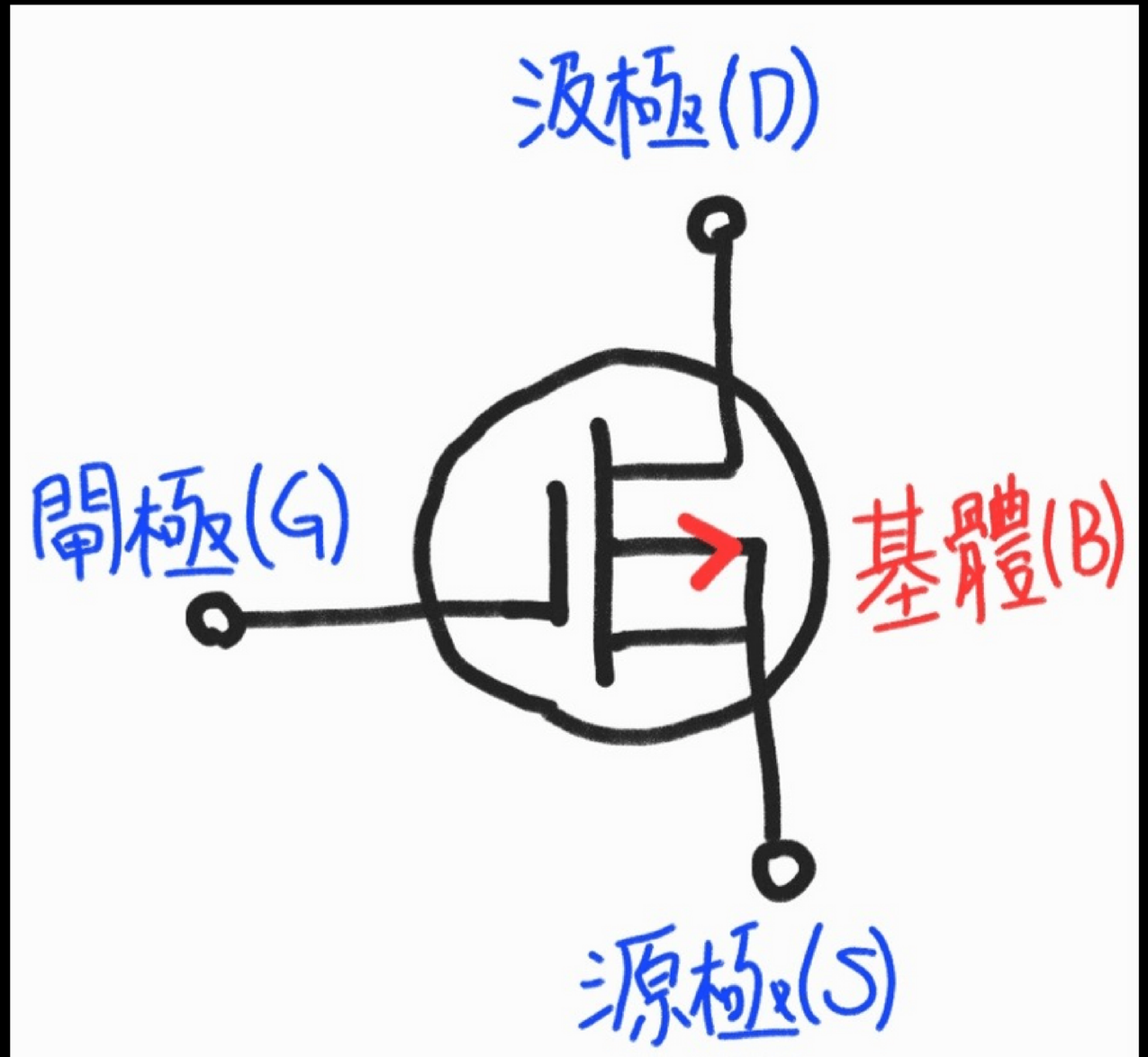
NCH D-MOSFET



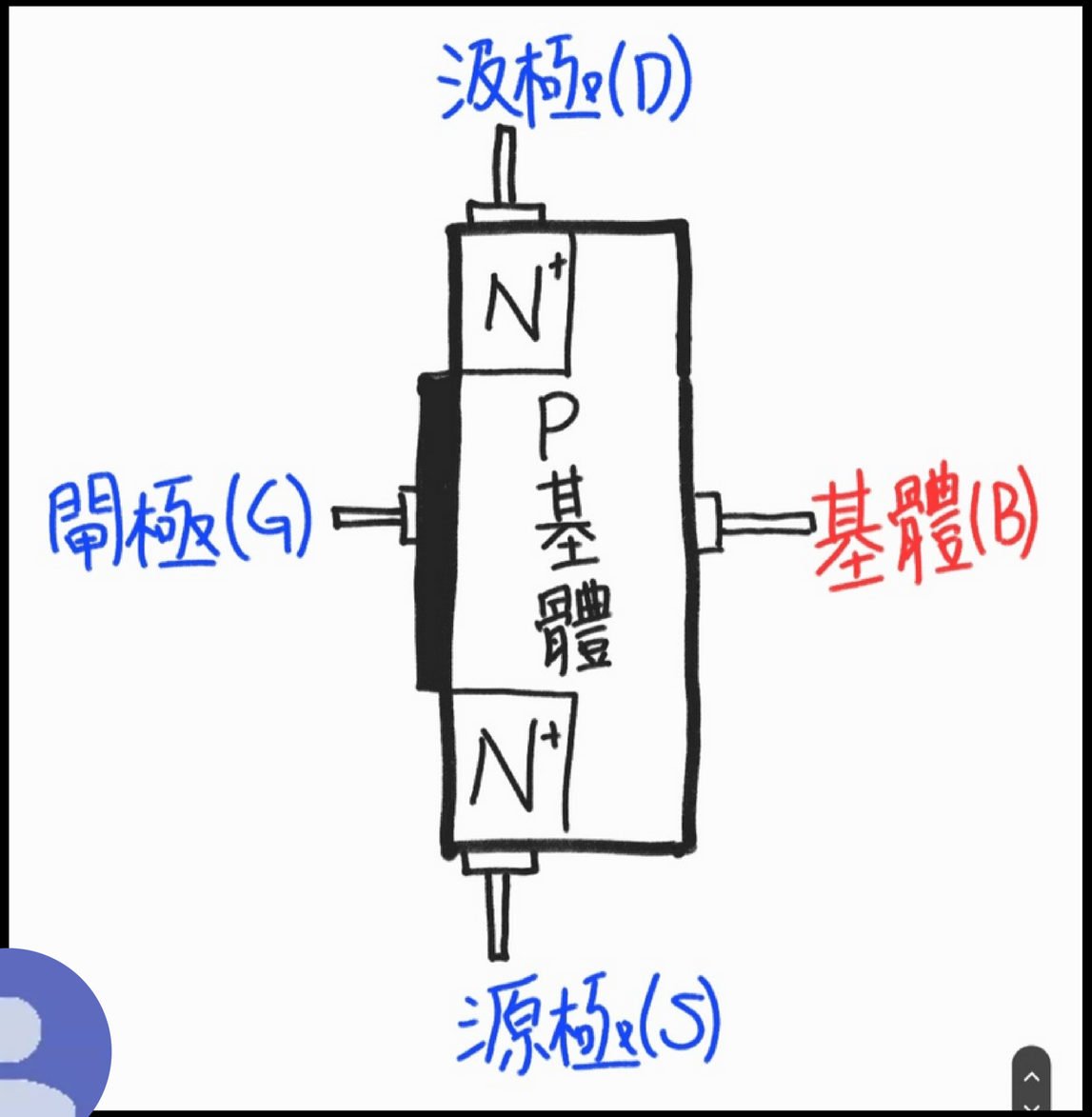


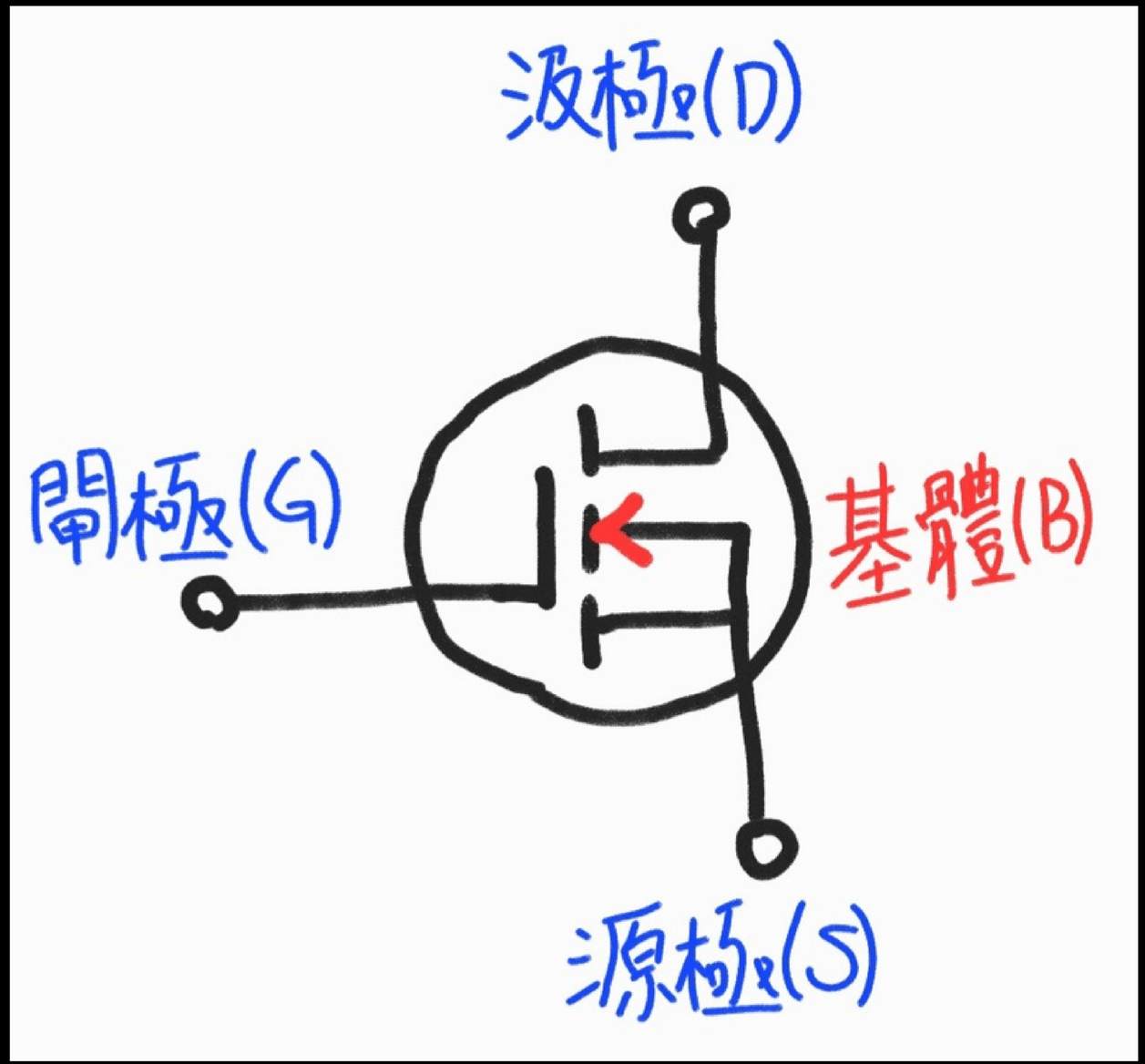
PCH D-MOSFET



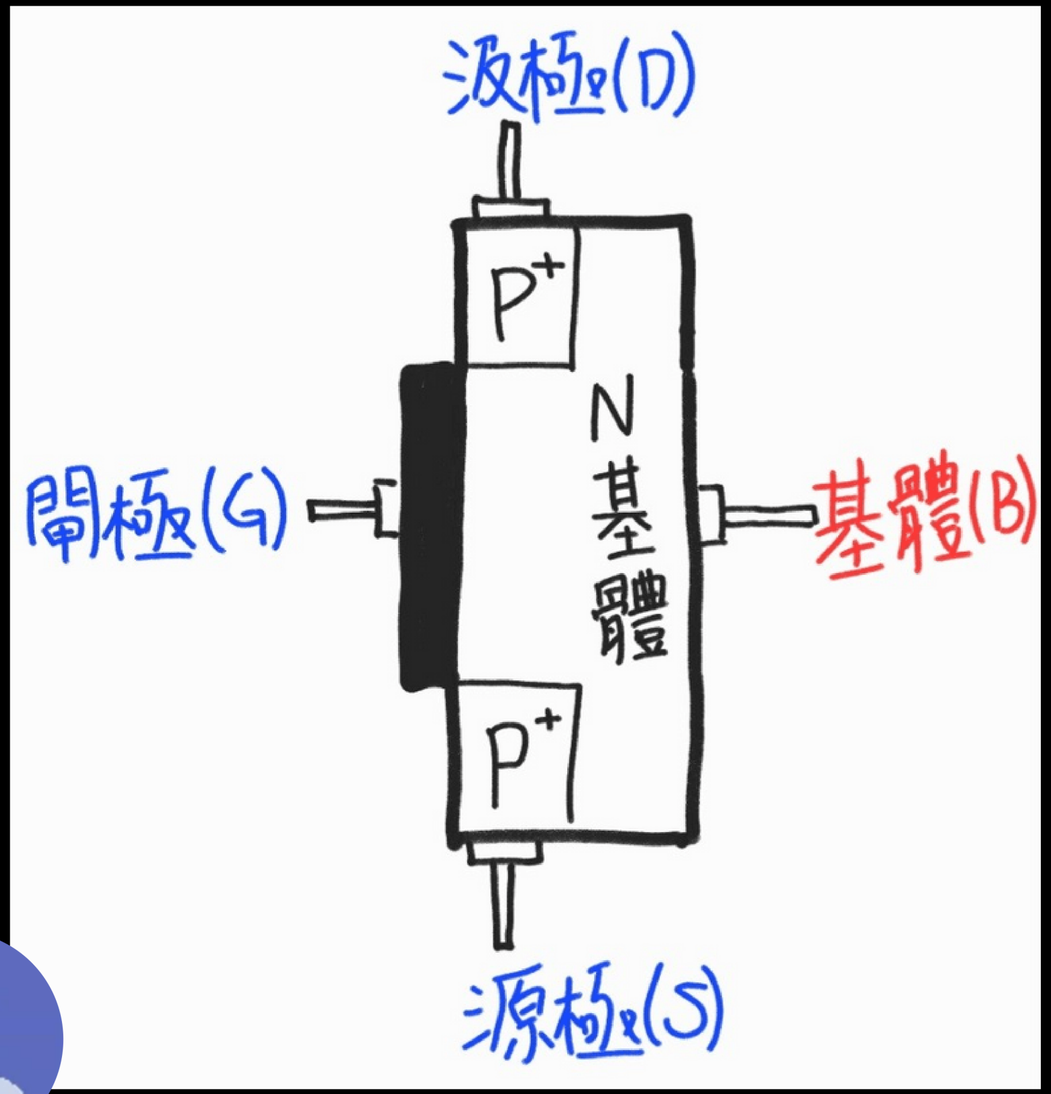


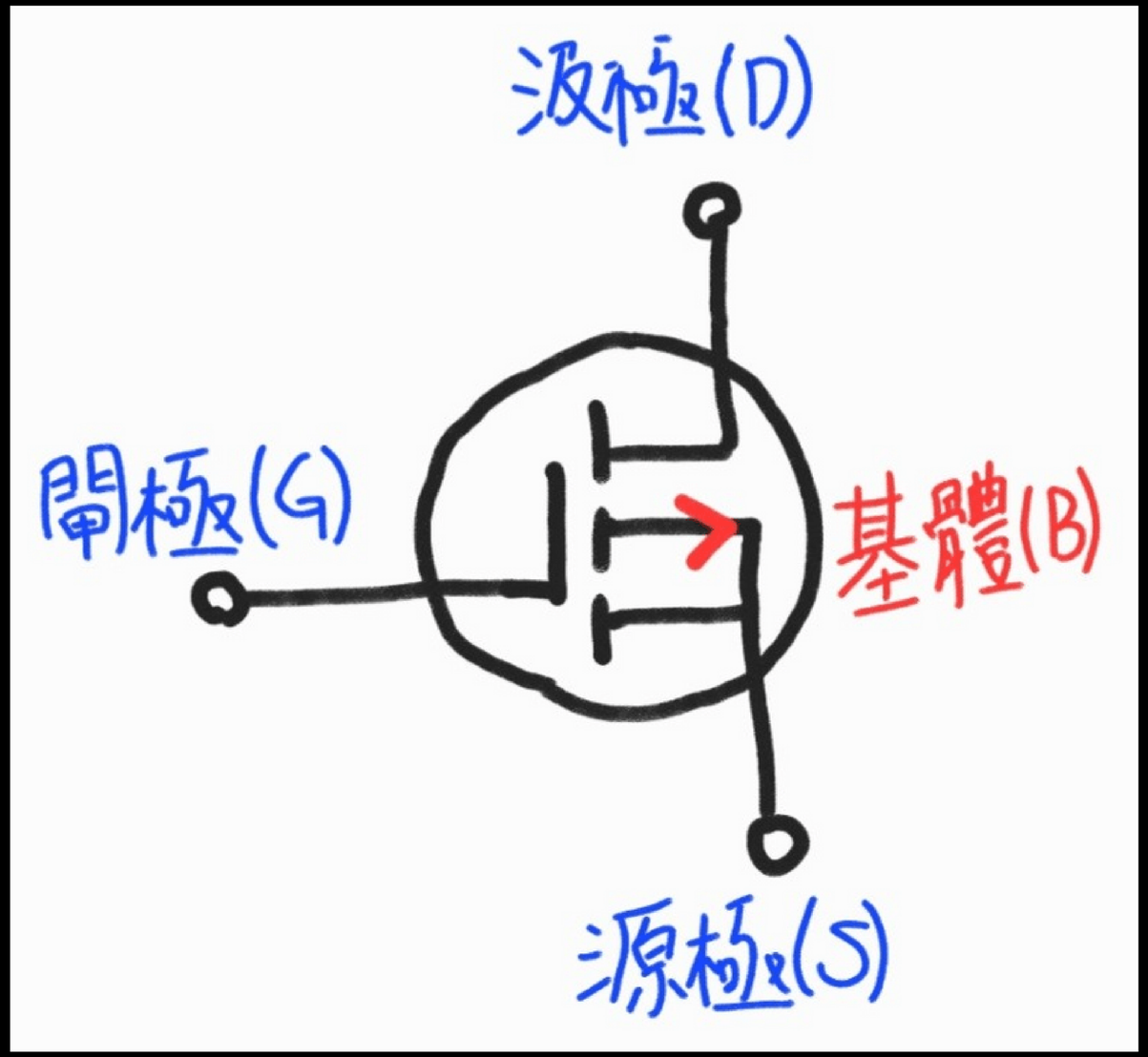
NCH E-MOSFET



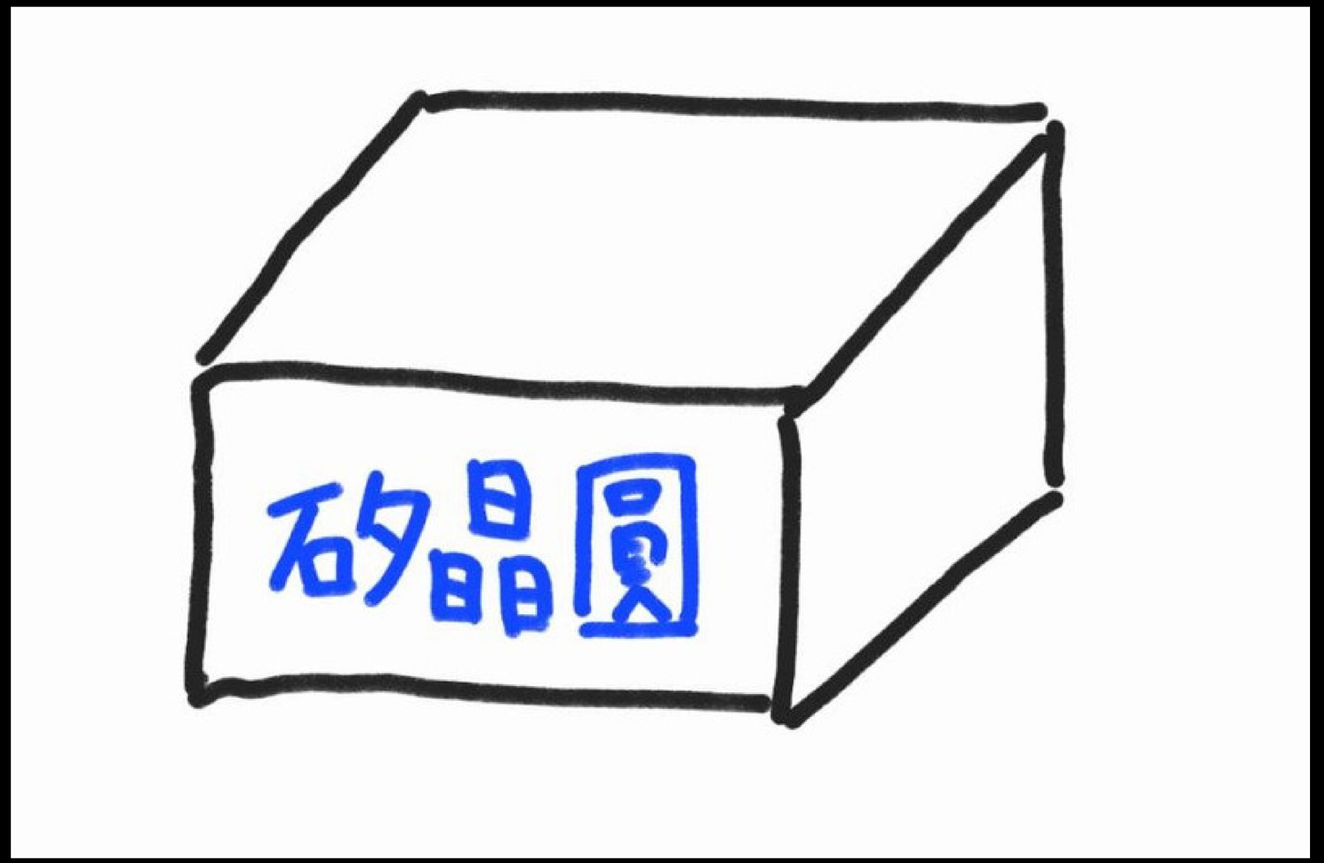


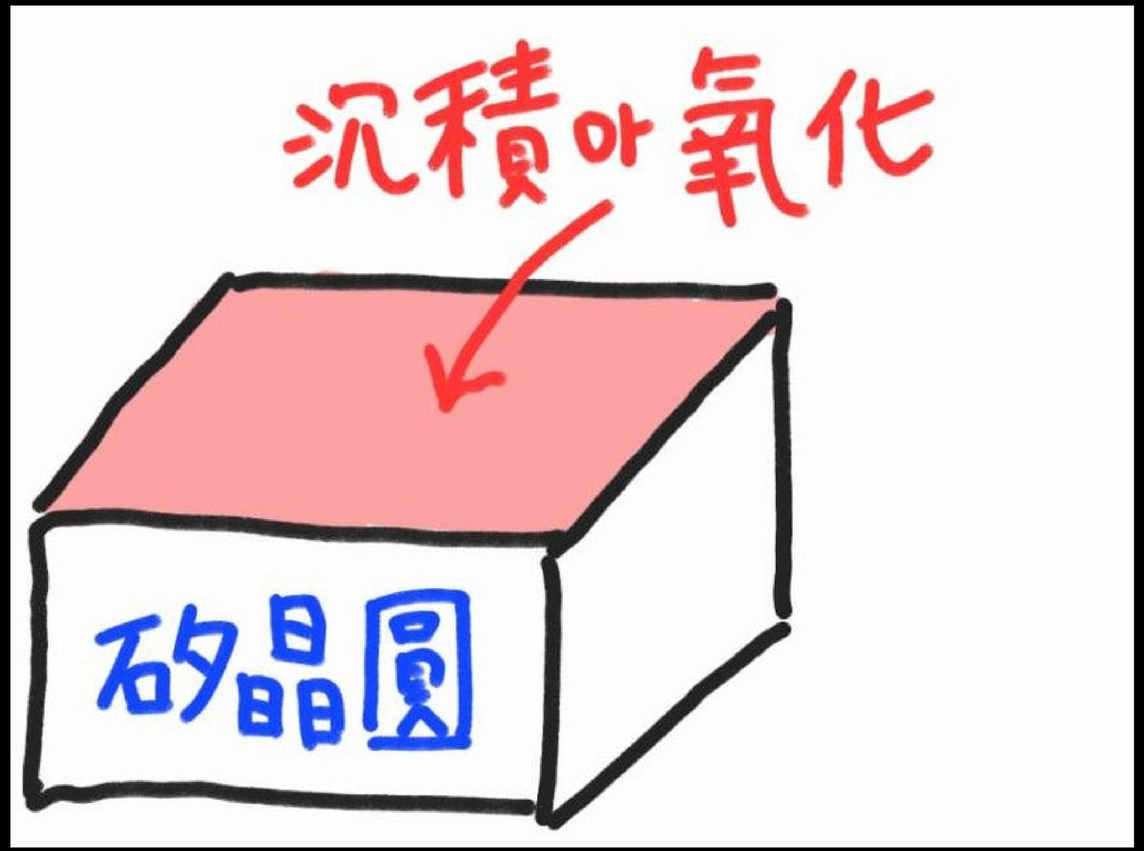
PCH E-MOSFET

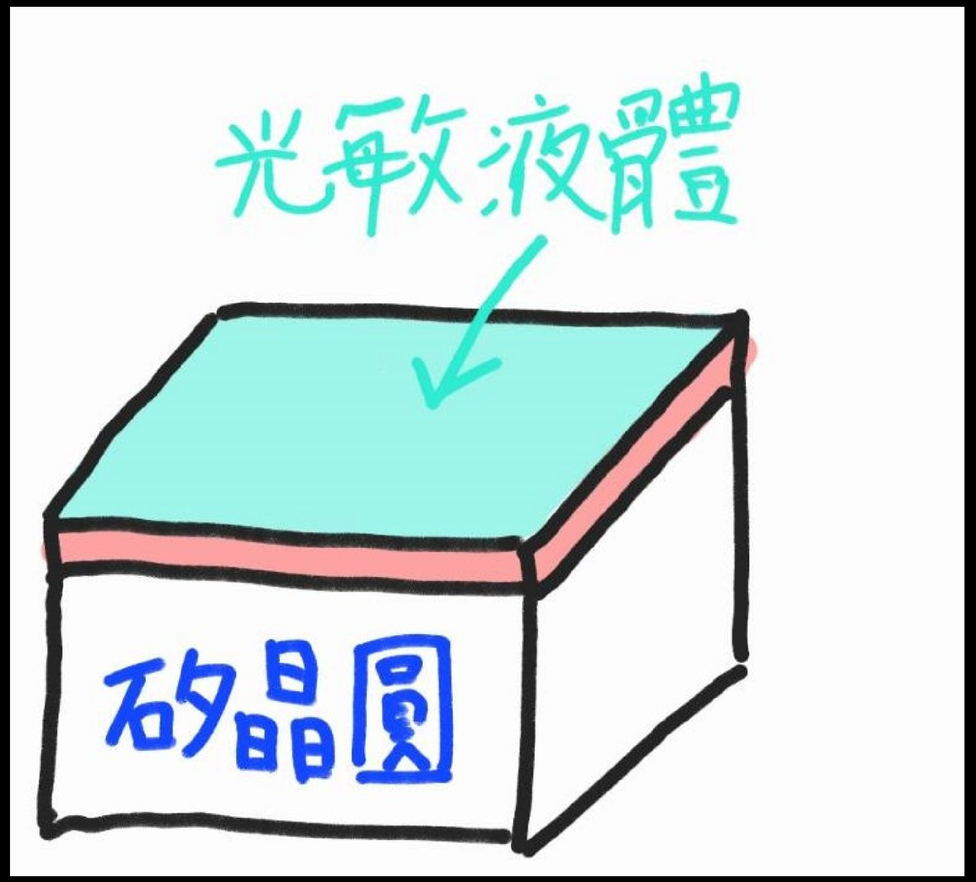


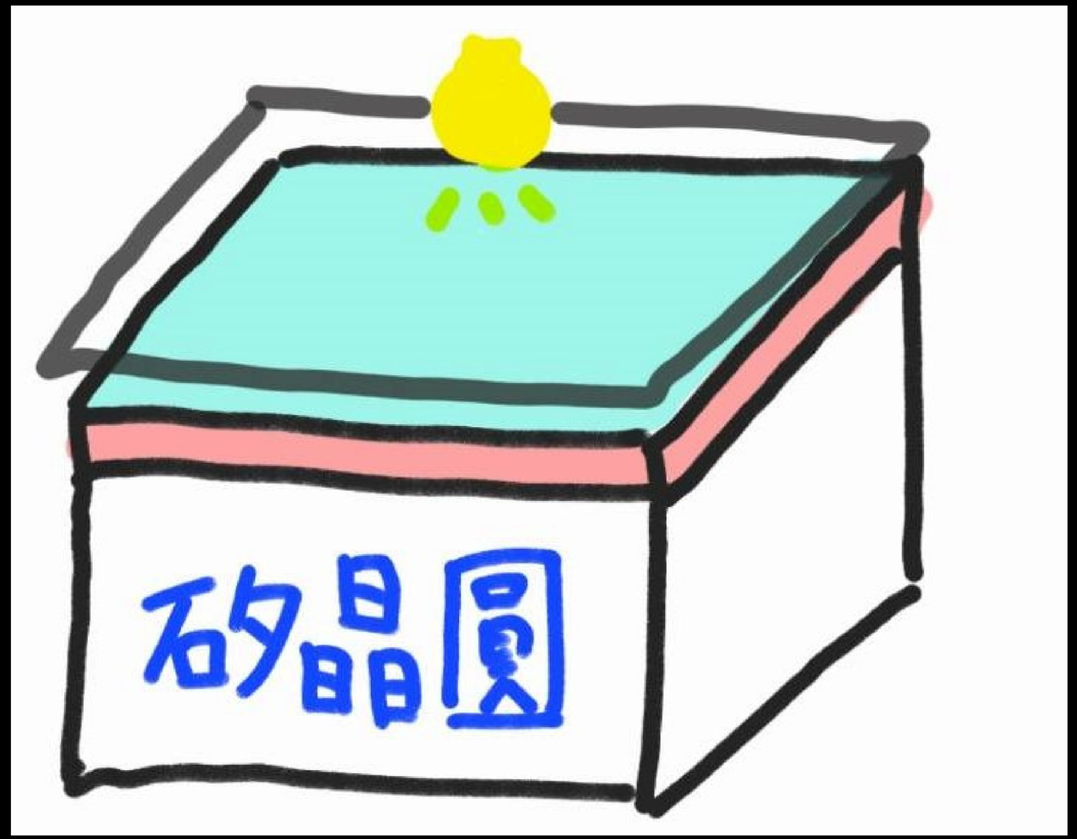


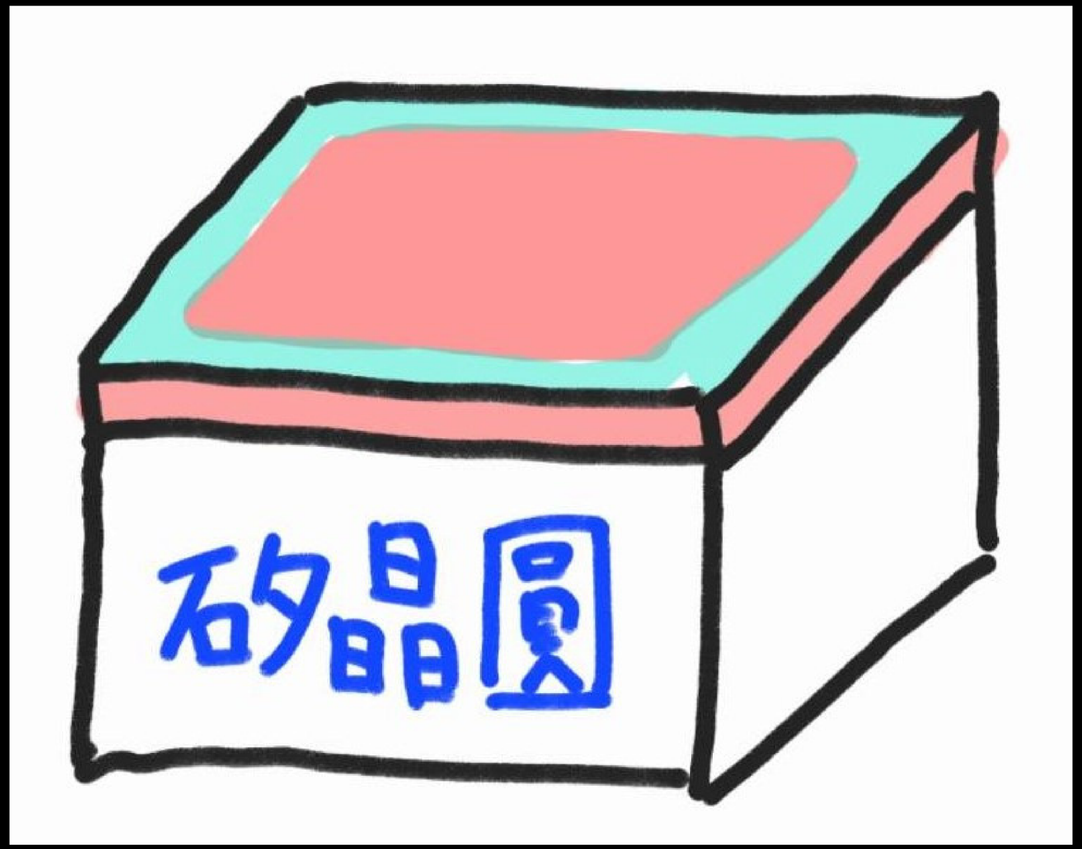
電晶體製作

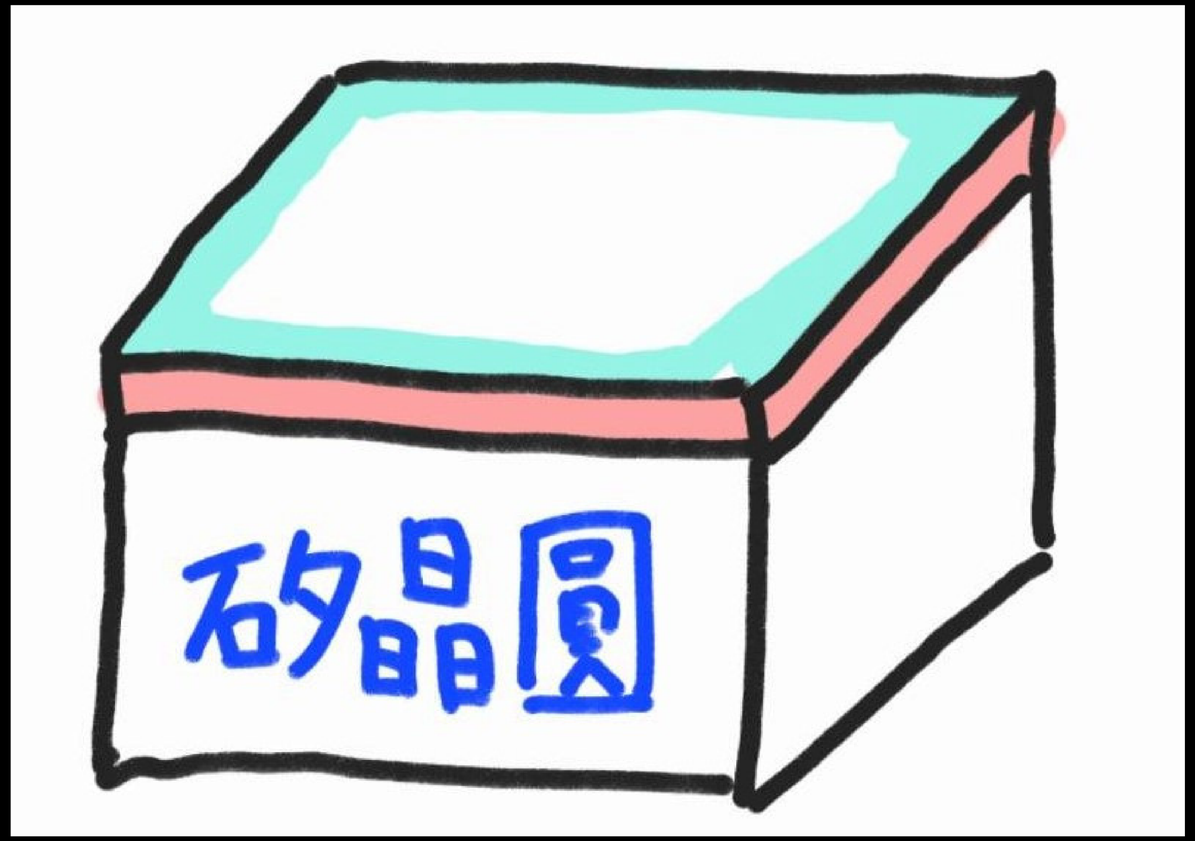

矽晶圓

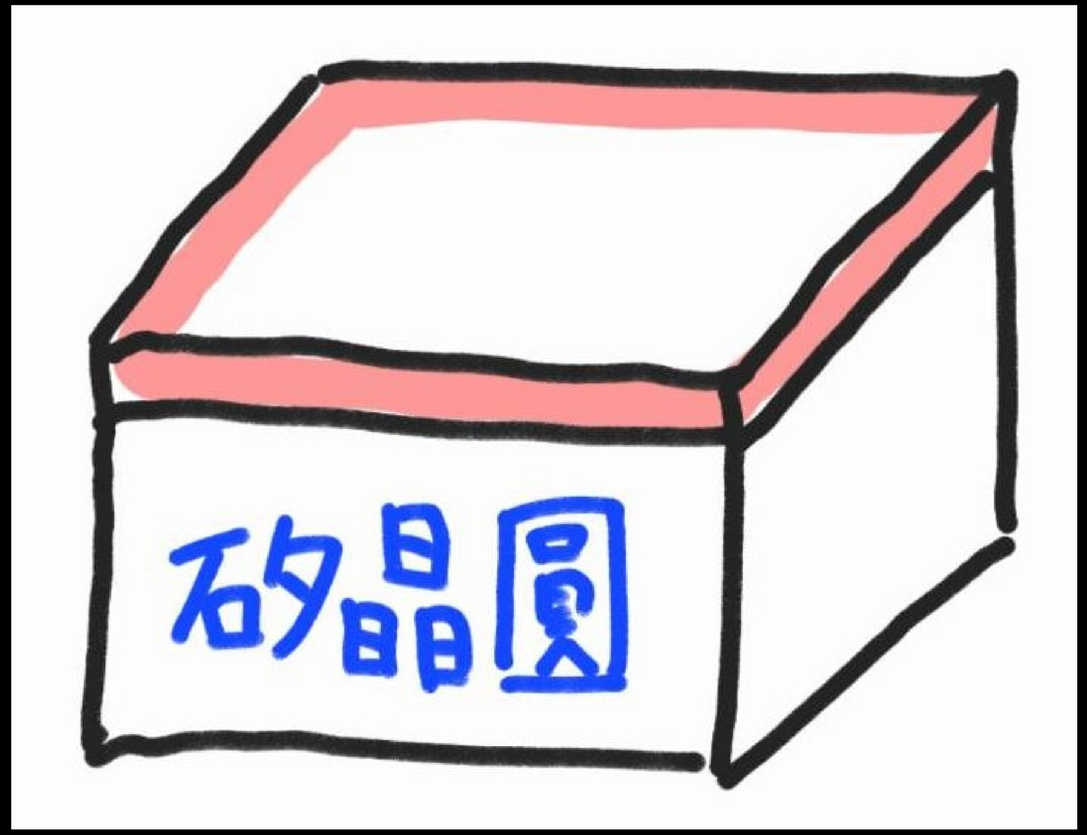

沉積아氧化
矽晶圓


光敏液體
矽晶圓


矽晶圓


矽晶圓


矽晶圓



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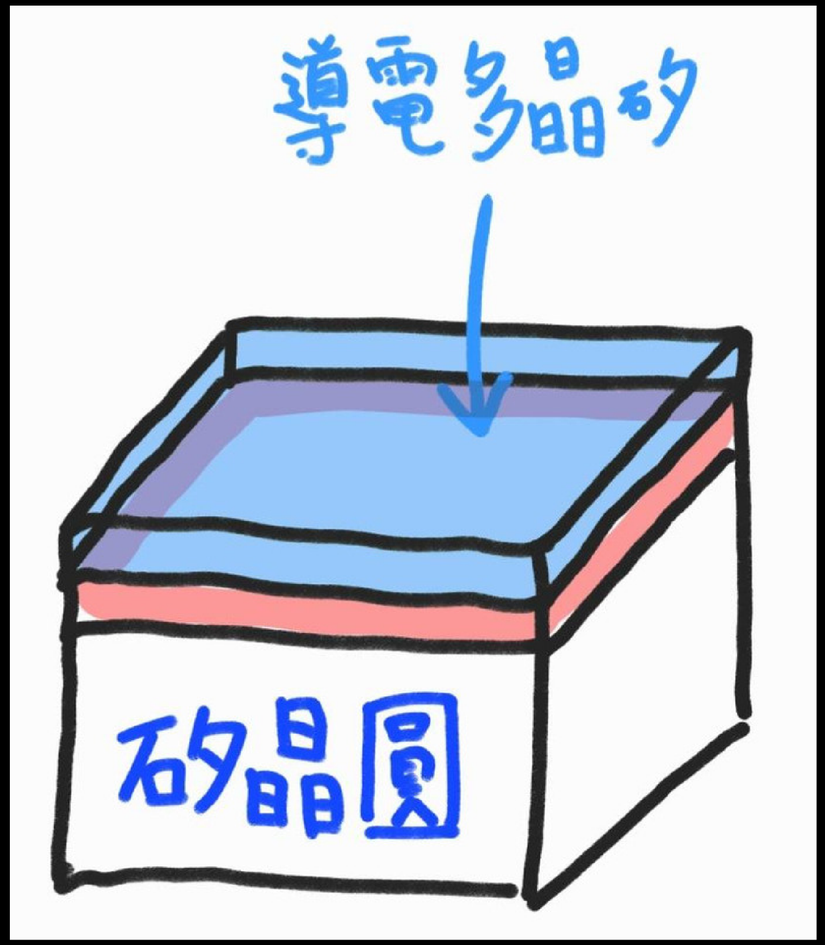
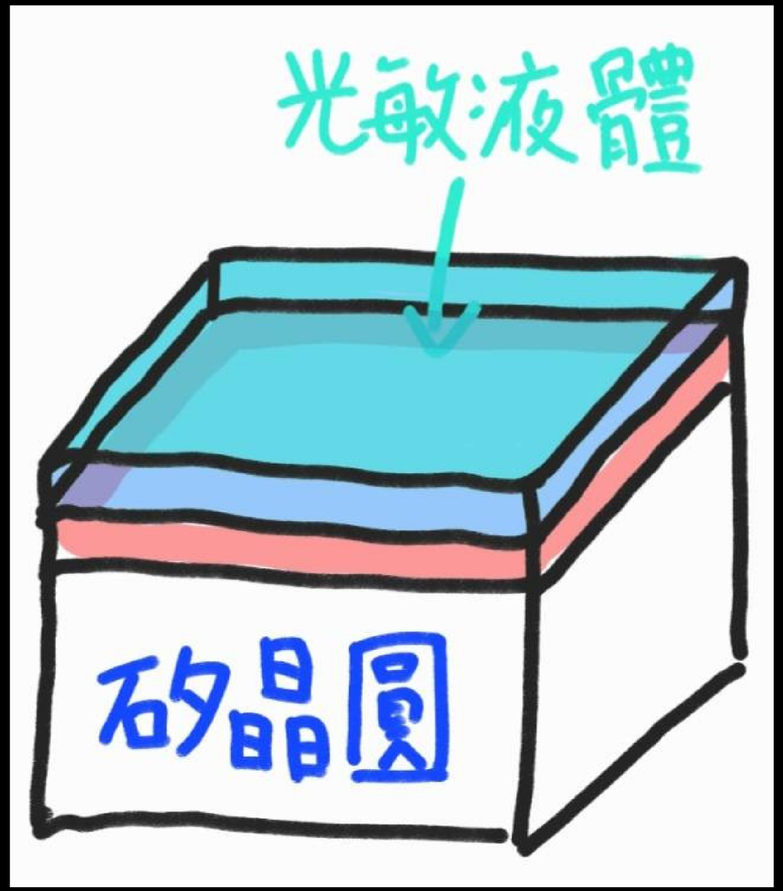

導電多晶矽
矽晶圓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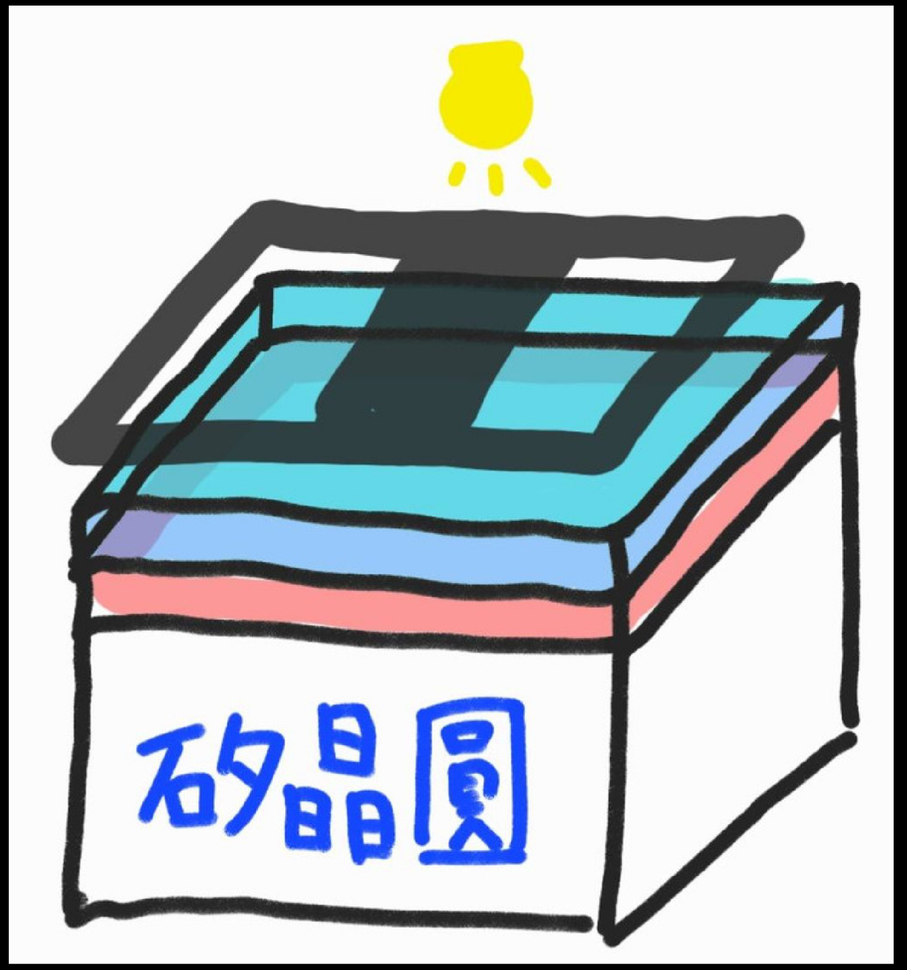
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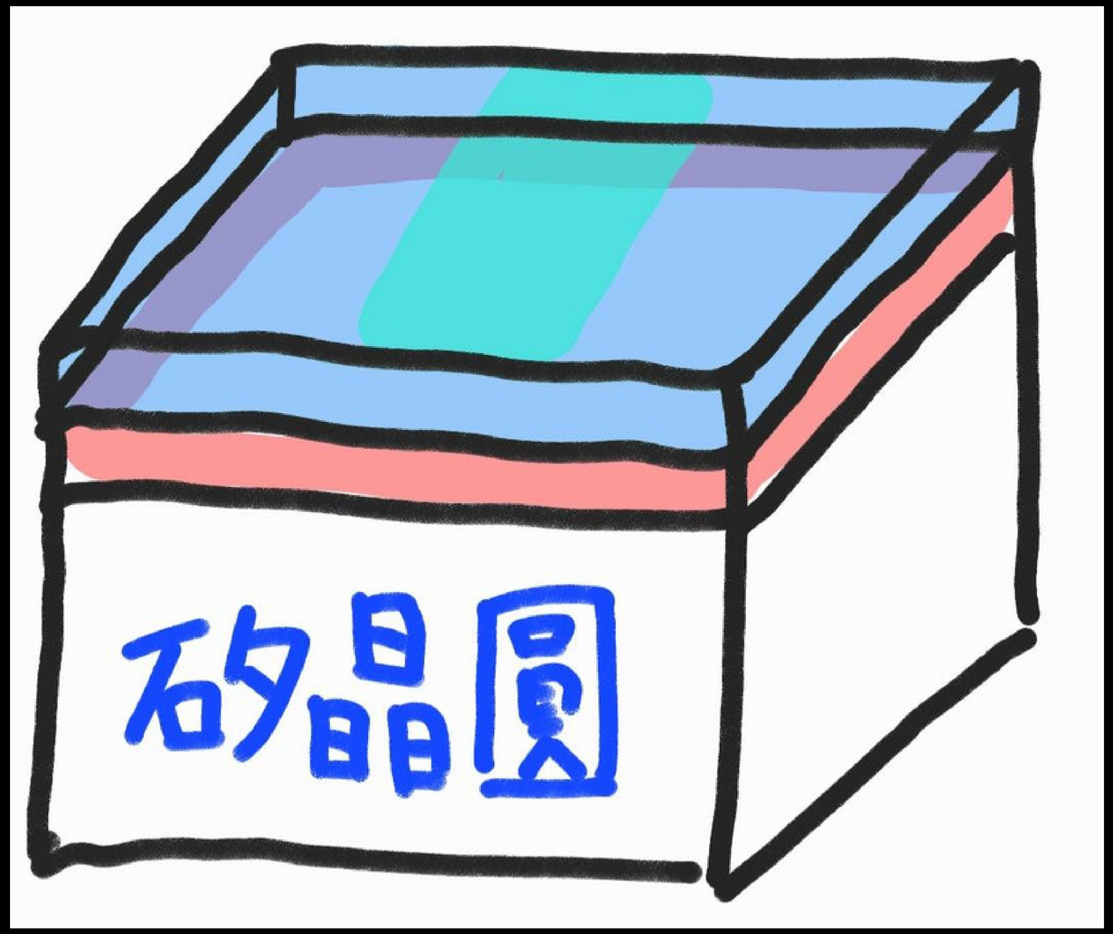

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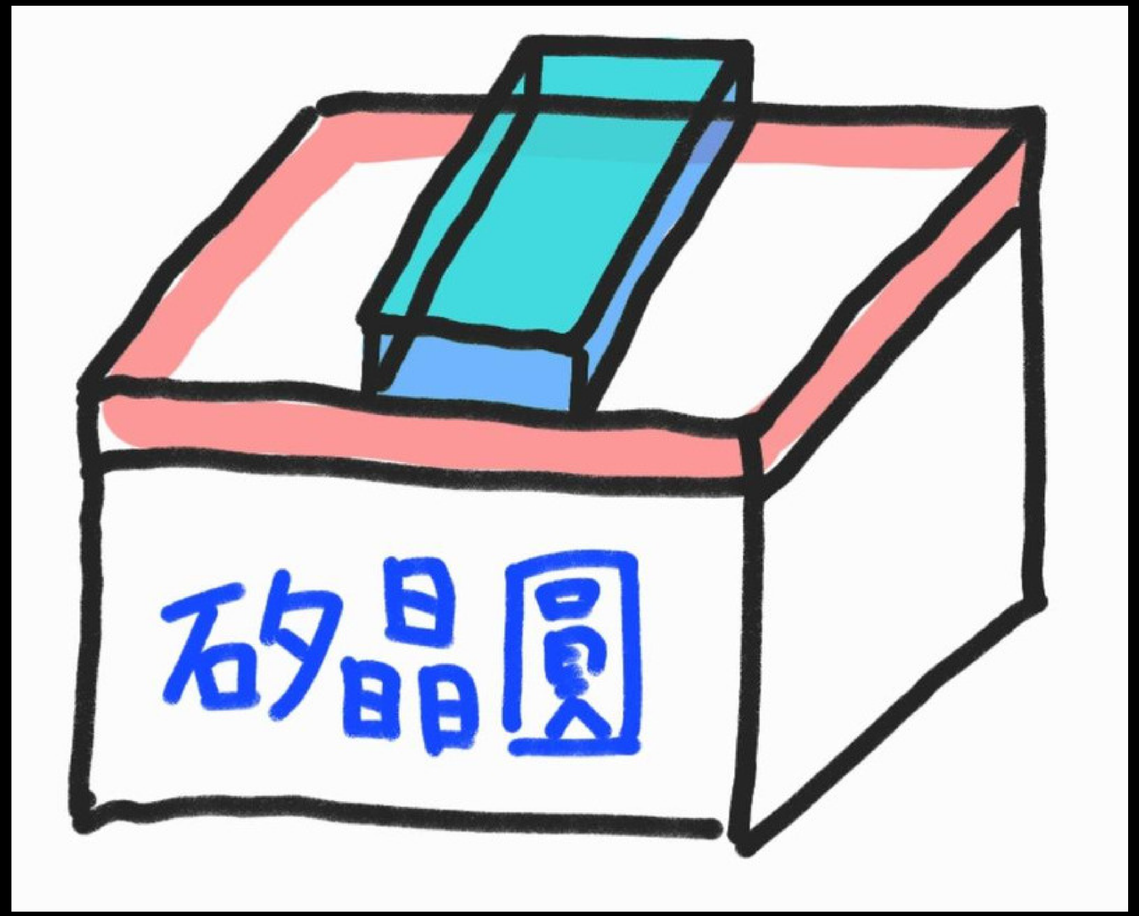

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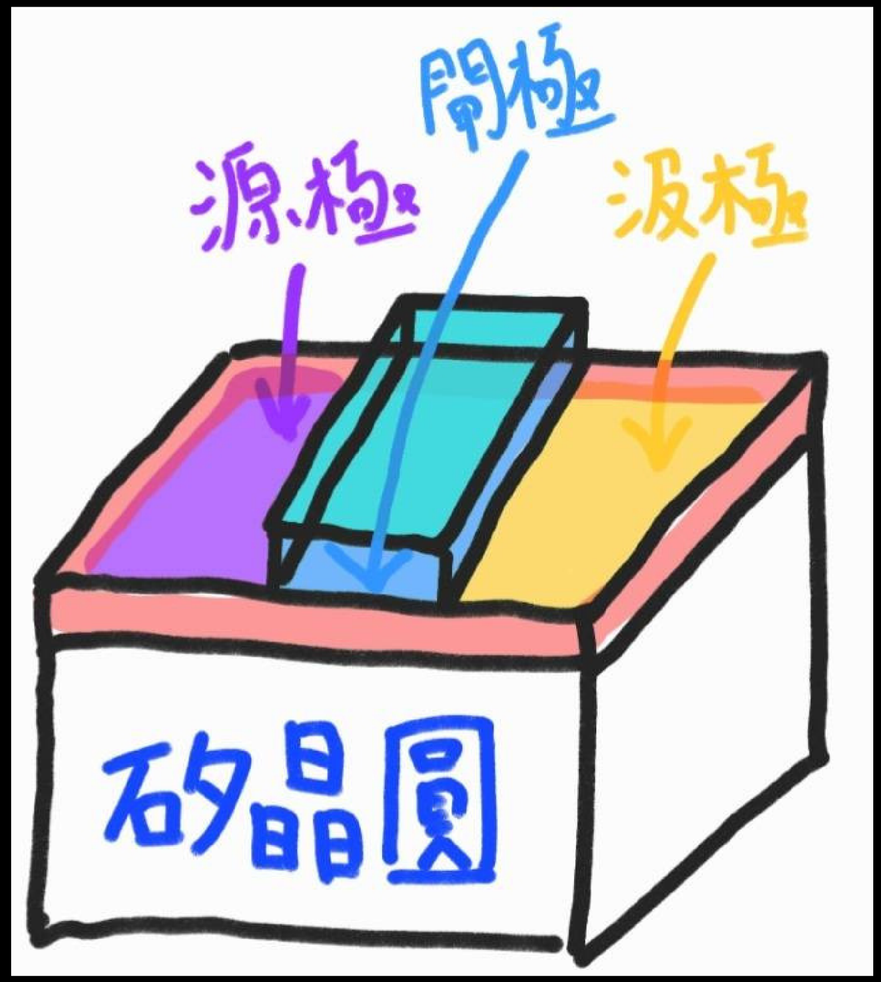
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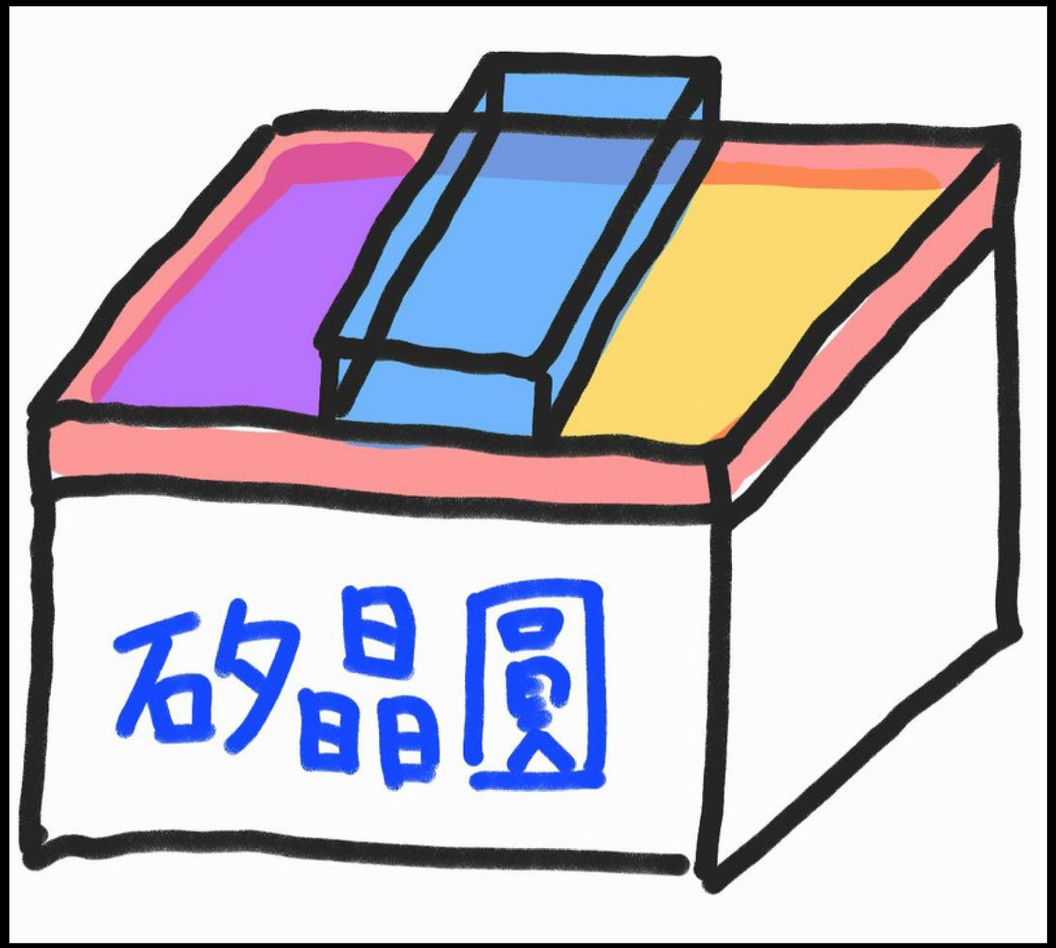
源極
汲極
矽晶圓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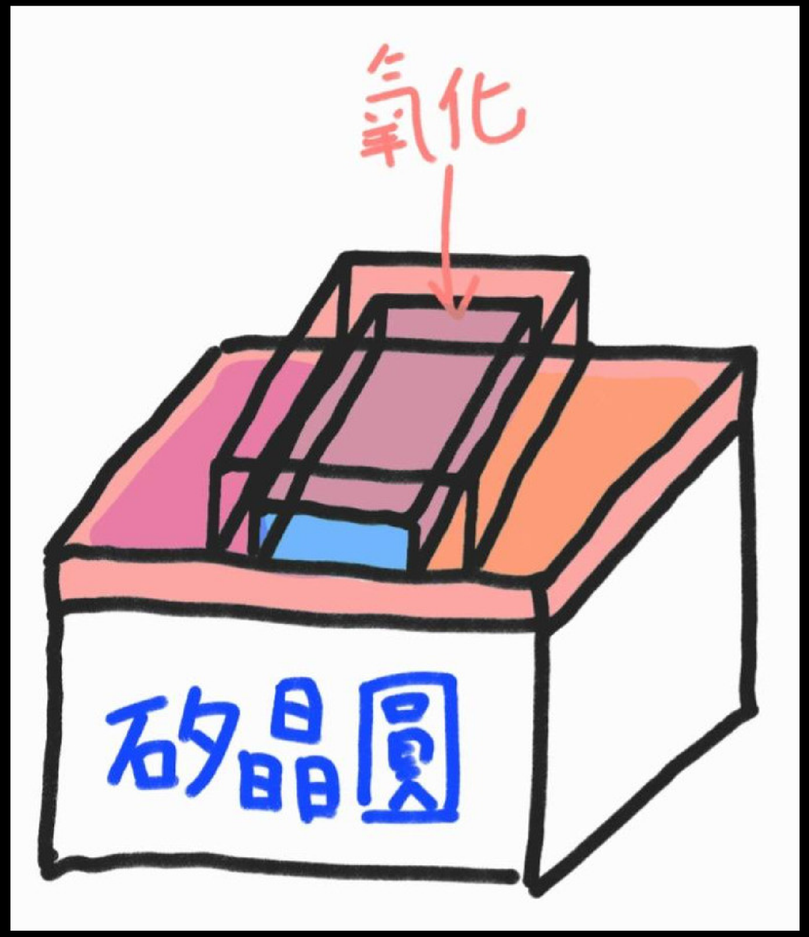
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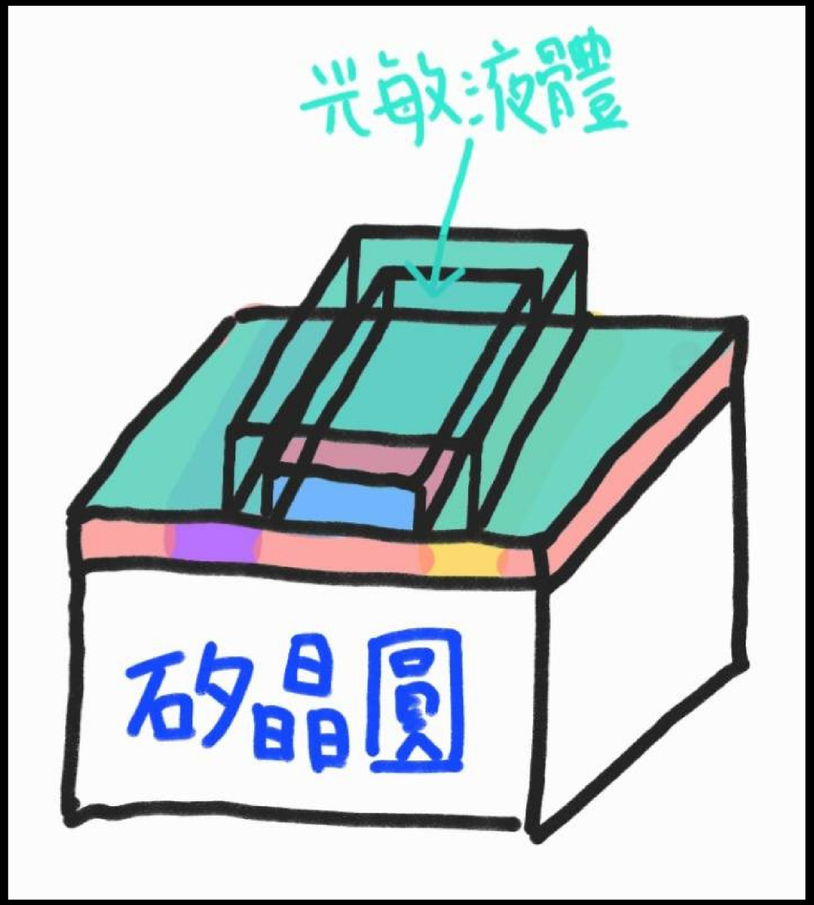
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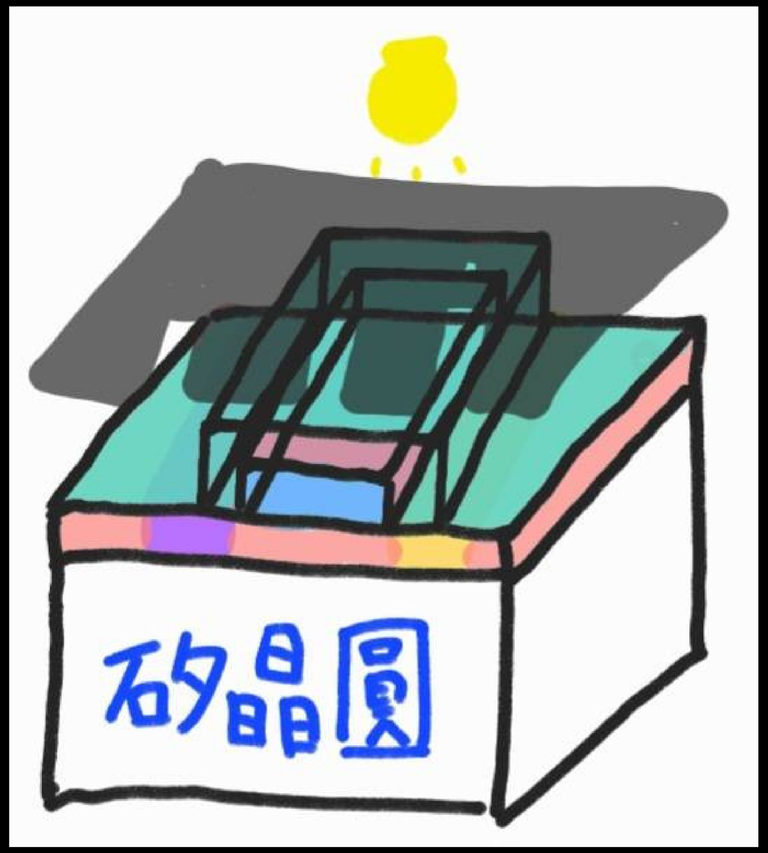
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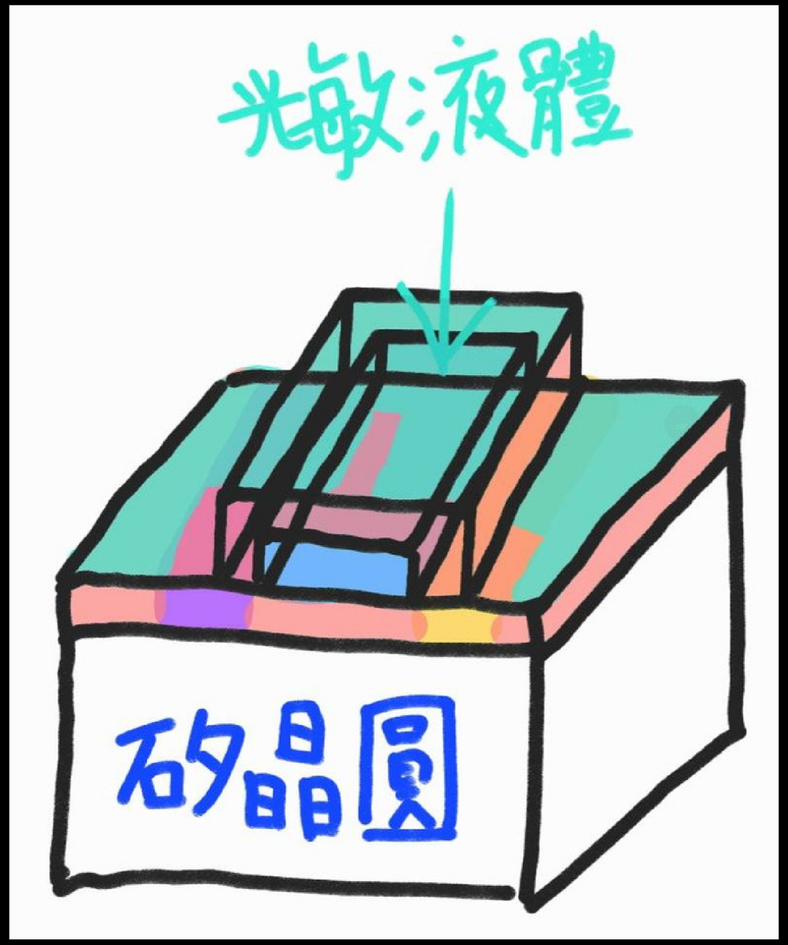
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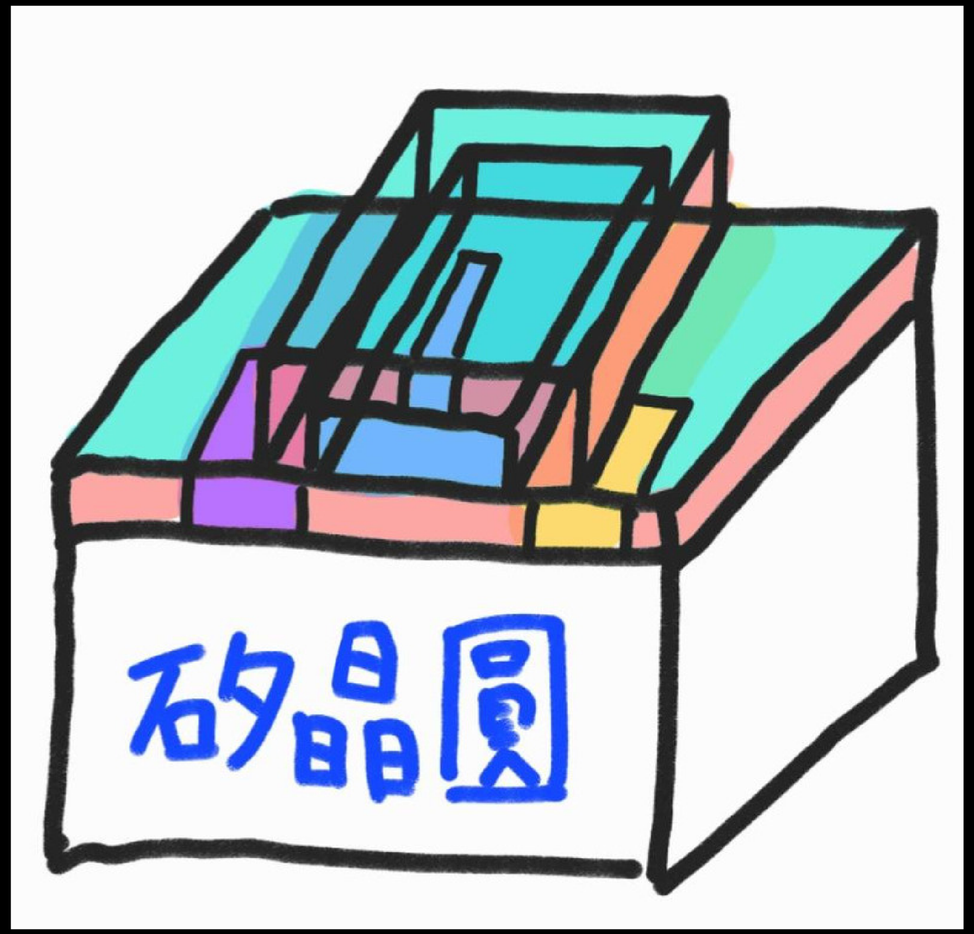
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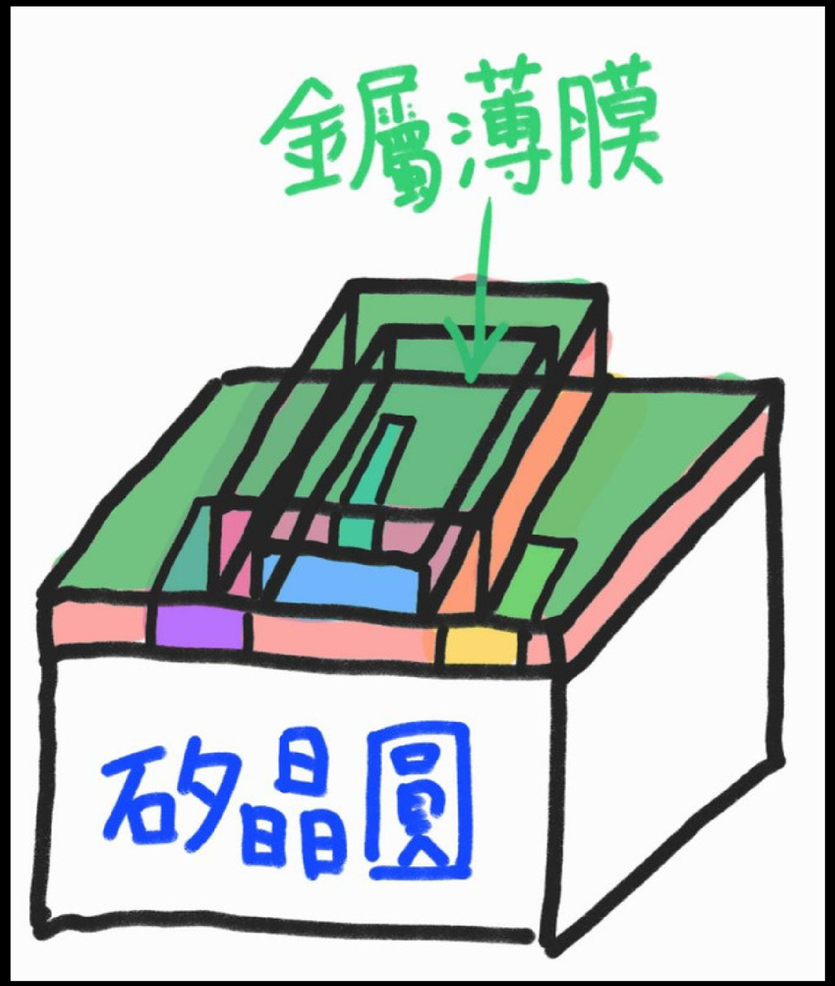
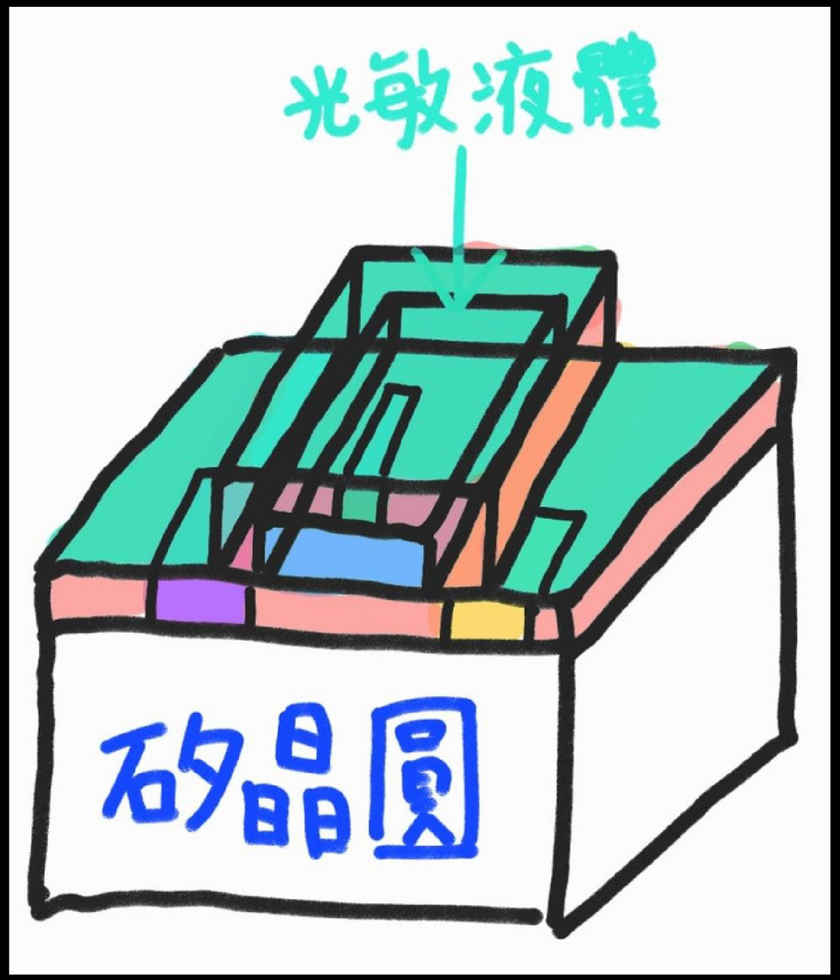

金屬薄膜
矽晶圓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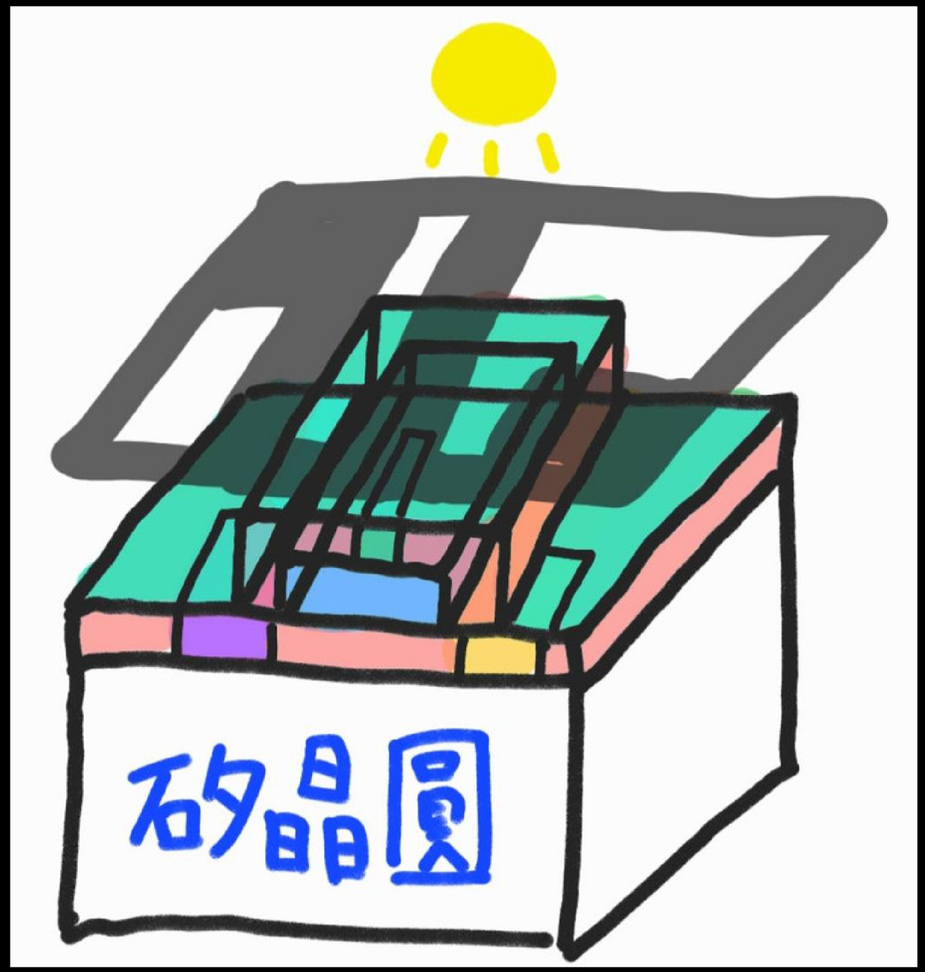
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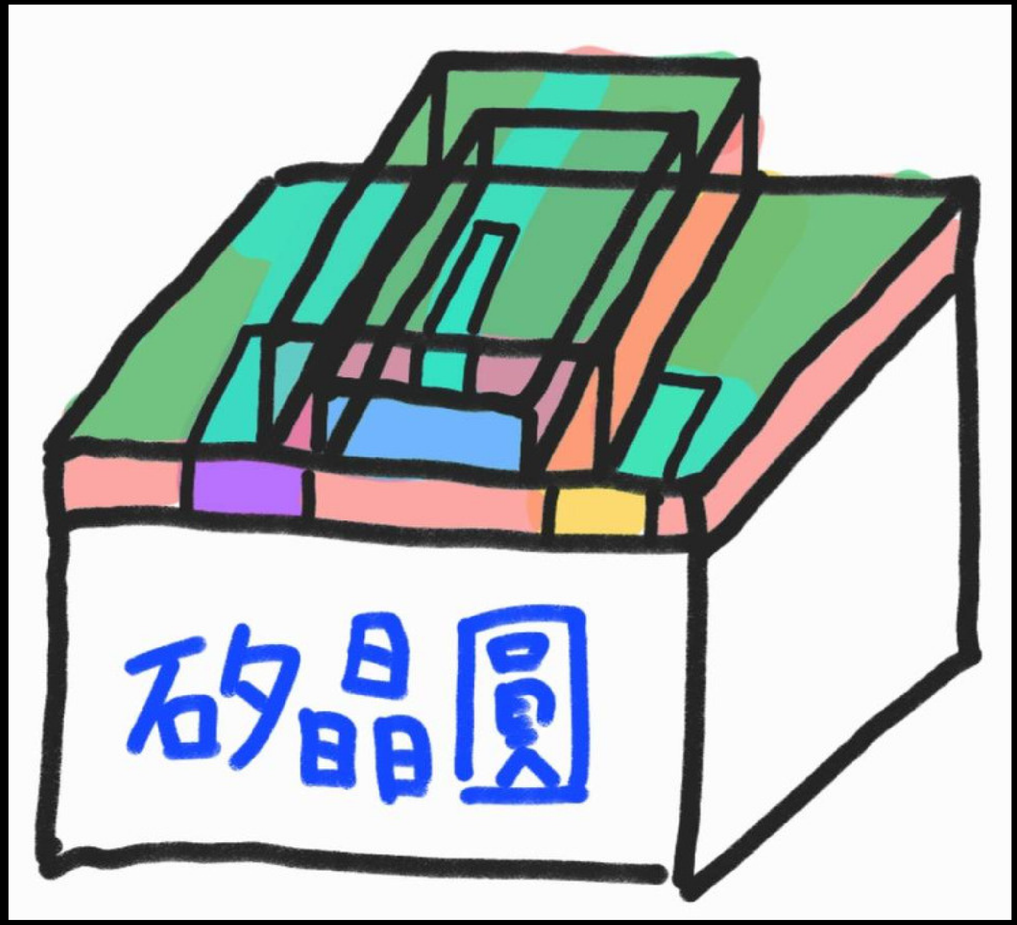
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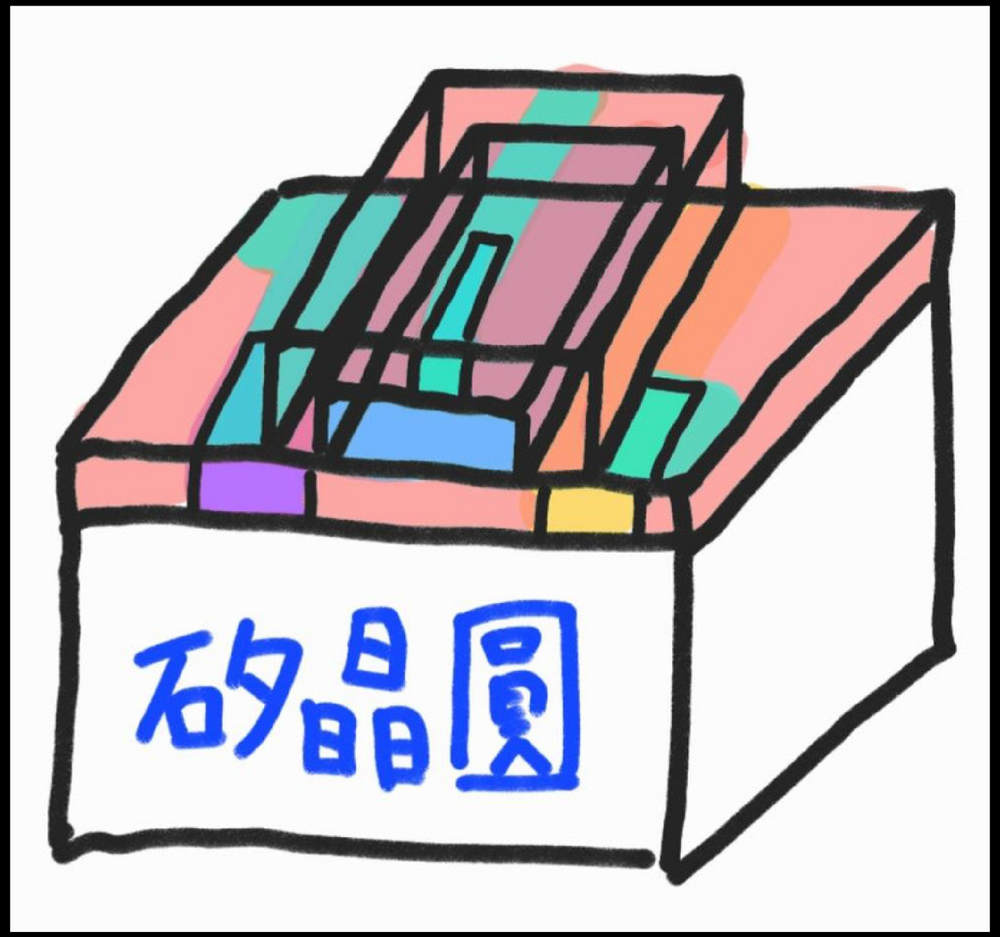
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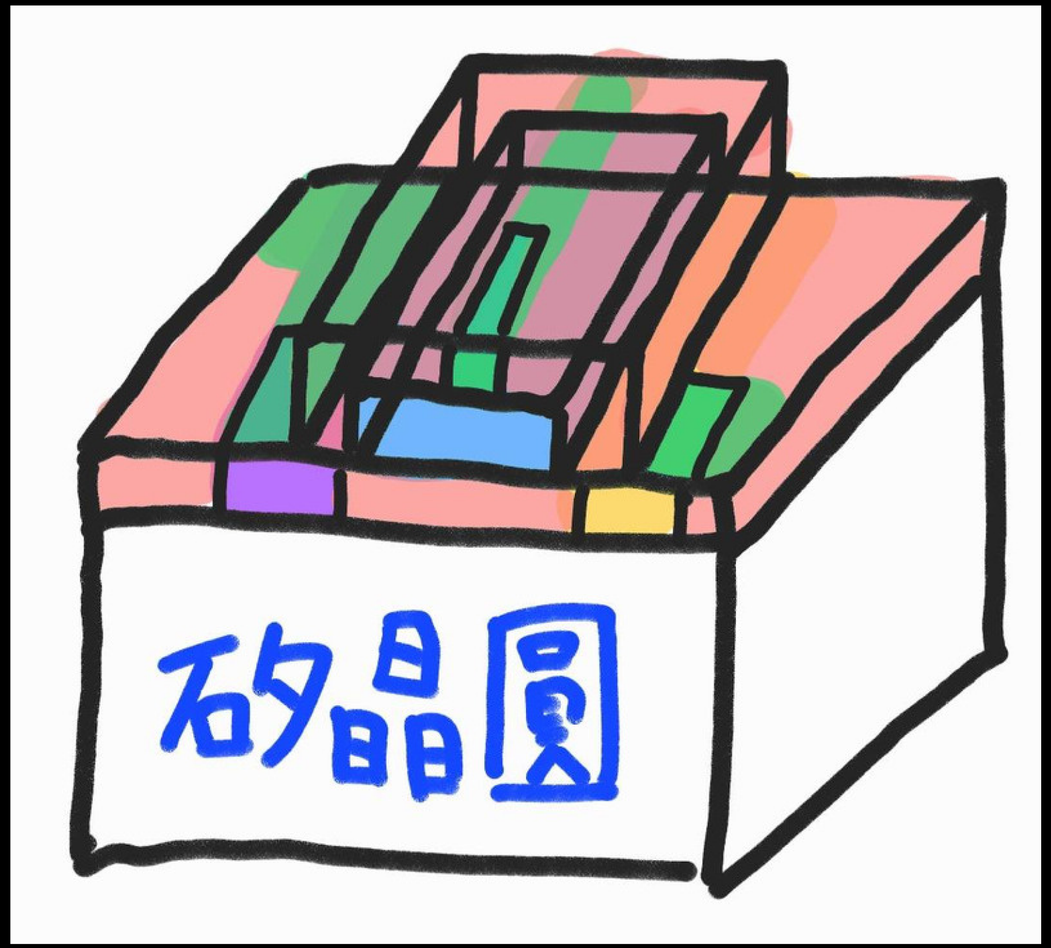
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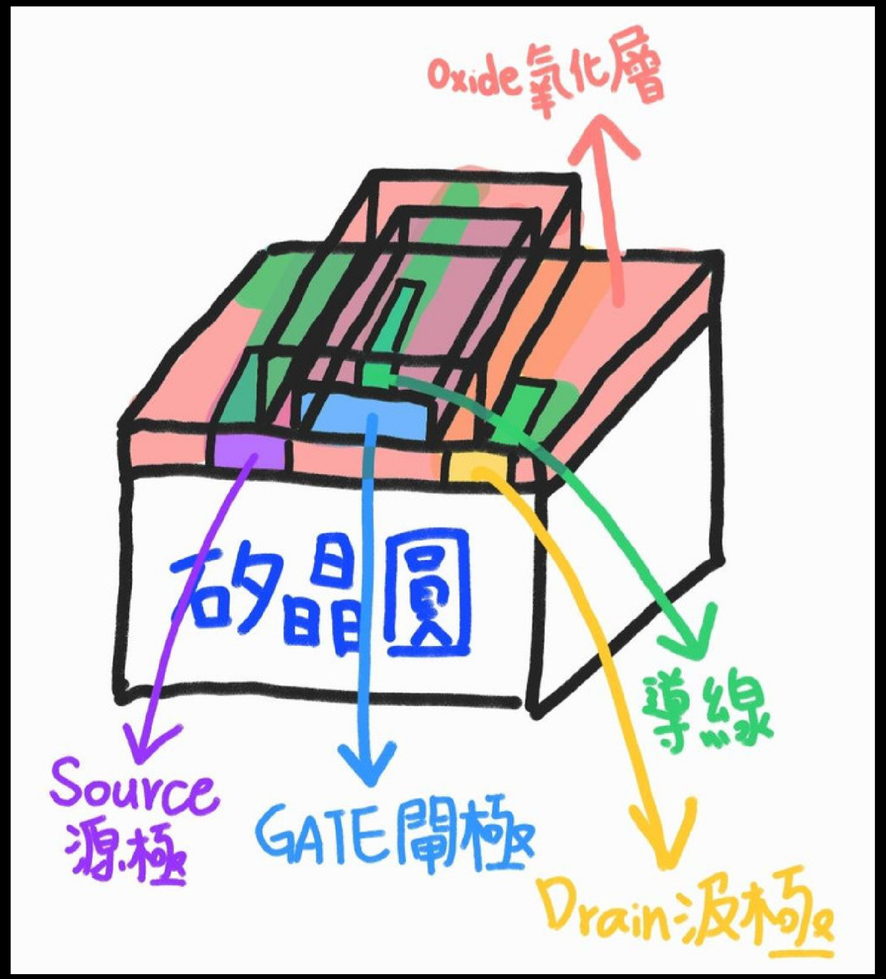
Oxide氧化層
矽晶圓
導線
Source
源極
GATE閘極
Drain汲極

結論

THANK YOU!

謝謝大家