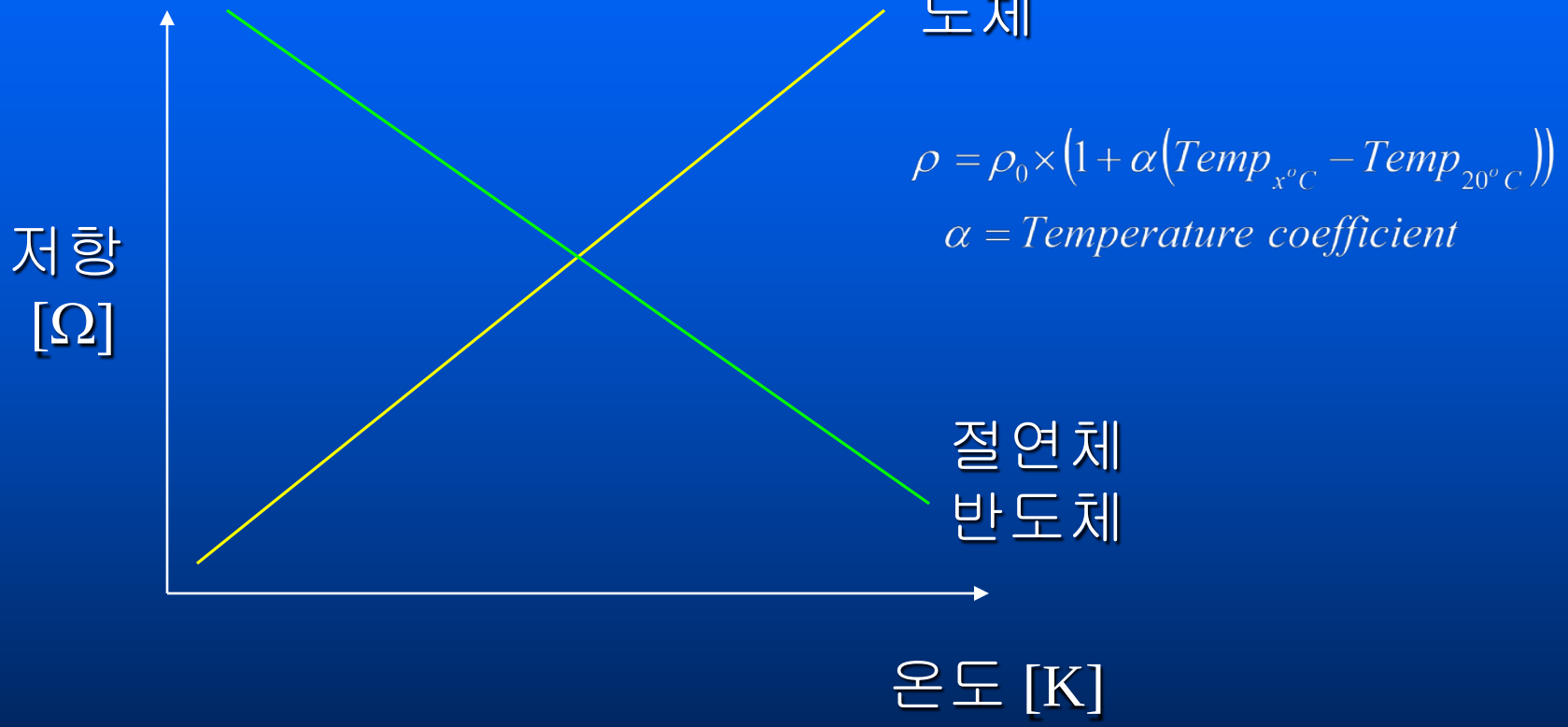
반도체의 물성

Semiconductor Properties

1. 물질의 전기적 구분

물질	특성
도체(conductor)	전기가 잘흐름
반도체(semiconductor)	도체와 절연체 중간
절연체(insulator)	전기가 잘안흐름

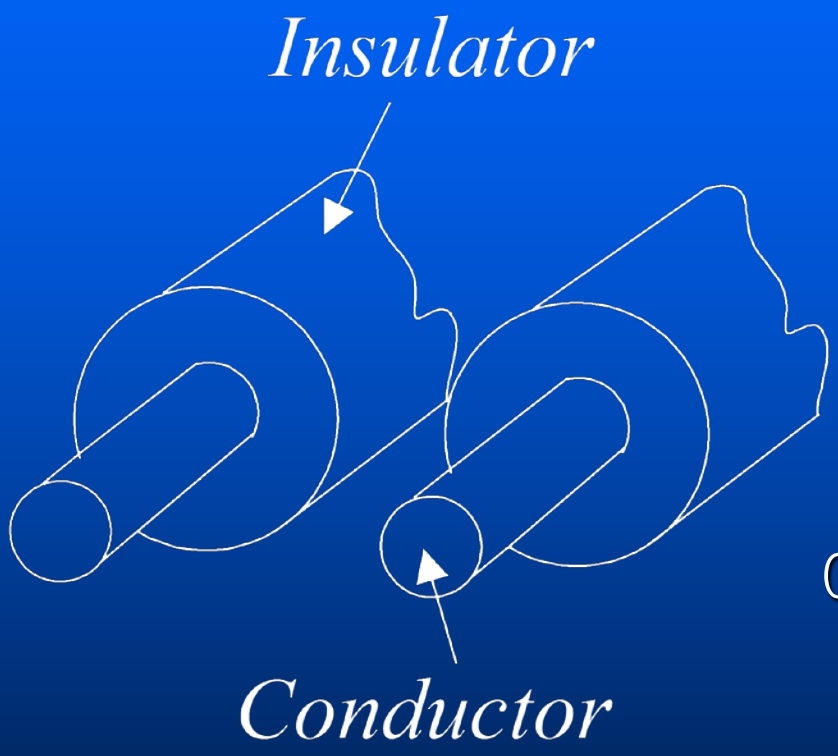
2. 물질의 온도 특성



$$\rho = \rho_0 \times \left(1 + \alpha\left(Temp_{x^oC} - Temp_{20^oC}\right)\right)$$

$$\alpha = Temperature\ coefficient$$

전선의 온도 특성



여름과 겨울의 저항은 ?

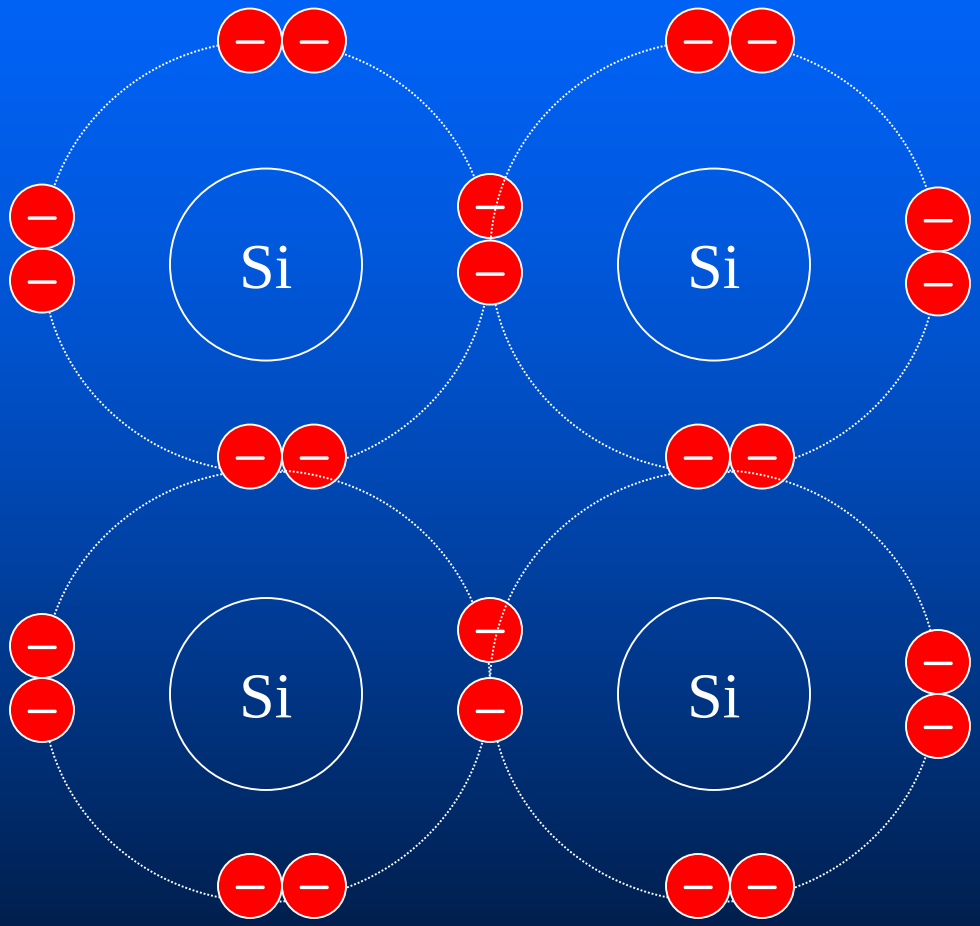
3. 주기율표(Periodical Table)

1	2											3	4	5	6	7	8
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun								

* 족(가)=최외곽전자의 수

58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

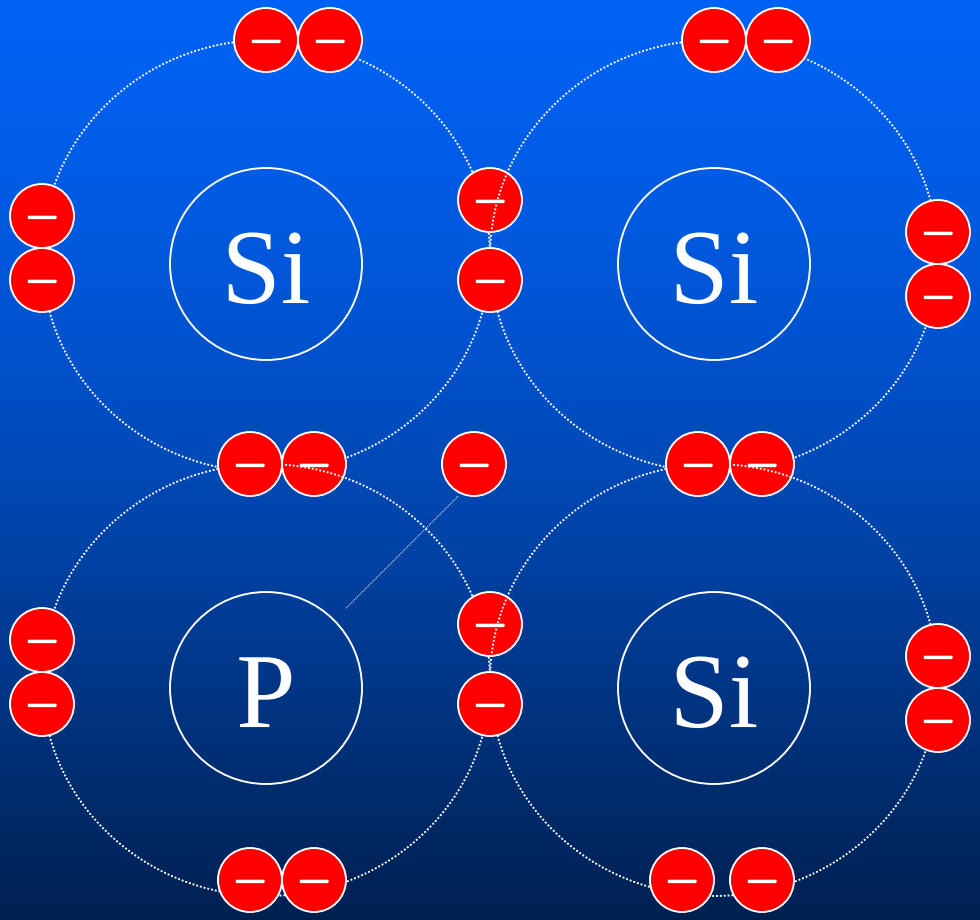
5. Silicon의 공유 결합



공유결합

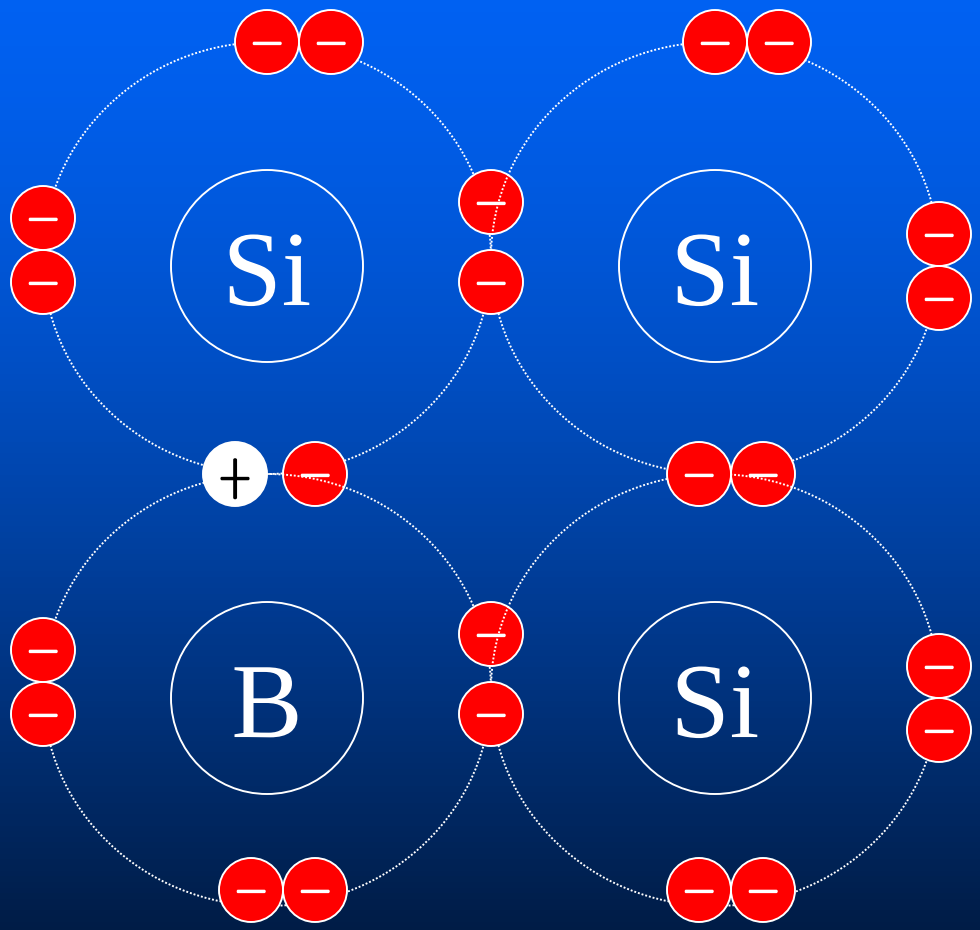
- ✓ 최외곽 궤도 (Valance Band)의 전자의 결합
- ✓ 전자의 합이 8이 되어야 안정됨

6. 불순물 반도체(N-Type)



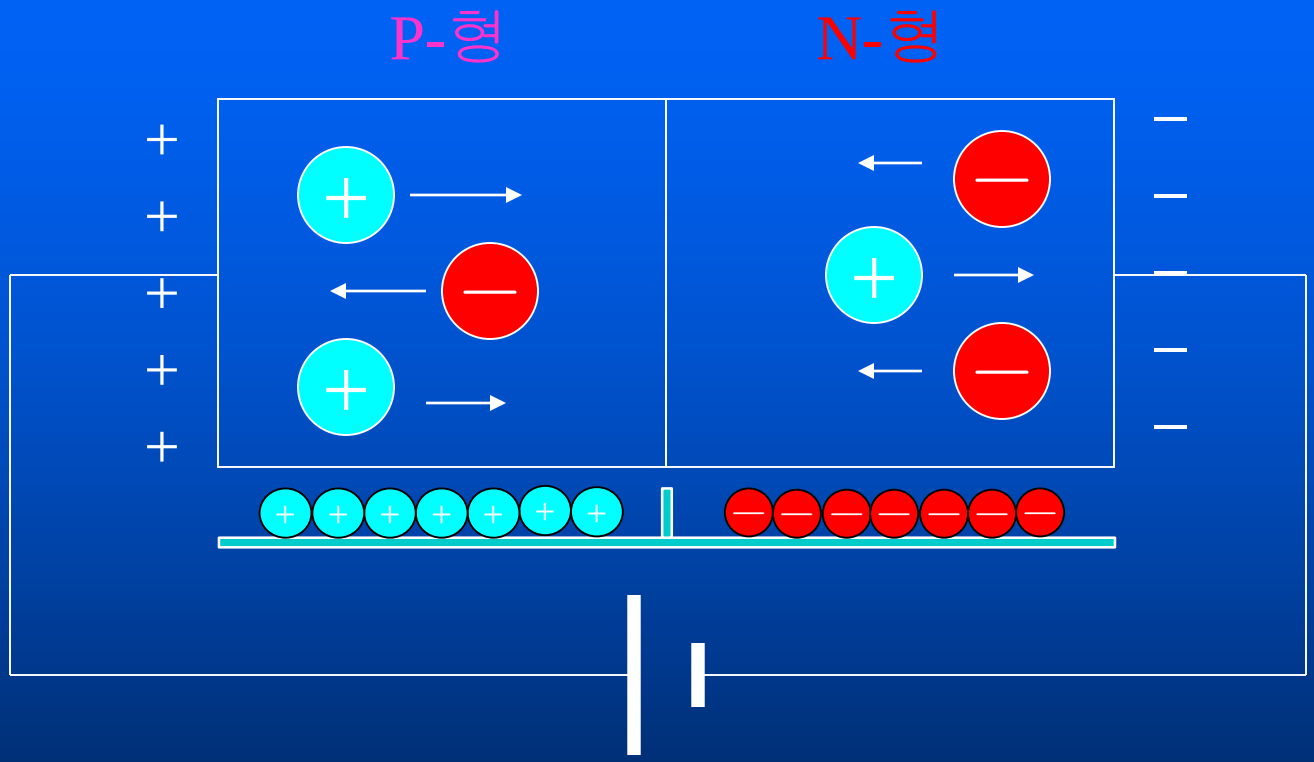
- N(negative) Type
  - ✓ Si은 도전율이 낮음
  - ✓ Si에 5족의 원소 (N, P, As, Sb, Bi)을 첨가
  - ✓ 전자가 4+5=9로 되어 1개가 남아 자유전자 (free electron)가 생김
  - ✓ 자유전자에 의하여 도전율이 증가

7. 불순물 반도체(P-Type)



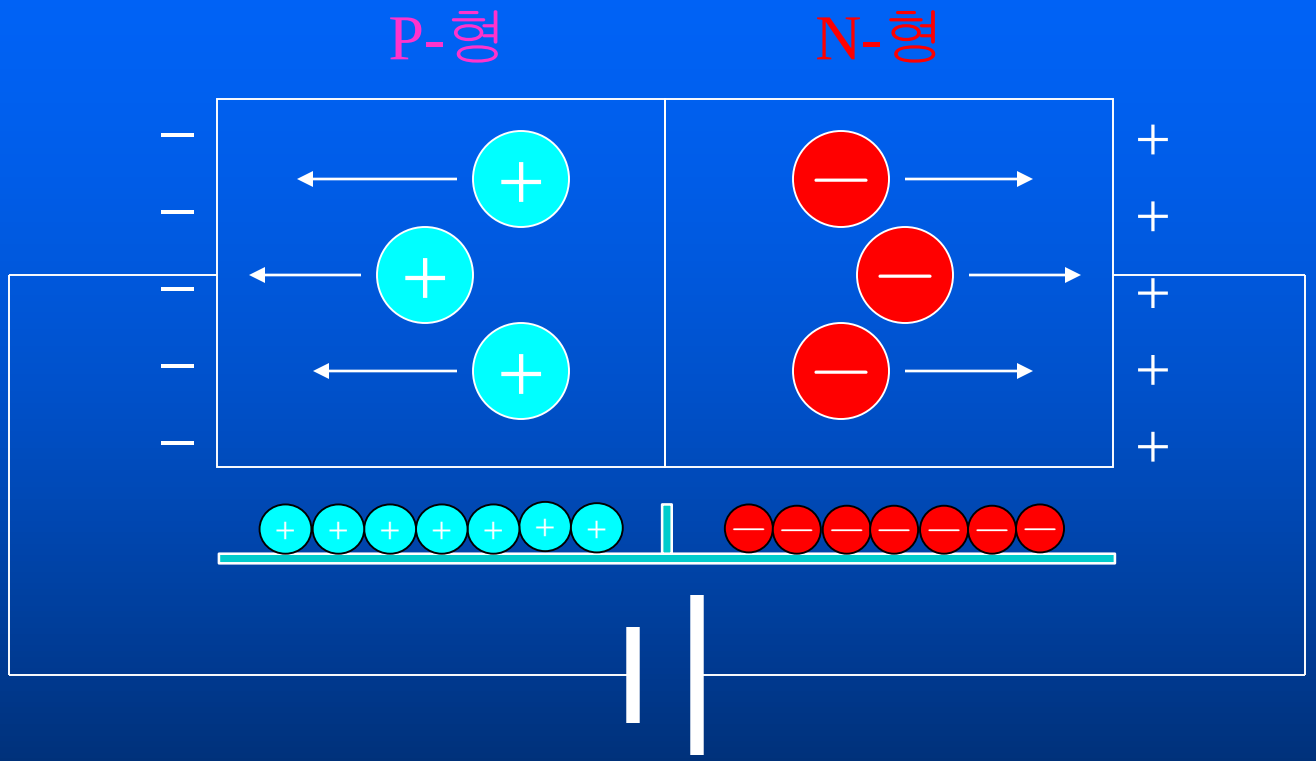
- P(positive) Type
  - ✓ Si은 도전율이 낮음
  - ✓ Si에 3족의 원소 (B,Al,Ga In, Tl)을 첨가
  - ✓ 전자가 4+3=7로 되어 1개가 부족 정공(hole)이 생김
  - ✓ 정공에 의하여 도전율이 증가

8. Diode의 동작원리: 순방향 (Forward)



- 전류 = 전자전류 + 정공전류
- 전자는 전류와 반대 방향
- 정공은 전류와 같은 방향

9. Diode의 동작원리: 역방향 (Reverse)



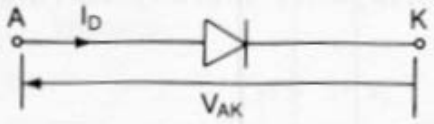
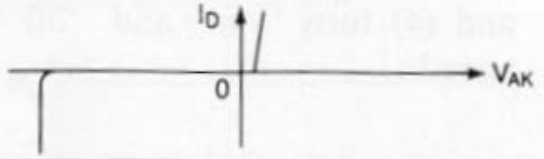
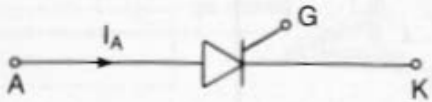
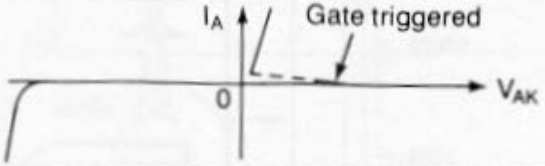
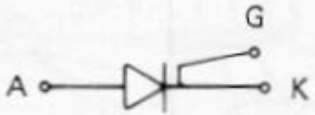
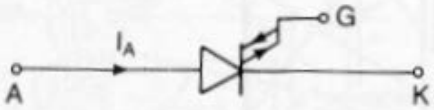
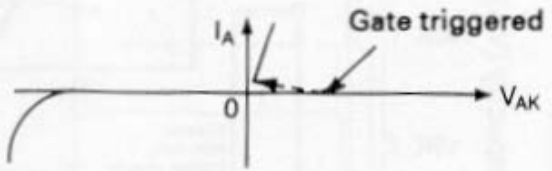
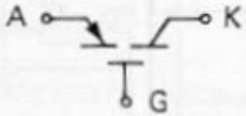
- 전류 = 전자전류 + 정공전류
- 전류가 흐르지 못함

10. P-N 접합(Junction)의 현상

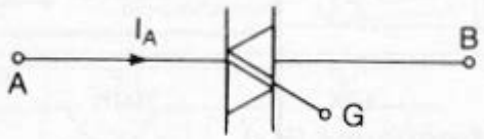
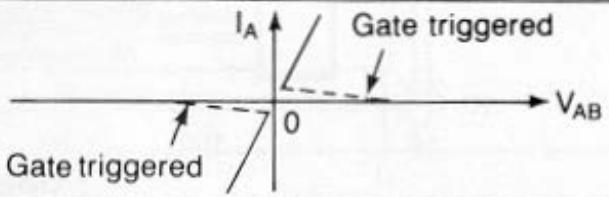
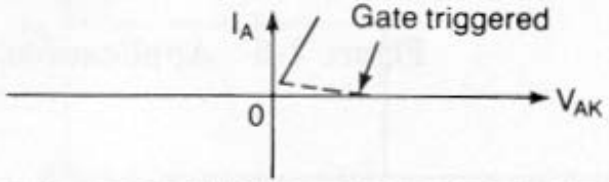
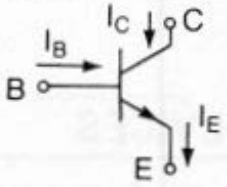
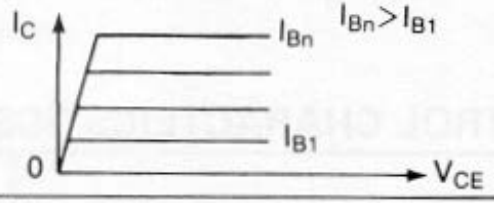
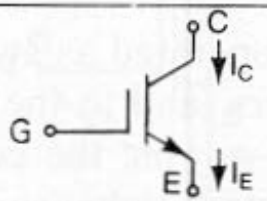
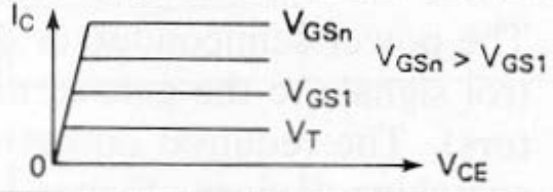
P-N 접합에서는 여러 가지 물리적인 현상 발생

1. 압력 인가 → Capacitance 값 변화, 전압 발생(압전 현상)
2. 외부전원 인가 → 정류 작용 : Diode
3. 외부 빛 인가 → 전류가 흐름(수광소자) : Photo Diode
4. 외부전원 인가 → 빛을 발생(발광소자) : LED(Light Emitting Diode)

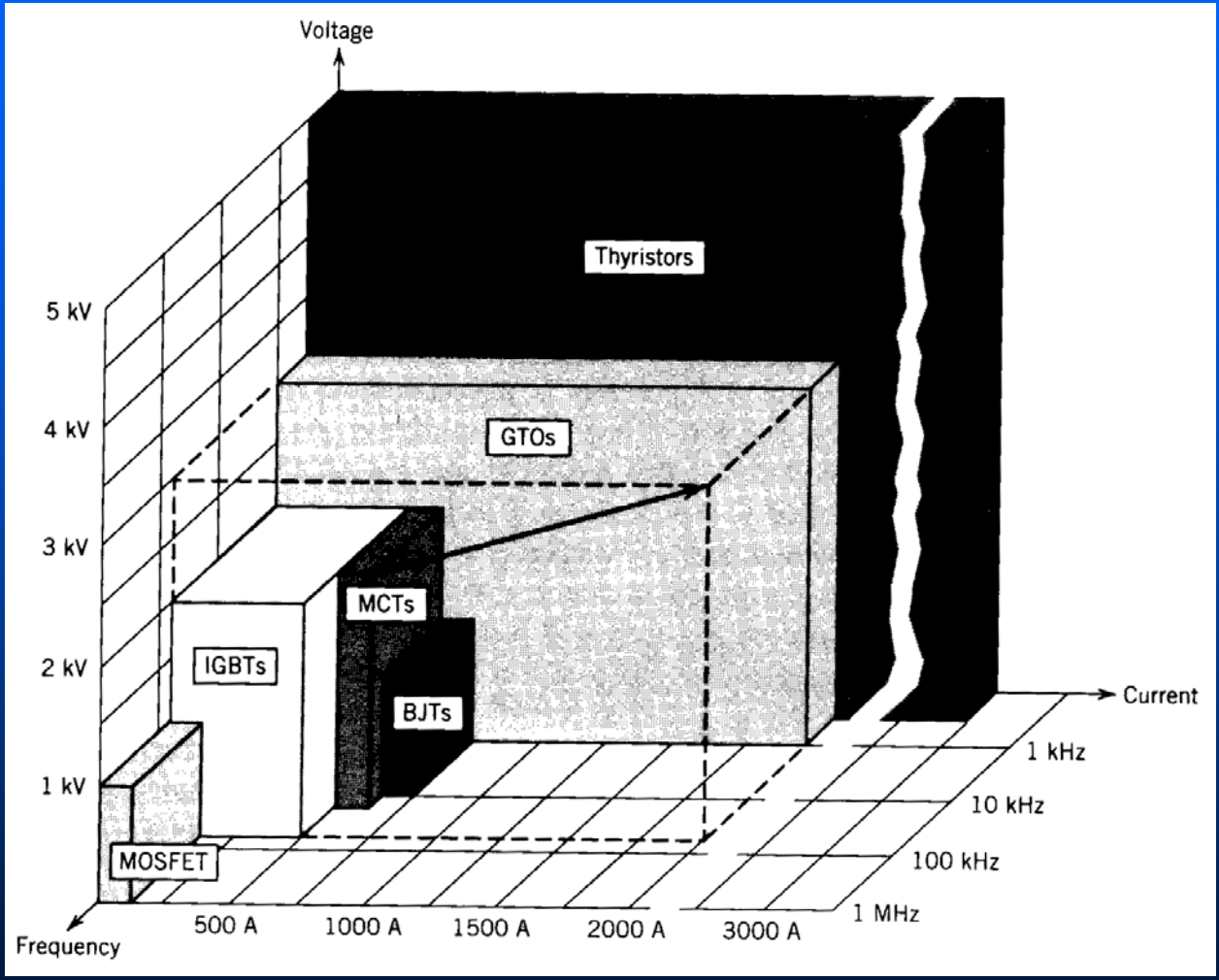
주요소자 1(Components 1)

Devices	Symbols	Characteristics
Diode		
Thyristor		
SITH		
GTO		
MCT		

주요소자 2(Components 2)

TRIAC		
LASCR		
NPN BJT		
IGBT		

Switching 소자의 전기적 정격



Switching 소자의 전기적 특성

소자	용량	스위칭 속도
BJT	Medium	Medium
MOSFET	Low	Fast
GTO/SCR	High	Slow
IGBT	Medium	Medium
MCT	Medium	Medium