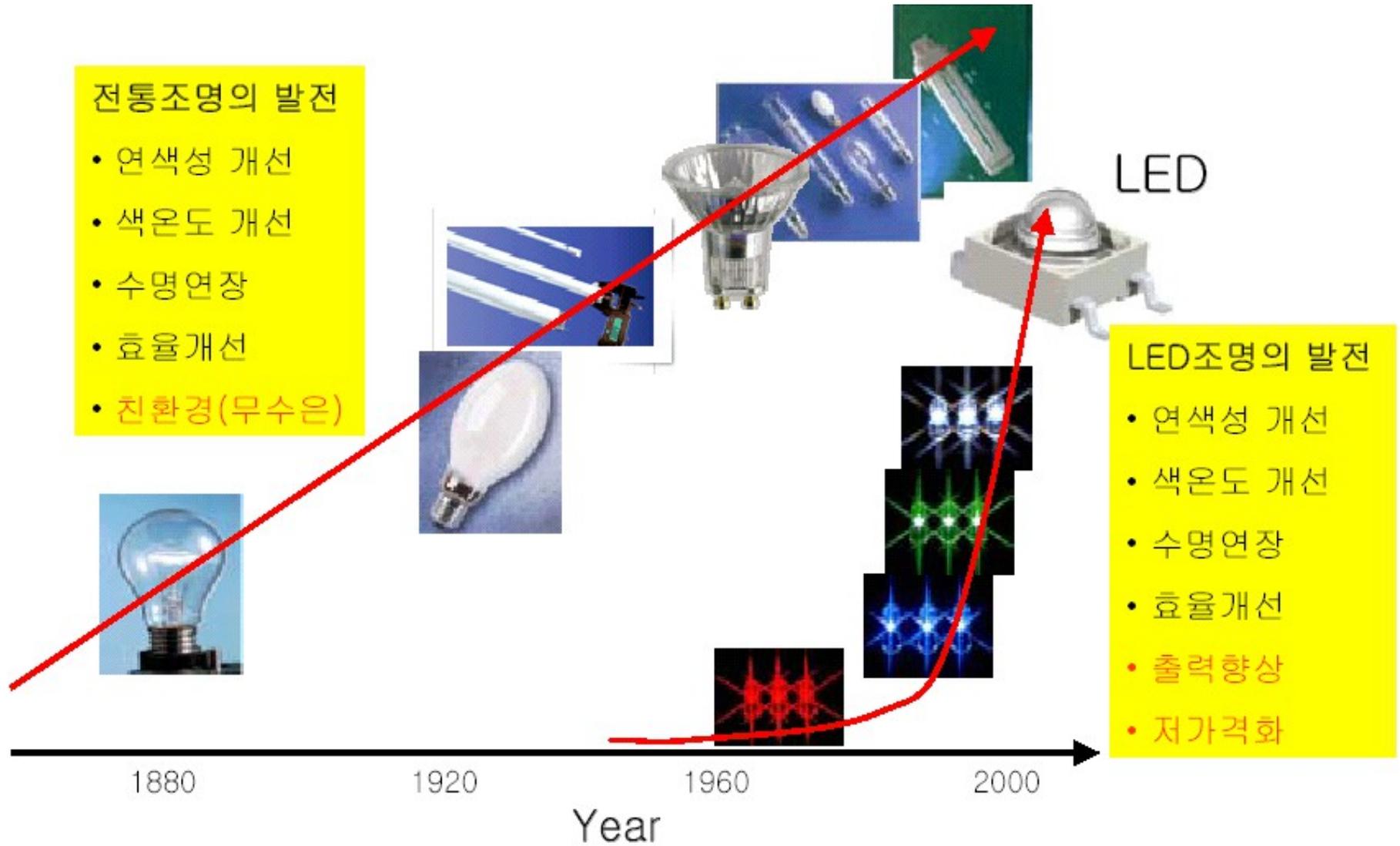




**TCC ADHESIVE TEAM**

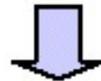




등잔불/촛불 : Chemically fueled black body emission



백열등 : Electrically fueled black body emission

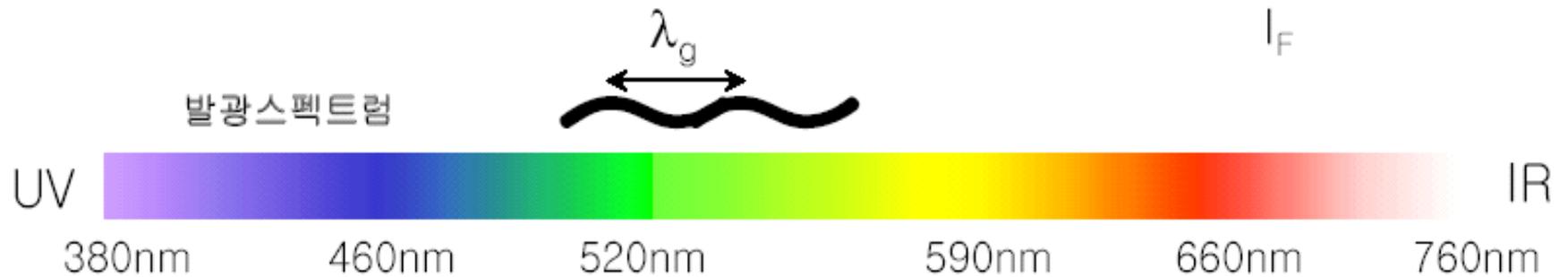
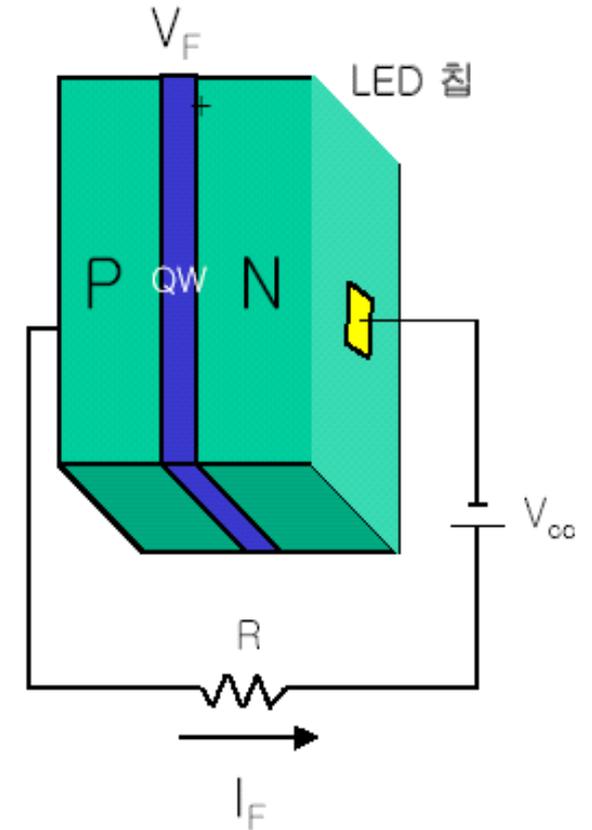
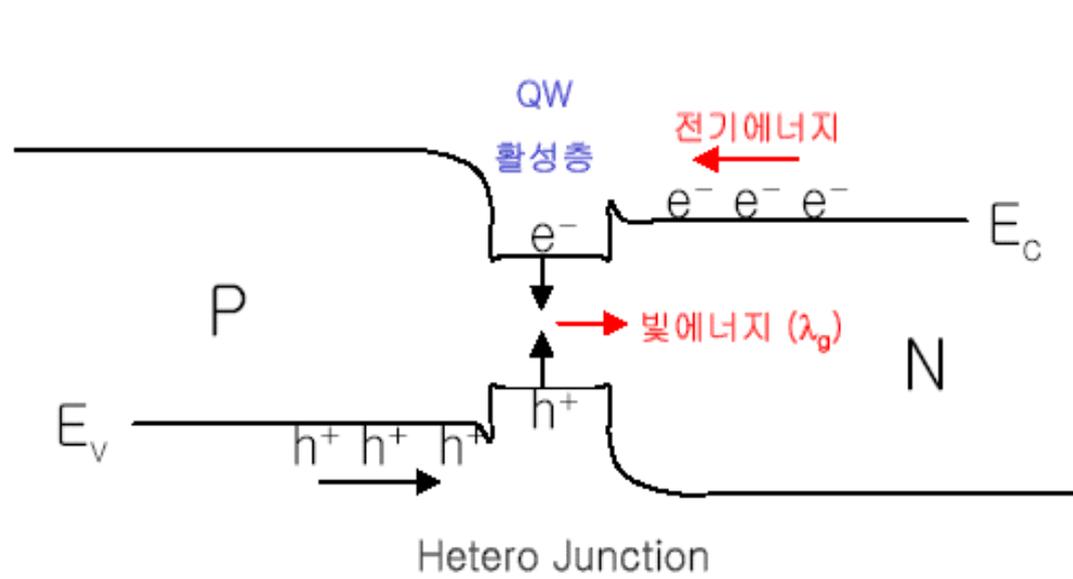


형광등/가스방전등 : Electrically fueled narrow band emission from gases



Solid state lighting : Electrically fueled narrow band emission from solids

**LED, OLED, LD, 고체레이저**

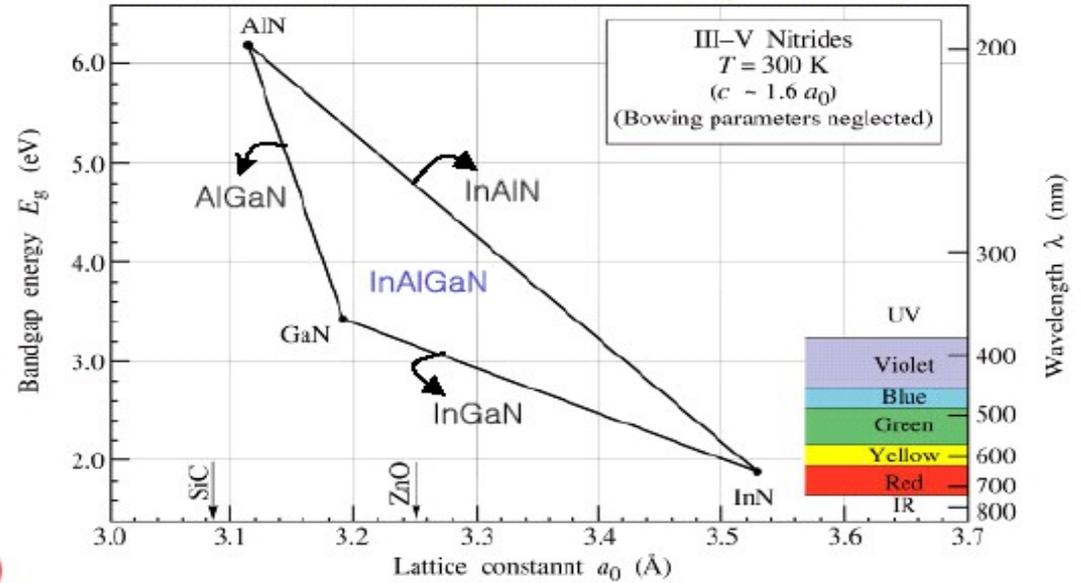


## LED 재료

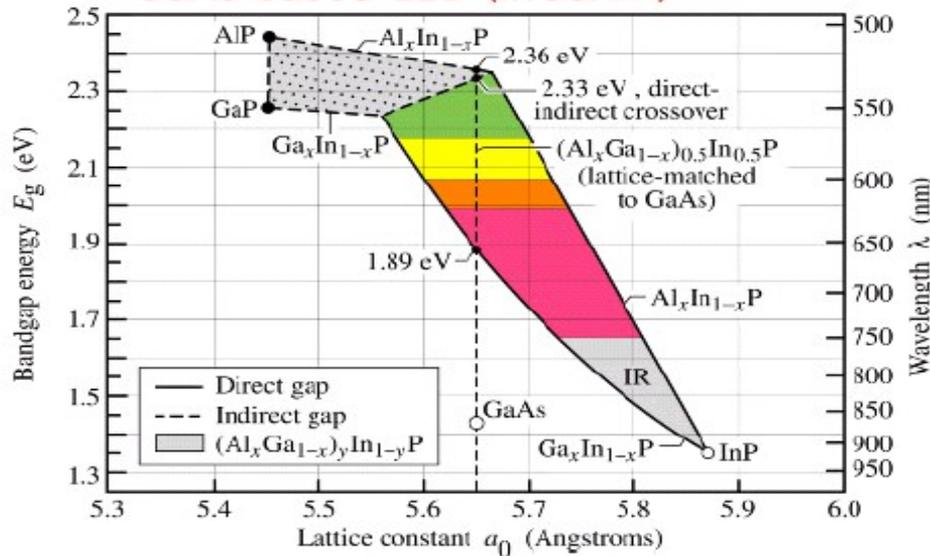
UV/Blue/Green

Yellow/Orange/Red/IR

### Sapphire(or SiC) based LED (InGaAlN)



### GaAs based LED (InGaAlP)



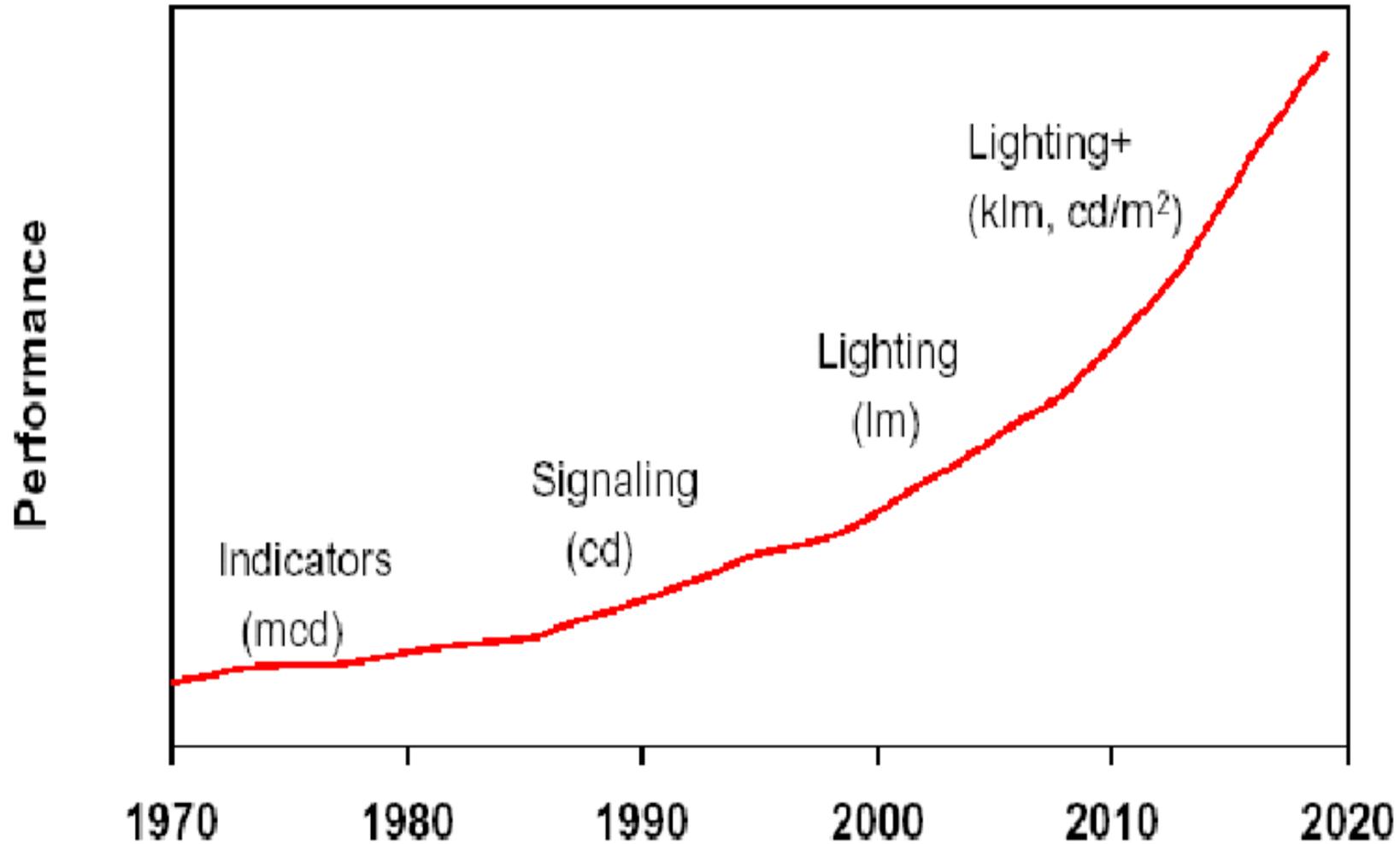
AlP  
 $E_g = 2.45 \text{ eV}$   
 $a_0 = 5.4510 \text{ \AA}$

GaP  
 $E_g = 2.26 \text{ eV}$   
 $a_0 = 5.4512 \text{ \AA}$

InP  
 $E_g = 1.35 \text{ eV}$   
 $a_0 = 5.8686 \text{ \AA}$

GaAs  
 $E_g = 1.424 \text{ eV}$   
 $a_0 = 5.6533 \text{ \AA}$

| 용어                            | 단위                             | 의미  |
|-------------------------------|--------------------------------|---|
| 광(선)속<br>(Luminous flux)      | lm<br>(루멘)                     | 광원으로부터 나오는 광의 총량 * 시감도.<br>1 lm = 1/683 W @ 555 nm  |
| 광도<br>(Luminous intensity)    | cd<br>(칸델라)                    | 단위입체각당 광속 (lm/sr).<br><i>진동수 <math>540 \times 10^{12}</math> 헤르츠인 단색광을 방출하는 광원의 복사도가 어떤 주어진 방향으로 매 스테라디안 당 1/683 W 일때 이 방향에 대한 광도</i> |
| 조(명)도<br>(Illuminance)        | lx<br>(룩스)                     | 빛이 비춰지는 면의 단위면적당 광속<br>1 lx = 1 lm/m <sup>2</sup><br>(직사광 지면위 : 10만 룩스, 보름달 지면위 0.2 룩스)   |
| 휘도<br>(Brightness, Luminance) | nt(니트)<br>(cd/m <sup>2</sup> ) | 단위 입체각당, 단위면적에서 조사되는 광속<br>양초 : 1 nt, 달의면 : 0.3 nt, 태양 160k nt  |
| 조명효율<br>(Luminous efficiency) | lm/W                           | 소비전력당 광속  |



## 기술적 측면

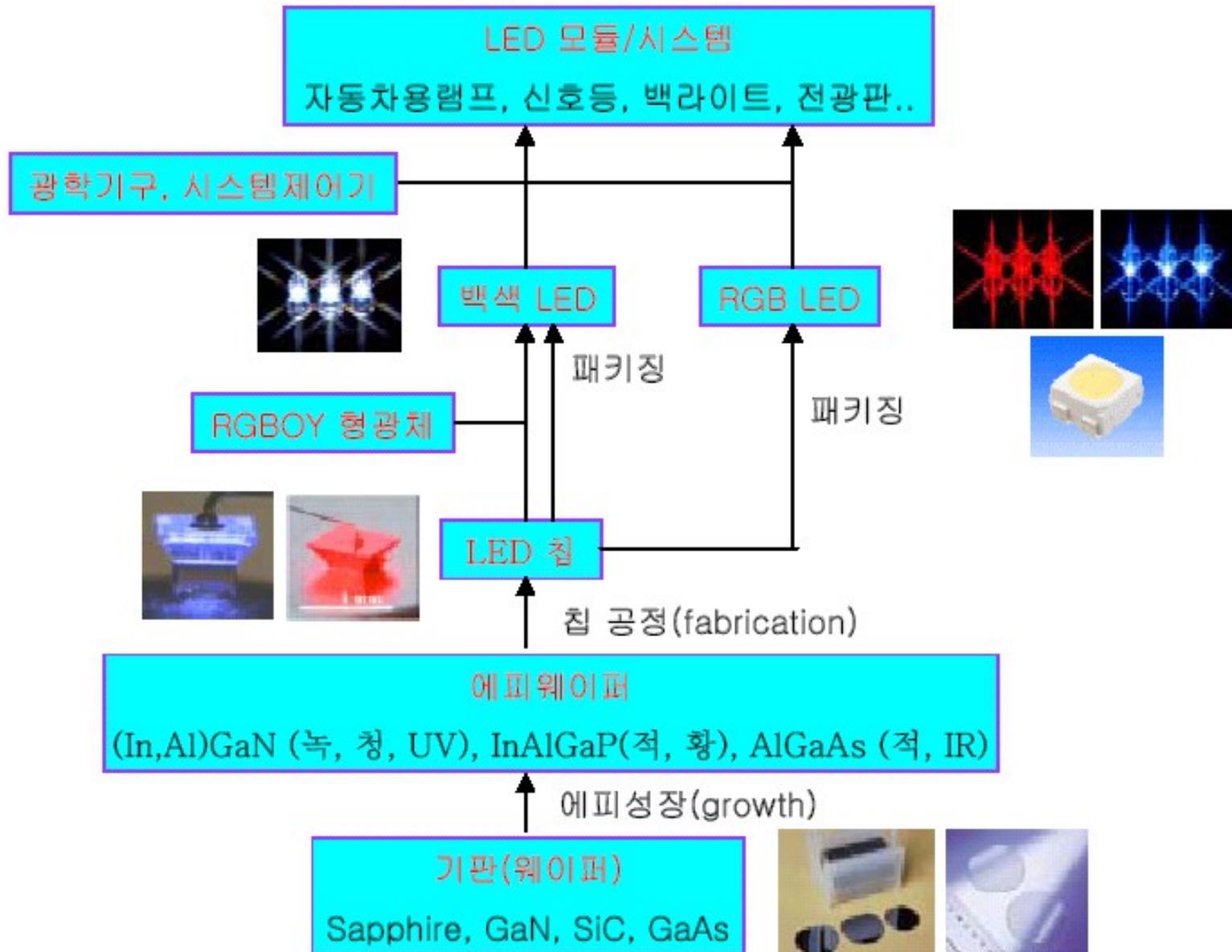
- 저전력, 장수명, 고효율, 소형, 고속응답
- 온도에 민감
- 구동회로의 복잡성

## 산업적 측면

- 전방위 산업에 응용 (자동차, 휴대용 가전, LCD 모니터..)
- 친 환경 산업/고성장 산업
- 높은 초기 구매가격

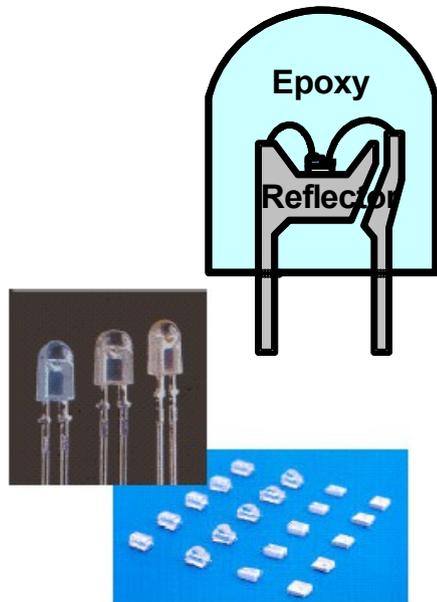
## 환경/정책적 측면

- 에너지 절감 및 친 환경 정책에 의한 대체광원 후보
- 선진국에서는 대형 국책사업으로 LED 조명기술 개발 중
- 국내 생산기술 기반 및 지원은 상대적으로 취약
- 중국/대만의 저가공세, 미국/일본의 기술 및 특허동맹
- 표준화경쟁



과거

**THT package : lamp type LED  
(through-hole technology )**

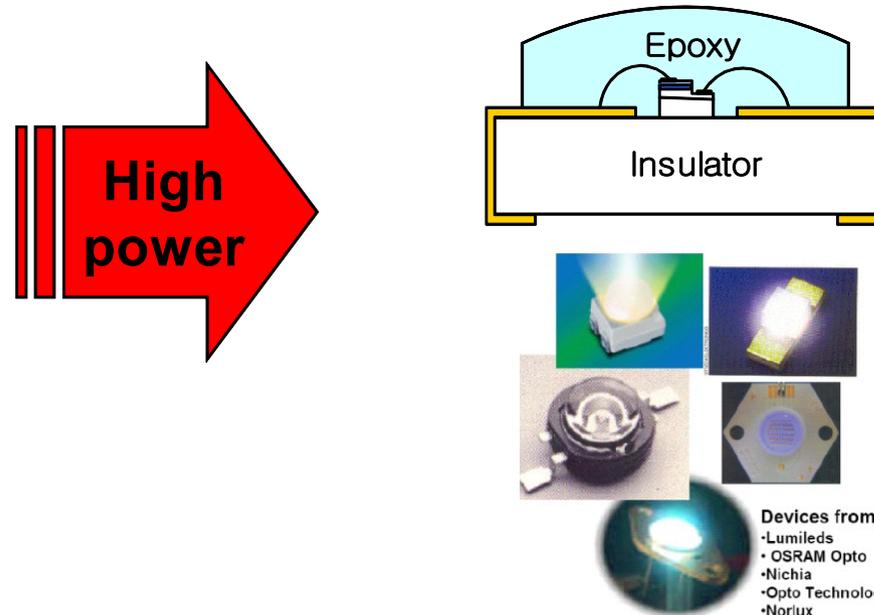


**용도 : Indicator LEDs (지시용, 표시용)**

- 3mm, 5mm, SMD
- 광도의 낮은 효율
- 매우 낮은 광속
- 높은 가격 저하율

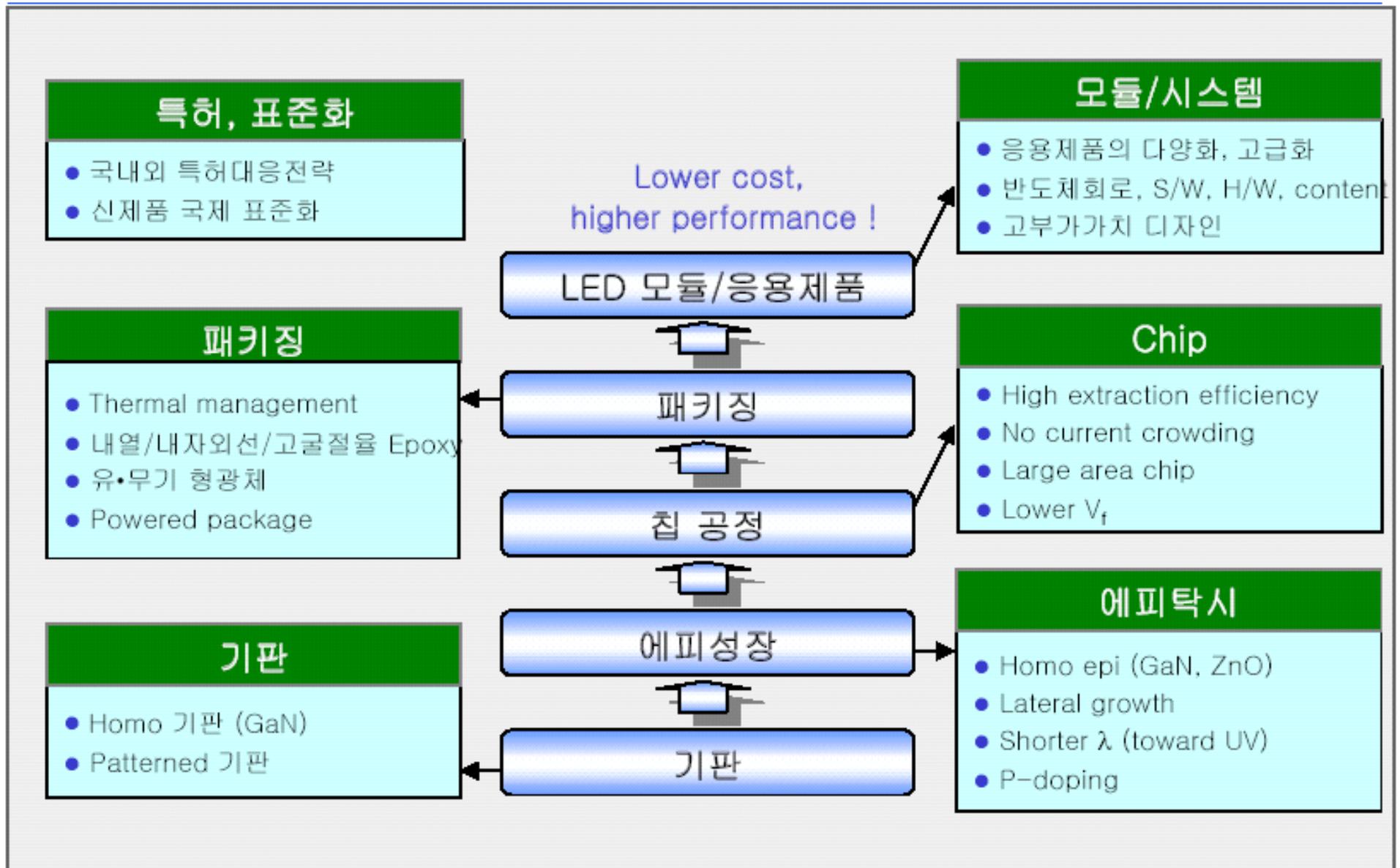
현재

**Advanced SMT package : SMD-type LED  
(surface-mount technology)**

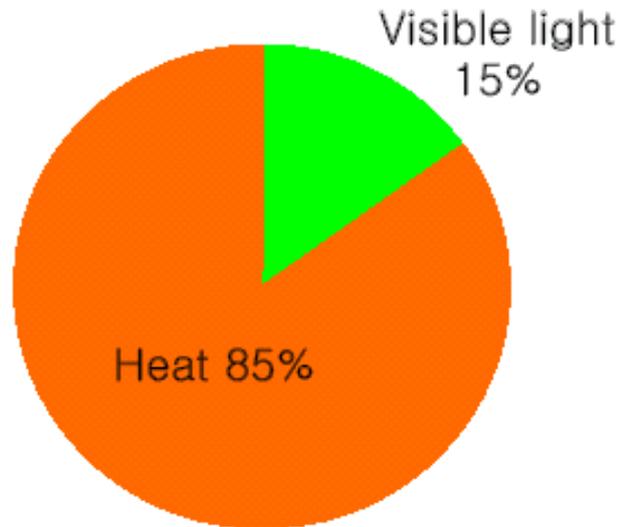


**용도: Illuminator LEDs (조명용)**

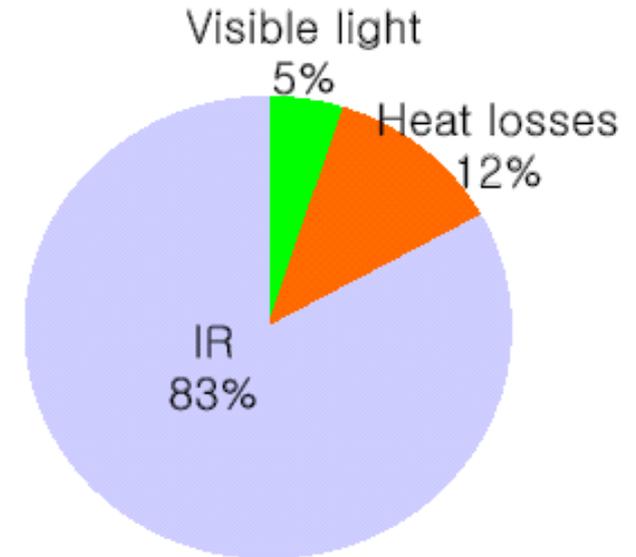
- Advanced SMD
- 광효율 증대
- High-power drive
- 보다 우수한 열관리
- 보다 우수한 광속유지



## LED Energy



## 100 W 백열전구



- LED electronic driver efficiency around 85%
- 15 % of available power in LED's converts to light
- 100W system means 87W of heat
- Thermal management is extremely important

- 빛의 삼원색 혼합

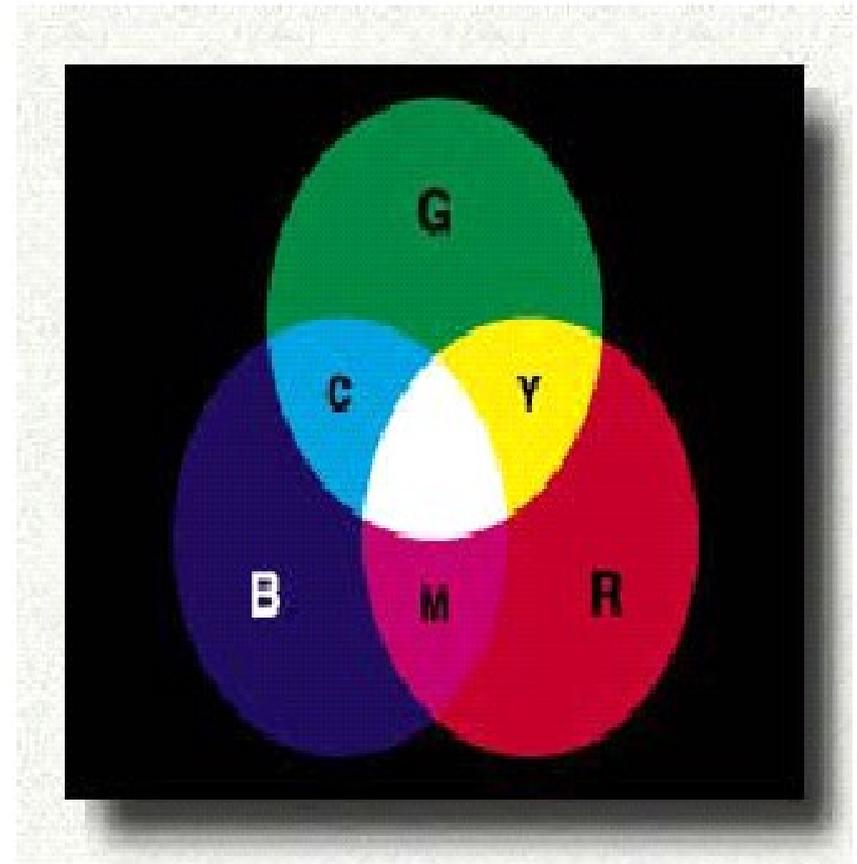
Red + Green + Blue = White

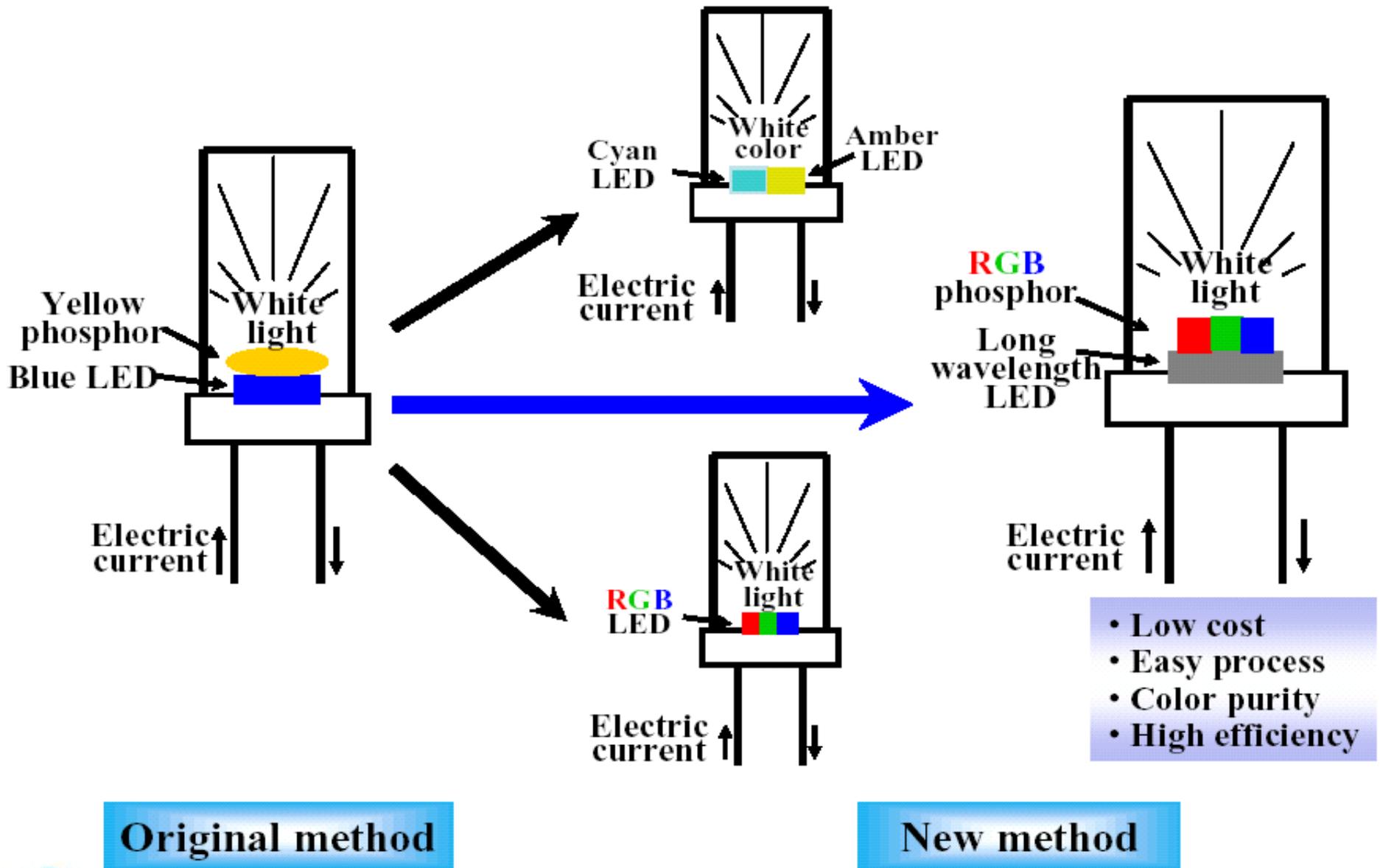
- 보색 혼합

Blue + Yellow = White

Cyan + Amber = White

Green + Magenta = White

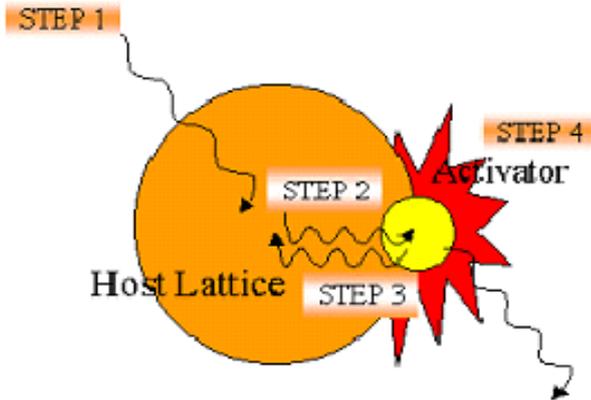




- Low cost
- Easy process
- Color purity
- High efficiency

|      | 1-chip solution            |                          | 2-chip solution      | 3-chip solution            |
|------|----------------------------|--------------------------|----------------------|----------------------------|
|      | Blue LED + Yellow Phosphor | UV LED + RGB phosphor    | Binary Complementary | RGB Multichip              |
| 연색성  | Δ                          | ◎                        | Δ                    | ○                          |
| 색안정성 | ○                          | ◎                        | Δ                    | Δ                          |
| 수명   | Δ                          | unproven                 | ○                    | ○                          |
| 효율   | Δ                          | ◎                        | ○                    | ○                          |
| 형광체  | 양산중                        | 양산중                      | 필요없음                 | 필요없음                       |
| 특징   | 제조용이, 색상 균일성 떨어짐           | 좋은 연색성, 패키지 재료의 내 자외선 요구 | 좋은 출력, 연색성 떨어짐       | 좋은 색 연출성, 좋은 출력<br>신뢰성 떨어짐 |
| 응용   | 백라이트                       | 조명                       | Task light           | 전광판                        |

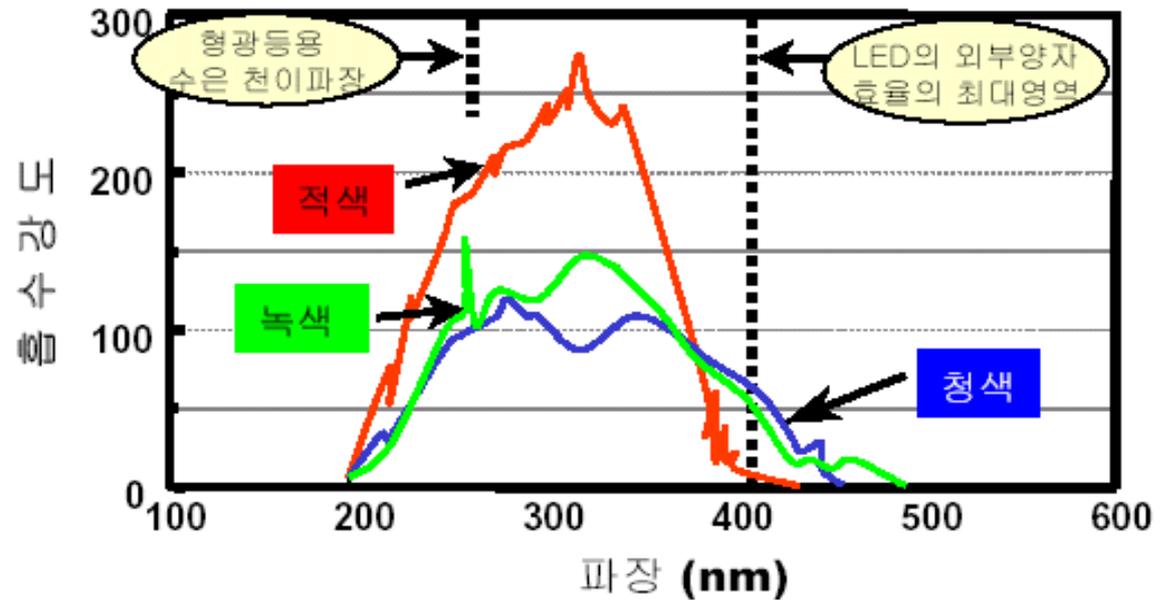
형광체: 자신보다 높은 광에너지 자극에 의해 고유의 빛을 방출.



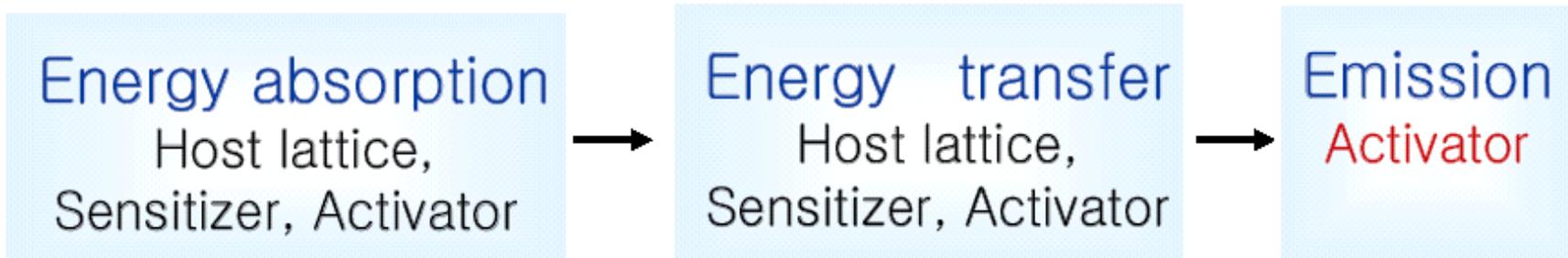
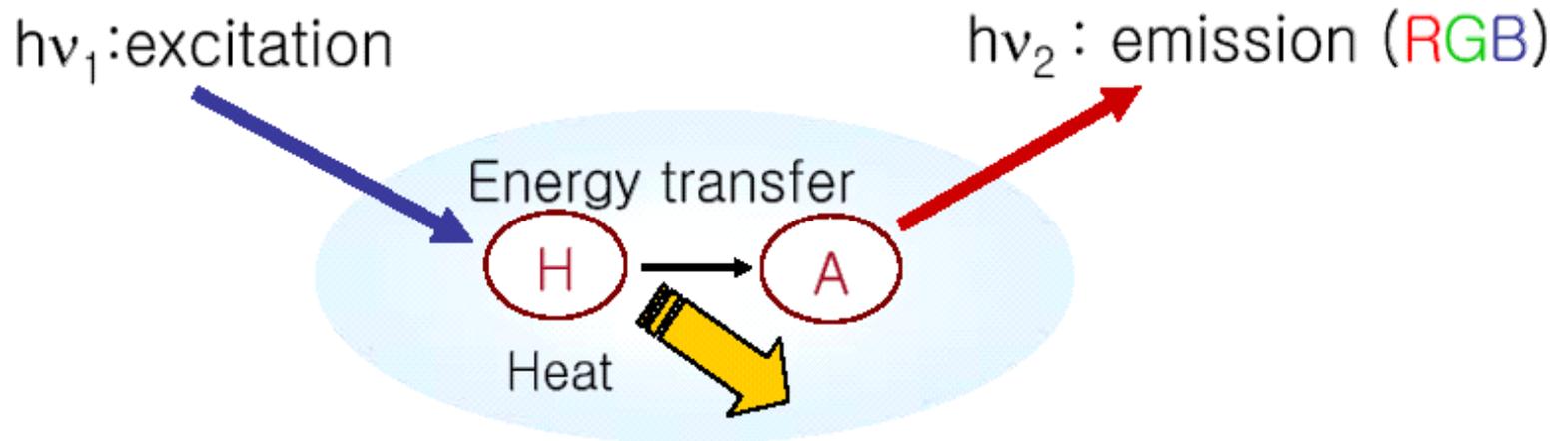
- Step 1 : Absorption
- Step 2 : Excitation
- Step 3 : Relaxation
- Step 4 : Emission

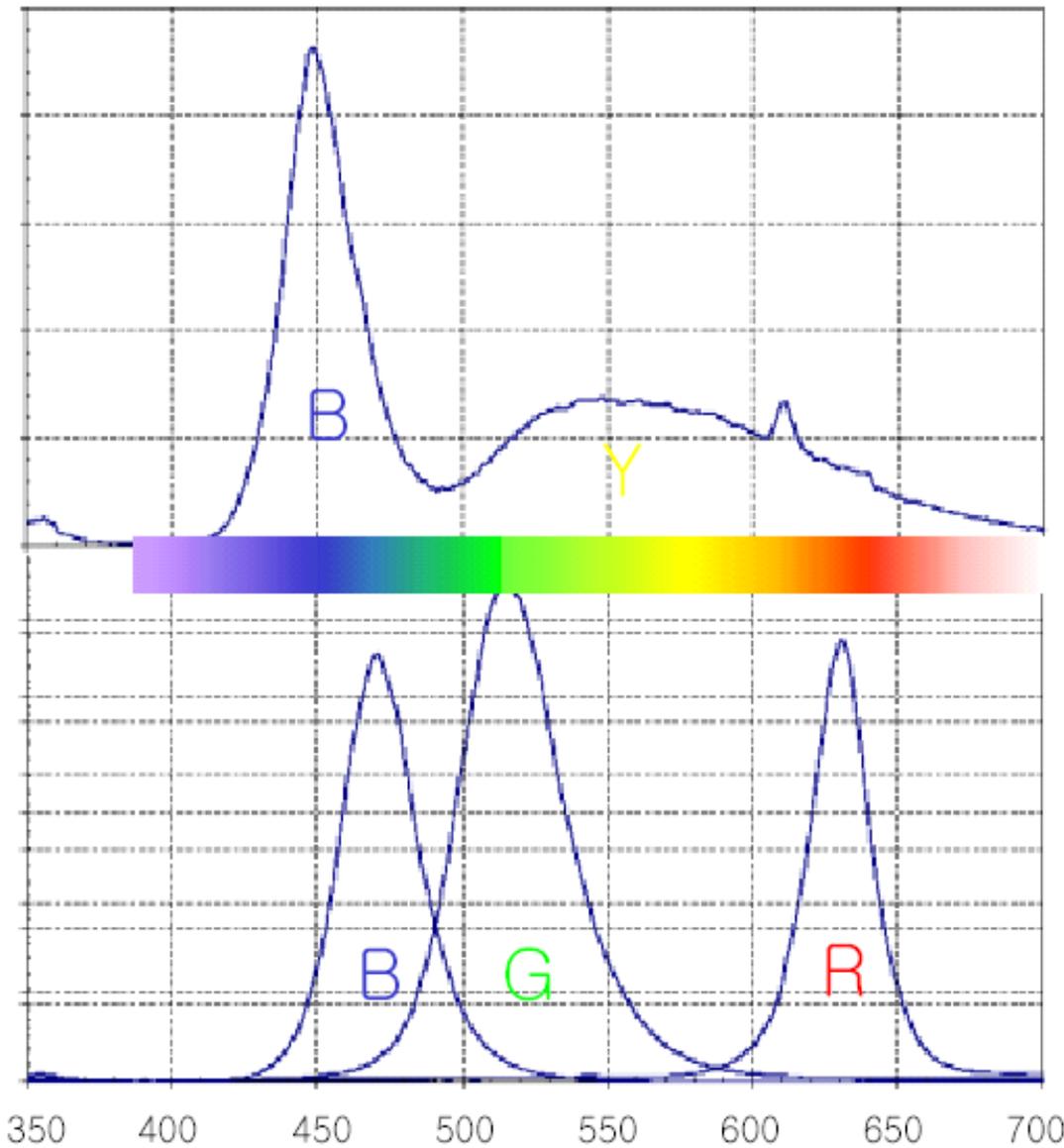
## 주요 특성

- LED 파장에서의 흡수강도
- 형광체에 의한 2차 산란 빛의 투과도
- 내열성
- 수명



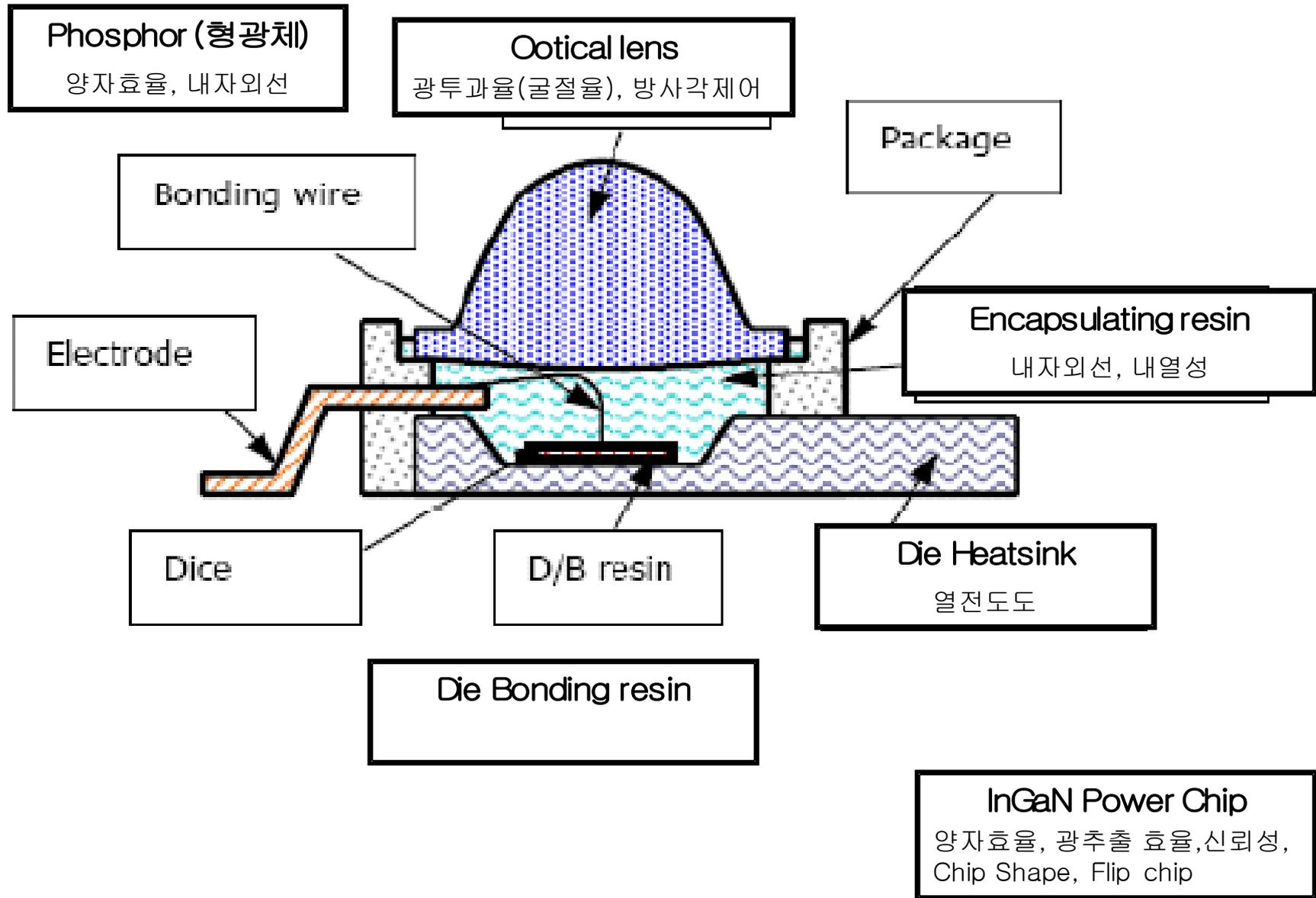
- ◆ Phosphor (Luminescent materials);  $Y_2O_3:Eu$ , YAG:Ce  
 ↗ host, activator and sensitizer( or co-activator)





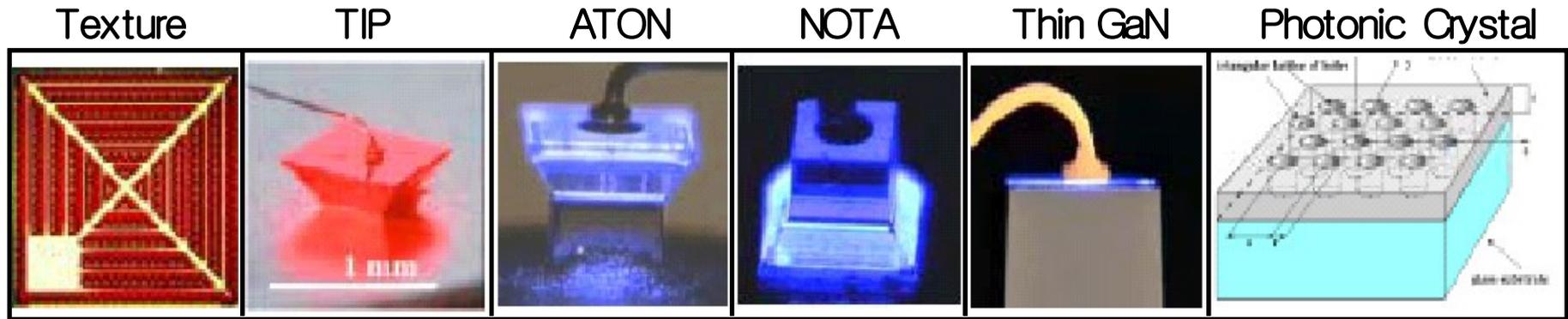
Blue LED + Yellow 형광체

RGB multi chips



## 1. 광 추출효율 향상기술

- ① Shaped chip ② Flip chip

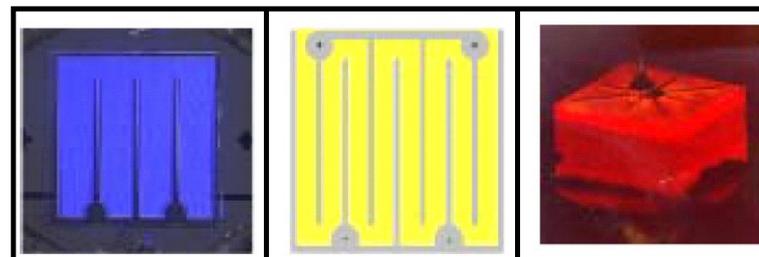


## 2. P층 Hole spreading (current crowding)

- ① 비금속 투명전극(ITO, IZO) ② Contact design

## 3. 대면적 Chip ( > 1 × 1mm<sup>2</sup> )

- ① Finger 형 전극  
② Multiple parallel cell

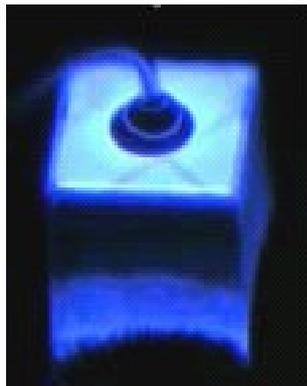
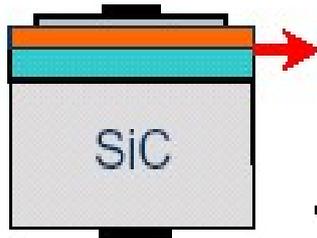


Top-top

Top-top

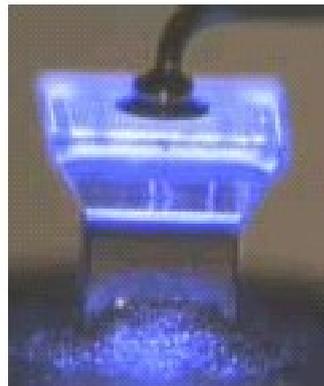
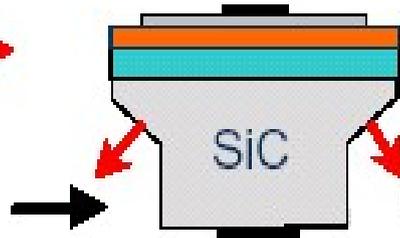
Top-bottom

Standard



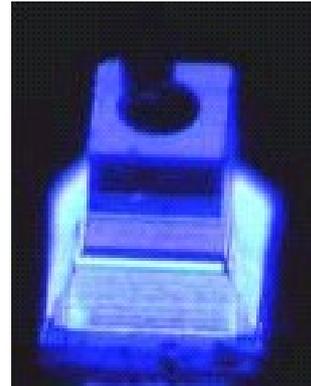
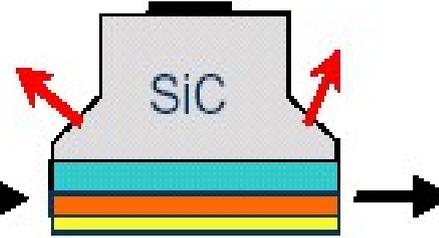
$$\eta_{\text{extract.}} = 25\%$$

ATON



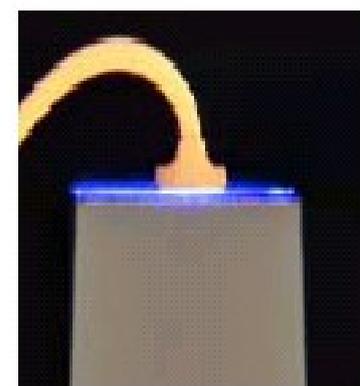
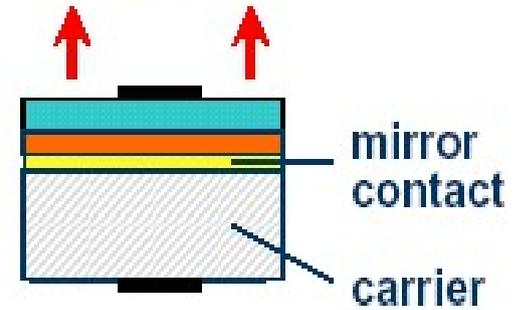
52%

NOTA

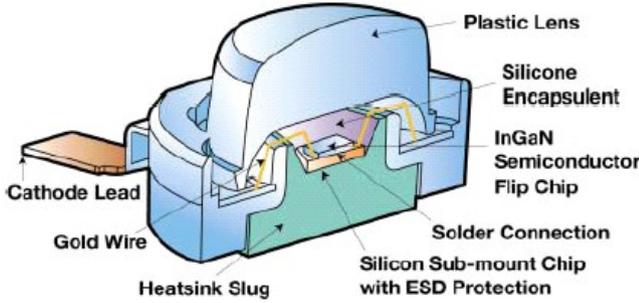
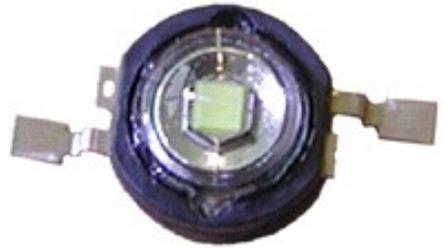
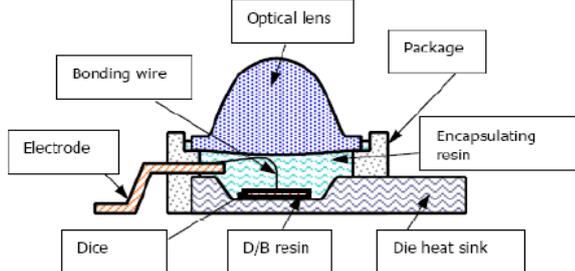
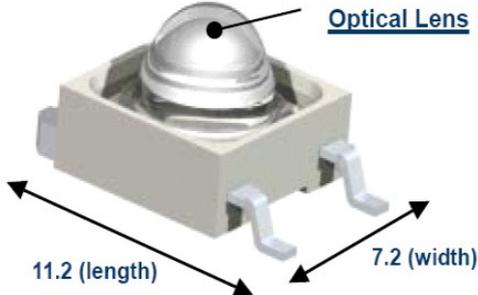


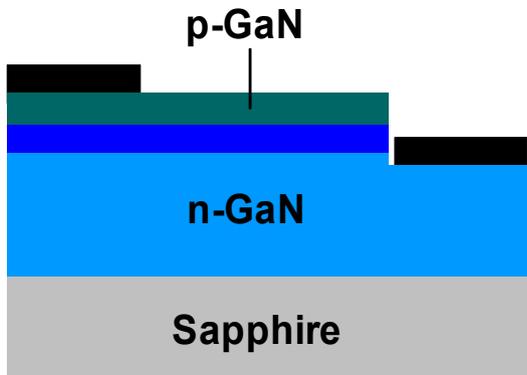
60%

ThinGaN



75%

| Company                              | Package 구조   |   |
|--------------------------------------|--|---|
| <p>Luxeon<br/>(Lumileds ㄸ)</p>       |    |    |
| <p>Side-Emitter<br/>(Lumileds ㄸ)</p> |   |   |
| <p>Jupiter<br/>(Nichia)</p>          |  |  |



일반 LED type

High power

