

1.

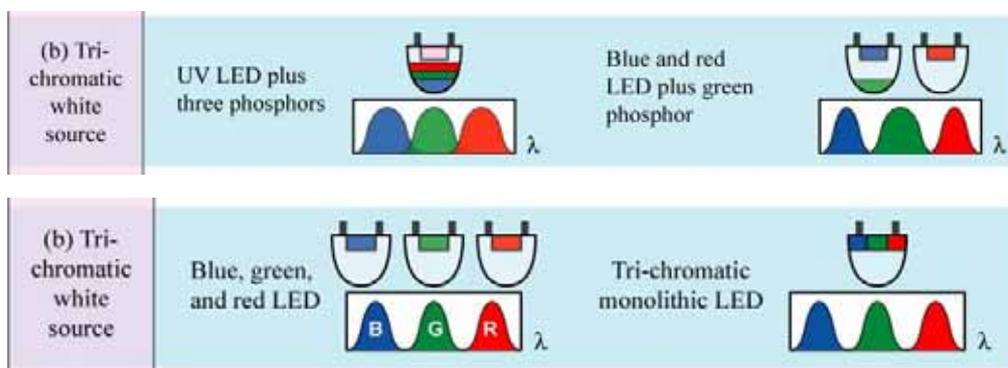
A.

1) phosphor

- UV LED 3 phosphor
- Blue, red LED Green phosphor

2) LED

- RGB 3 LED
- Trichromatic monolithic LED



B.

가

dichromatic white LED blue LED yellow phosphor
 yellow phosphor , LED
 luminous efficacy가 . 가
 CRI가 color .

C. Red phosphor

Stokes shift

luminous efficiency가

(excitation 460 nm, emission 655 nm).

yellow phosphor

converter

IQE 100% 가

red phosphor

CRI

D.

LED chip

phosphor

, viewing angel

LED chip

phosphor

가

LED

phosphor

converting

가

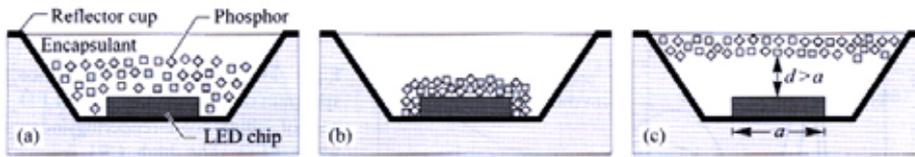


Fig. 21.11. (a) Proximate phosphor distribution, (b) proximate conformal phosphor distribution, and (c) remote phosphor distribution in which phosphor and chip are separated by at least one times the lateral dimension of the chip (after Kim *et al.*, 2005).

2. cone rod . Cone cell color
 intensity RGB 3 3 cone
 Photopic region cone color intensity
 Rod color visible spectrum
 scotopic region

3.

1) 200 cm

$$150 \text{ lm/W} \times 15 \text{ W} = 2250 \text{ lm}$$

LED

luminous flux

$$\frac{4\pi r^2}{2} = \frac{4\pi 2^2}{2} = 25.13 \text{ m}^2$$

$$\text{illuminance} = 2250 \text{ lm} / 25.13 \text{ m}^2$$

$$= 89.5 \text{ lm/m}^2 = 89.5 \text{ lux}$$

30~300 lux 가

2) 50 cm

1443 lux

4.

- Ga-face GaN (+) charge Ga (-) charge
 spontaneous electric field가 InGaN Ga
 site가 In
- Piezoelectric polarization
 : GaN unit cell net charge=0 Ga N tetrahedral 가

GaN InGaN
 compressive stress
 가
 polarization
 electric field
 z-
 dipole
 electric field가
 가
 - +
 spontaneous

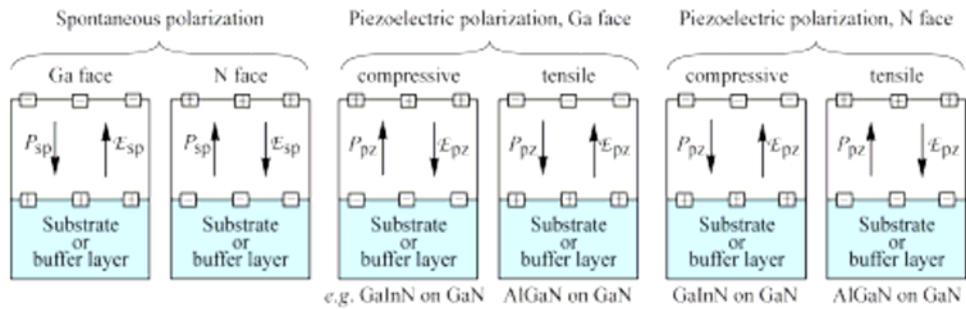
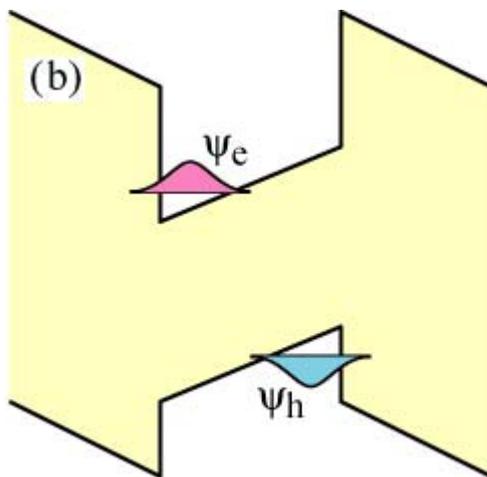


Fig. 13.3. Surface charges and direction of electric field and polarization field for spontaneous and piezoelectric polarization in III-V nitrides for Ga and N face orientation.

- E_{pz} E_{sp}
 electric field가
 가
 E-k space
 recombination
 band bending
 electron hole
 가
 k
 internal carrier



- A, M plane
 polarization effect가
 band bending
 GaN
 polarization
 active region