

# 나노구조 소재를 이용한 LED 최신 동향 II

2004 3 15 19 5 5  
 International Symposium on Blue Laser and Light Emitting Diodes (ISBLLED -  
 2004) LED . ISBLLED -  
 2004 LED nonradiative site threading  
 dislocation(TD) Lateral Epitaxial Overgrowth, Buffer -Layer  
 Quantum Well (QW), Quantum Dot (QD), Nano Wire (NW)  
 가

## 1. Nanostructure

### 1.1 GaN nano -columns 發光

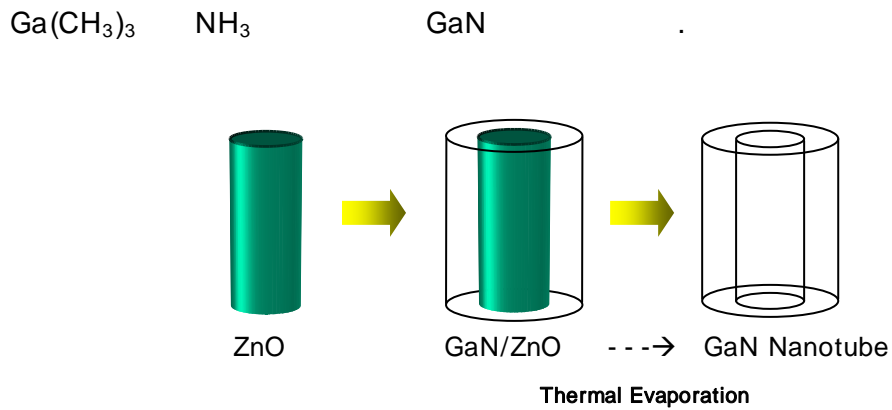
GaN nano -column AIN buffer layer RF -MBE(molecular  
 beam epitaxy) . Column 850  
 80 nm, 2.0 μm,  $2 \times 10^{10} \text{ cm}^{-2}$  . MOCVD GaN  
 nano -column defect

### 1.2 Metal Initiated GaN Nanowires

10 ~ 20 nm Ni, Au, Fe Ga(CH<sub>3</sub>)<sub>3</sub> NH<sub>3</sub>  
 MOCVD GaN nanowire  
 800 ~ 1000 . GaN nanowire  
 carrier gas . Au H<sub>2</sub> gas  
 triangular (210) Fe N<sub>2</sub> gas  
 trapezoidal (110)

### 1.3 GaN/ZnO Nanorod and GaN Nanotube

GaN/ZnO Coaxial Nanorod ZnO nanorod GaN  
 epitaxial growth . 1 Core 10 nm  
 ZnO nanorod Zn(C<sub>2</sub>H<sub>5</sub>)<sub>2</sub> O<sub>2</sub> nanorod



1. GaN/ZnO coaxial nanorods and GaN nanotubes

GaN    ZnO                      interface                      GaN  
 defect free single crystal                      High Resolution TEM  
 GaN nanotube    ZnO    thermal evaporation  
 GaN/ZnO nanorod    GaN nanotube    gate                      field effect transistor

1.4 In

*InGaN Nanorod*

In                      가    c -                      InGaN nanorod  
 Si(111)                      Hydride Vapor Phase Epitaxy  
 In                      In metal                      HCl  
 $\text{In}_x\text{Ga}_{1-x}\text{N}$     In                       $x < 0.1$                       428 nm                      In  
 가                       $x = 0.3$                       501 nm                      가

1.5

*InAlGaN*

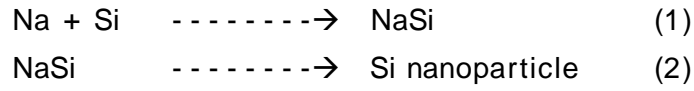
luminescence                      InAlGaN                      local cathod  
 (nanocluster)가                      defect                      defect                      Raman, SEM, EDS  
 nanocluster                      defect                      defect                      가  
 (recombination site)

1.6 Si nanoparticles for LED phosphor

Si nanoparticle

1 nm

GaN LED          4 nm  
 UV 가          (phosphor)  
 organic, mono-layer-stabilized Si nanoparticle  
 sonochemistry



(1) 750 , Ar          3          (2) 85  
 ethylene glycole          1  
 . Photoluminescence

## 2. Quantum Well, Quantum Dots

QW, QD 1982 Arakawa  
 . QD QW

### 2.1 Quantum Well, Quantum Dot

QW          CVD          QD          Stranski-Krastanow (SK) growth mode  
 . SK growth mode          island          model          ,          AlN  
 GaN          Ga rich          QD  
 .          QD          ~  $10^{10}/\text{cm}^2$

### 2.2 QW, QD 가

QD, QW  
 QW, QD          defect  
 carrier          QW, QD          random potential minima

TD nonradiative recombination site

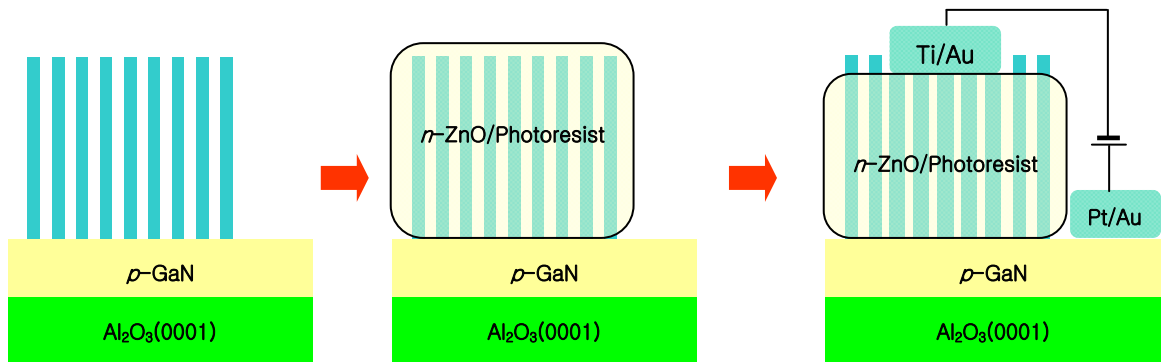
### 3. ZnO Nanowires

Bandgap 3,37 eV ZnO photonic device

nanowire

3.1 *p*-GaN

*n*-ZnO nanowire LED



*n*-type ZnO nanowire 형성

Photoresist Coating

Plasma O<sub>2</sub> + 전극 형성

2 *n*-ZnO/*p*-GaN nanowire device

ZnO nanowire	<i>p</i> -type doping	<i>p</i> -GaN	<i>n</i> -ZnO
heterojunction	LED	<i>p</i> -GaN	
electroluminescence	mechanism	reverse bias	
tunneling			2
<i>p</i> -GaN nanowire	<i>n</i> -ZnO nanowire	photoresist nanowire	coating
	plasma O <sub>2</sub>		

가

device fabrication

3.2 ZnO nanowire

ZnO nanowire

Si	Ni, Au, NiO	가	NiO	needle
shape ZnO가	Ni, Au		nanowire가	Si

NH<sub>3</sub>

nanowire

4.

Quantum well, quantum dot, nanowire

LED

carrier가

defect

nonradiative center

defect

5.

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가

가

Proceeding