AIN template on Sapphire for Deep UV LED

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• Growth Method: HVPE
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Growth Method: HVPE

- Hydride Vapor Phase Epitaxy: 3 pcs x 2 inch wafer (Usually Sapphire)
- Maximum growth temperature: **1150°C**
- Crack free AlN layer thickness: typical ~ 2.0μm (maximum ~ 3.0 μm)
Basic Properties: As grown AlN template

- FWHM of X-ray Rocking Curve, Optical transmission at Deep UV Range
- Surface morphology: Should be improved for Epi-Ready

- FWHM of X-ray rocking curve
  - FWHM(002): 292 arcsec
  - FWHM(102): 420 arcsec

- Optical Transmission

- Surface morphology by OM (X200)
  - Ra = 7.227 nm

- Surface morphology by AFM (20x20 μm)
Improvement of Surface morphology

- Epi-Ready surface by introduction of Chemical Mechanical Polishing Process

As Grown surface
- Surface morphology by OM (X200)

After CMP surface
- Surface morphology by AFM (20x20 μm)
  - Ra = 7.227 nm
- Surface morphology by AFM (20x20 μm)
  - Ra = 0.223 nm
AlN on Patterned Sapphire Substrate

AlN on Cylindrical PSS

- **FWHM of X-ray rocking curve**
  - FWHM(002) : 428 arcsec
  - FWHM(102) : 530 arcsec

- **View of Cross-Section**

- **Surface morphology by AFM (20x20 μm)**
  - Ra = 33.68 nm
  - Ra = 0.26 nm

As Grown surface

CMP Process

After CMP surface
AlGaN Regrowth on AlN template

- AlGaN(Al: 50%) on AlN template by conventional MOCVD (Veecon D300)

**Transmission of AlGaN template**

- FWHM(102) of AlGaN layer: 500 arcsec
AlGaN on AlN template (HVPE vs MOCVD)

XRD of AlGaN (Al: 50%) on AlN template (HVPE vs MOCVD)

- 1 μm-thick –Al$_{0.5}$GaN (1070°C, MOCVD)
- AlN/Al$_{0.5}$GaN SLs
- 1 μm-thick –AlN
- Sapphire

- 1 μm-thick –Al$_{0.5}$GaN (1070°C, MOCVD)
- 0.2 μm-thick –Al$_{0.75}$GaN (1070°C, MOCVD)
- 1 μm-thick –AlN
- Sapphire
MQW on AlN template (HVPE vs MOCVD): Strain Effect?

![Graph showing PL intensity and wavelength for MQWs on HVPE-AlN and MOCVD-AlN templates.]

- 1 μm-thick Al₅₀GaN (1070°C, MOCVD)
- 0.2 μm-thick Al₇₅GaN (1070°C, MOCVD)
- 1 μm-thick AlN
- Sapphire

PL Intensity (a.u.) vs Wavelength (nm) for MQWs on HVPE-AlN and MOCVD-AlN templates.
UV LED EPI regrowth

UV LED EPI Regrowth on Lumi’s AlN template

- Surface morphology by OM(X200)
- Vf of 275 nm UV LED epi-wafer