1310 nm DFB-LD Base Epiwafer

Descriptions

Two-inch base-epiwafers grown by MOVPE are available for 1310 nm DFB-LD fabrication. An epiwafer layer structure is shown in ***Figure* 1**.The active layer can be made from InAlGaAs (AlQ) or InGaAsP (PQ) material with multiple quantum wells (MQW) that have a PL wavelength near 1300 nm. Usually, the PQ-MQW DFB base-wafer is used for buried-heterostructure (BH) wave-guide, while the AlQ-MQW is fabricated into ridge wave-guide (RWG) structure. The second layer from the top is the PQ grating layer. It can be made into grating that will promote the 1310 nm wavelength light which propagates perpendicular to the grating. ***Figure 2*** shows the schematic drawings of a BH DFB-LD chip. (See1310nm FP-LD Epiwafer for RWG LD chip schematic.) As indicated, a BH structure needs 3-time re-growth (RG) process. Currently, the grating and mesa stripe formations must be done at the customer site. LandMark can offer its customers the DFB base-wafers, etching and re-growth services. ***Figure 3*** shows a TEM picture on a cleaved DFB-LD wafer after over-growth.

The PQ-MQW BH-DFB lasers have poorer characteristic temperature in Ith (To), however, they have lower threshold current and higher oscillation frequency due to smaller active volume (~0.75 um x 200 um) than in a RWG-DFB laser. To ensure better P-metal contact, the RWG-DFB active volume is quite larger, about (2 um x 200 um). For ultra high speed operations such as 20 Gbps, semi-insulating-InP takes the place of N-InP during 2nd re-growth in BH structure. Whatever the structure is, the DFB-LD is widely used in trans-mitters for the long haul fiber optic communications. Also, due to narrow spectrum width, ease of lasing wavelength control and very high SMSR (Side-Mode-Suppression-Ratio), DFB-LDs are widely used in high speed DWDM or CWDM fiber optic networks.

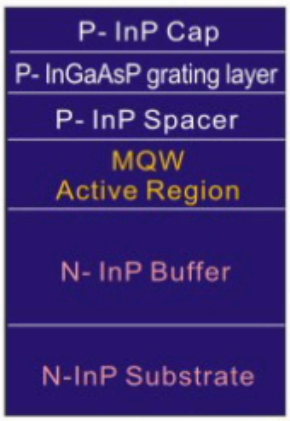

FIG.1

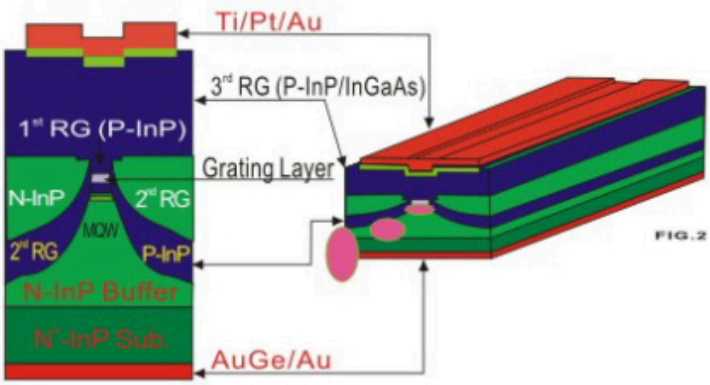

FIG.2

1310 nm DFB-LD Base Epiwafer

A TEM picture on a cleaved DFB-LD wafer after overgrowth.

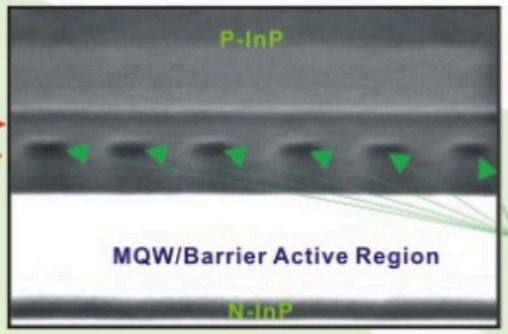

FIG.3

Wafer Characterization

Epiwafers are characterized by PL, DCXD and E-CV tests. A typical 5-point PL test results are shown in ***Figure 4***. Typically, the maximum fluctuation is within ± 5 nm at the inner 30mm of a wafer.

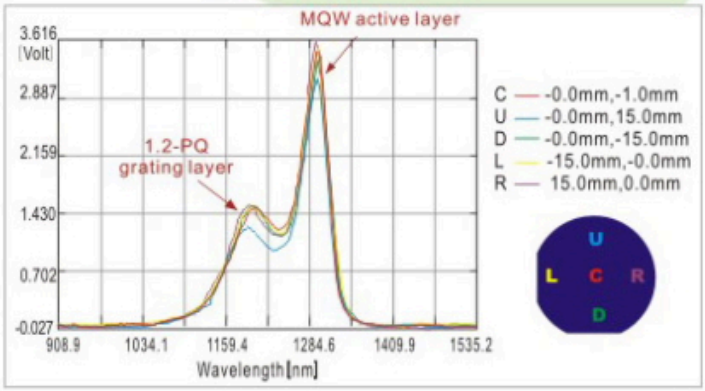

FIG.4

Figure 5 shows the 1000-point PL mapping on PQ- and AlQ-DFB base-wafers. Because of the material difference, it exhibits different characteristics in wavelength uniformity. ***Figure 5a*** is for PQ-MQW and ***5b*** is for AlQ-SC-MQW.

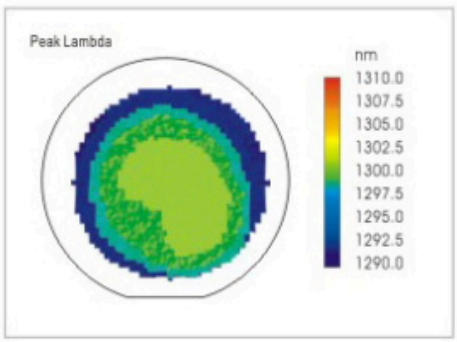

Figure 5a (PQ-MQW)

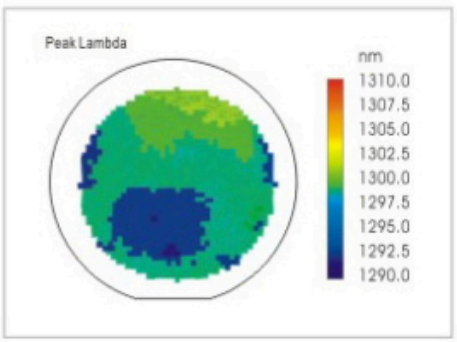

Figure 5b (AlQ-MQW)

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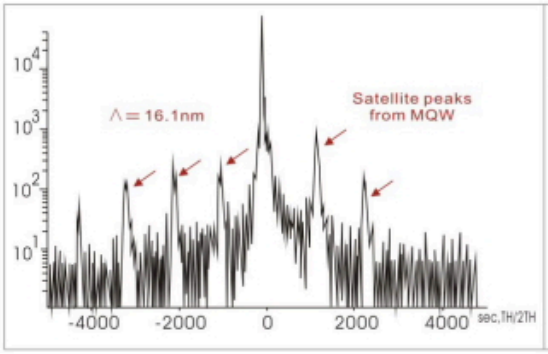
Wafer Characterization

Figure 6 shows a typical DCXD rocking curve measured at the center of a 1310nm DFB-LD base-epiwafer. The MQW/B arrier active region is made of InGaAsP material and the layer structure is similar to the one shown in ***Figure 1***.



PEAKS DETECTED:

Position sec	Peak Height -background	Width (FWHM) secretary
-3.838	36354.6	22.7
103.632	1074.9	33.8
1247.425	908.2	93.4
180.397	573.7	60.0
-2076.483	256.7	61.0
-948.043	224.7	109.2
2375.865	145.4	81.7
-3227.953	126.5	90.1

FIG.6

Typical Epitaxy Parameters

Parameters	Values
Thickness control	Better than ± 5%
Thickness uniformity	Better than ± 2.5% at the inner 40mm
PL Wavelength uniformity	~ ± 6.5 nm at the inner 40mm
Doping control	~ ± 20%
P-InP doping (cm^{-3})	Zn doped; 5E17 to 2E18
N-InP doping (cm^{-3})	Si doped, 5E17 to 2E18
InAlGaAs doping (cm^{-3})	1E17 to 2E18
InGaAsP doping (cm^{-3})	5E17 to 2E18
InGaAsP grating layer (1.15-1.25PQ)	λ_{PL} uniform to ± 1% at the inner 40mm
Defect density control (Diameter)	<50 cm^{-2}(D>10um)

Typical Device Performance

Parameter	Symbol	Typical Values
Threshold current @ 25°C	I_{th}	5 - 9 mA
*Wavelength	λ	1280 - 1360 nm
Slope efficiency	η	>0.35 W/A
SMSR	T	>40 dB
Serial resistance	Rs	< 5 Ω
Operating temperature	--	0 ~ 85°C
PQ-BH waveguide	250 um cavity length, coated facets	
*Customer defines the wavelength and applied in CWDM channels.		