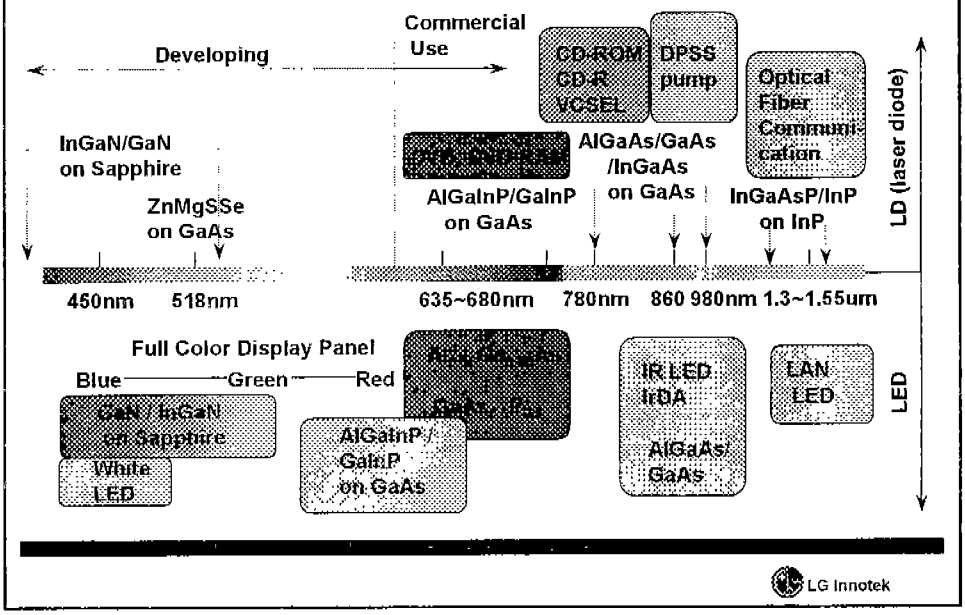
광소자용 반도체 소재 및 공정

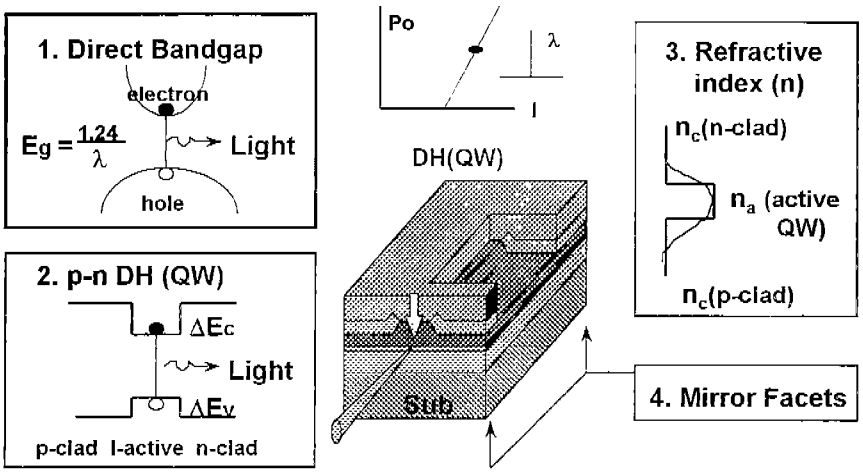
(Material and Process Issues in Laser Diode and LED)

Contents

1. Compound Semiconductor & Optical Components



2. LD(Laser Diode) Structure & Operation Principle



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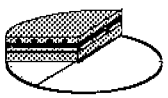
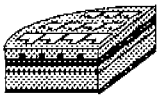
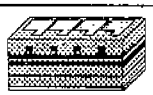
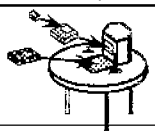
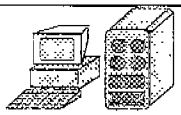
3. Laser Diode Fabrication Process and Equipment

LD Chip Fabrication Process				
Process				
Equipment	MOCVD/LPE W/S, OVEN	ALIGNER, E-BEAM, LAPPING MACHINE	SCRIBER, SPUTTER	BREAKER
Comments	1 Crystal Growth - DH Growth - CBL Selective Growth	2 Electrode Formation & Lapping	3.Chip bar Breaking & Facet Coating	4 Chip Breaking

LD Assembly and Testing			
Process			
Equipment	CHIP TESTER	WIRE BONDER, DIE BONDER, WELDER	SCREENING M/C / PACKAGE TEST
Comments	1. Chip I-L Testing	2. LD/MPD Bonding & Wiring	3. Burn-in test & Final Test

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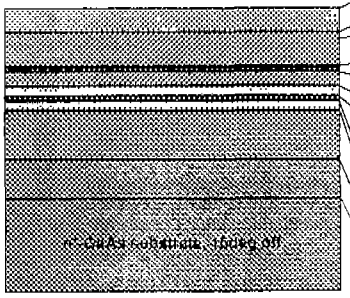
MOCVD 1st(DH) Growth Structure for 650nm LD



Layer	Material	thickness	Dop.
p^+- Cap	GaAs	0.5μm	$2x10^{19}$
p-buffer	$In_{0.5}Ga_{0.5}P$	0.1μm	$2x10^{18}$
2nd p-Clad	$In_{0.5}(Ga_{0.3}Al_{0.7})_{0.5}P$	0.85 ~ 0.9μm	$1x10^{18}$
p-ESL	~ 0.3% $In_xGa_{1-x}P$	70Å	$1x10^{19}$
1st p-Clad	$In_{0.5}(Ga_{0.27}Al_{0.73})_{0.5}P$	0.15 ~ 0.25μm	$6~7x10^{17}$
SCH	$In_{0.5}(Ga_{0.48}Al_{0.52})_{0.5}P$	0.1~ 0.12μm	
4QW Active (strain compensated structure)	0.8% compressively strained $In_xGa_{1-x}P$ well, 0.3% tensilely strained $In_x(Ga_{0.48}Al_{0.52})_{1-x}P$ barrier	45Å 60Å	
SCH	$In_{0.5}(Ga_{0.48}Al_{0.52})_{0.5}P$	0.1~ 0.12μm	
n-Clad	$In_{0.5}(Ga_{0.3}Al_{0.7})_{0.5}P$	0.8~1.0μm	$1x10^{18}$
n^+-Buffer	GaAs	0.8μm	$2x10^{18}$

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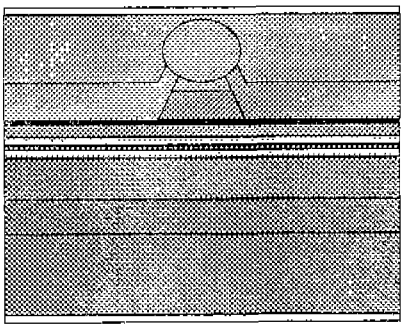
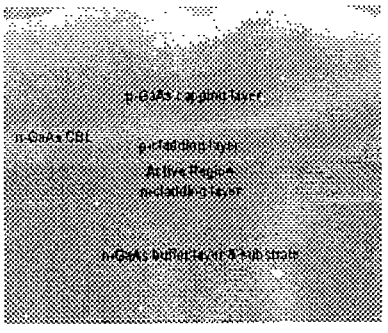
Total Growth Buried Ridge Structure

SEM Characterization





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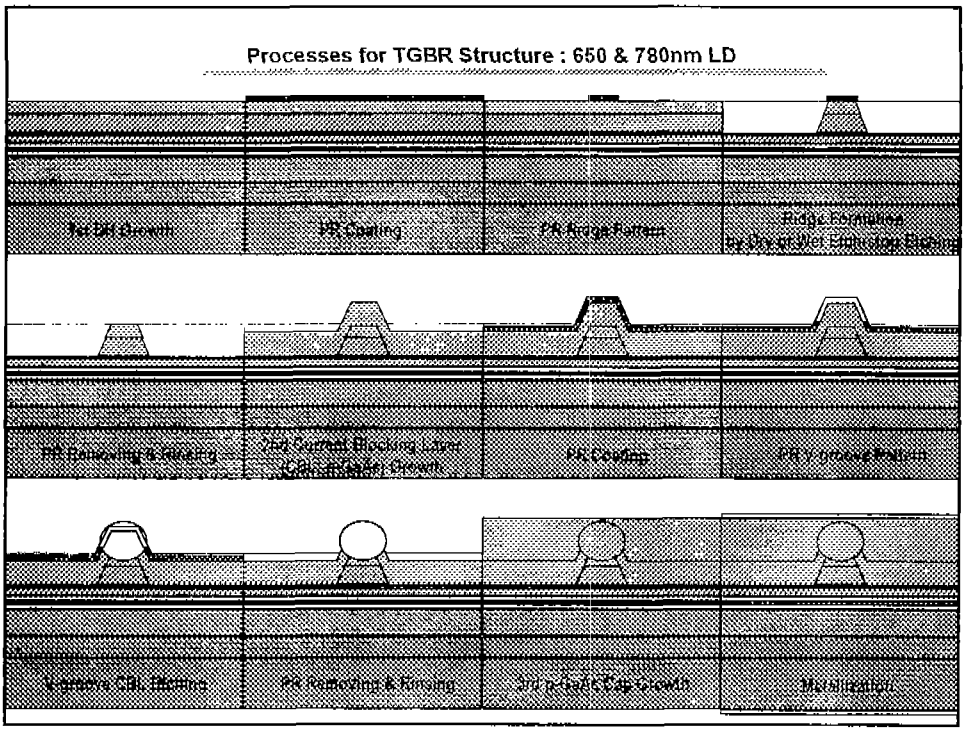
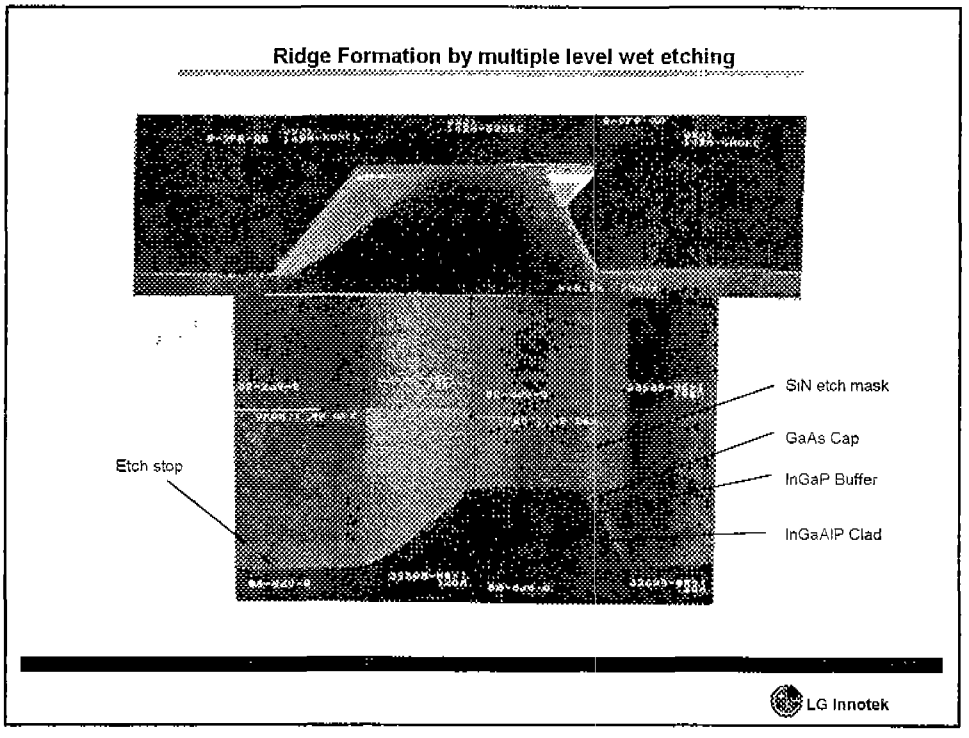

Processes for TGBR Structure : 650 & 780nm LD
PR Coating
PR Ridge Pattern
Ridge Formation
by Dry or Wet Etching Etching
PR Removing & Rinsing
2nd Current Blocking Layer
PR Coating
PR V-groove Pattern
V-groove Cap Etching
PR Removing & Rinsing
3rd p-GaAs Cap Growth
Metallization


Ridge Formation by multiple level wet etching
SiN etch mask
GaAs Cap
InGaP Buffer
InGaAlP Clad
Etch stop
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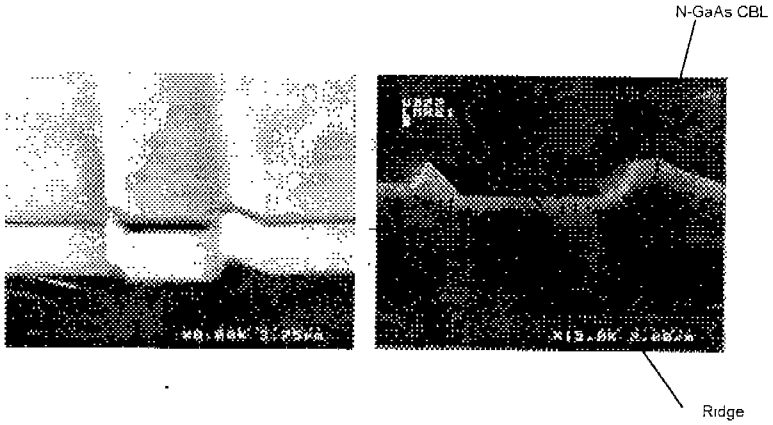
Selective growth of GaAs Current Blocking Layer



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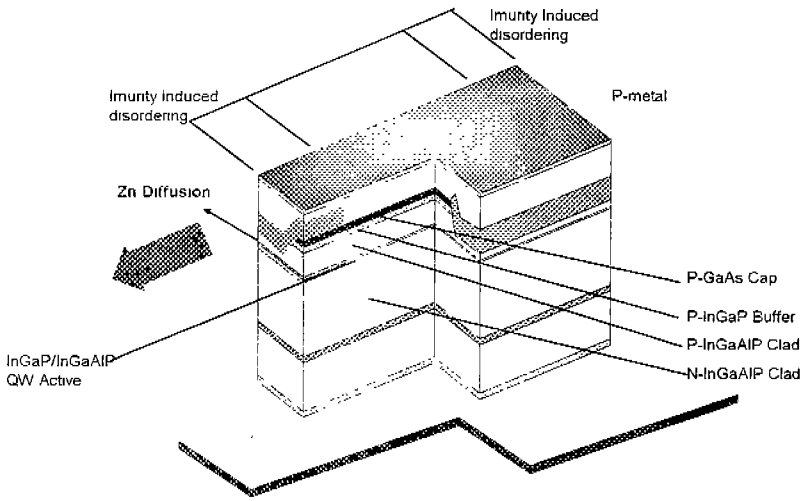
Schematic of DVD-RAM LD with Non-Absorbing Mirror



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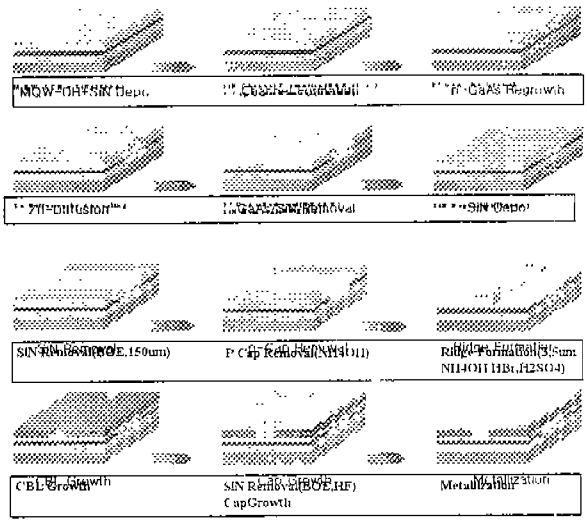
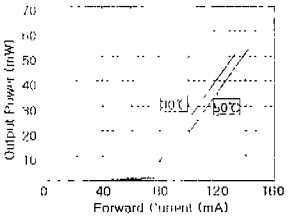
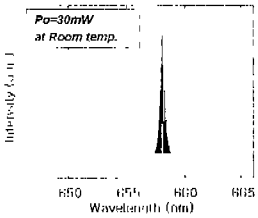
Non - Absorbing Mirror Processes for High Power Laser







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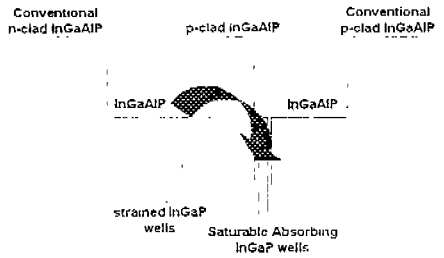
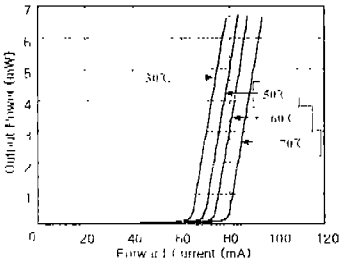
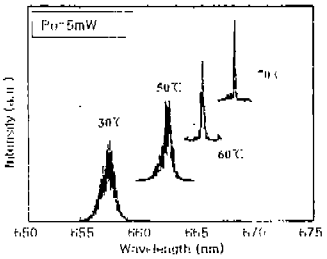
Self Pulsation with QW saturable absorber

To achieve self pulsation a laser must contain a nonlinear feedback mechanism between the electron and photon population which produces optical bistability.

Highly /n doped QWs for effective saturable absorber
Need Carrier overflow barrier between the active and the absorber (ex, Multiple Quantum Barrier)
Prevention of /n backdiffusion







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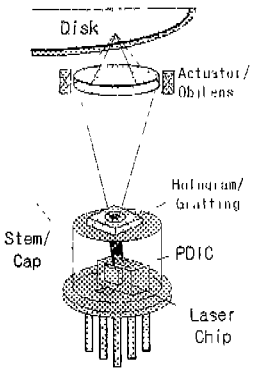
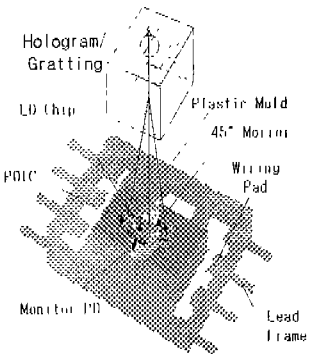
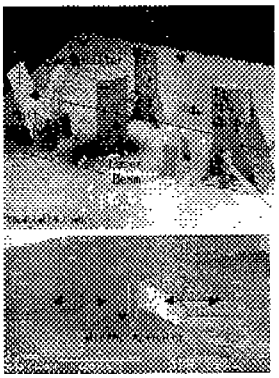
4. Technical Trend in Laser Diode Package



1'st Generation
(Can Type)



2'nd Generation
(Lead Frame)



3'rd Generation
(MEMS* Tech.)

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