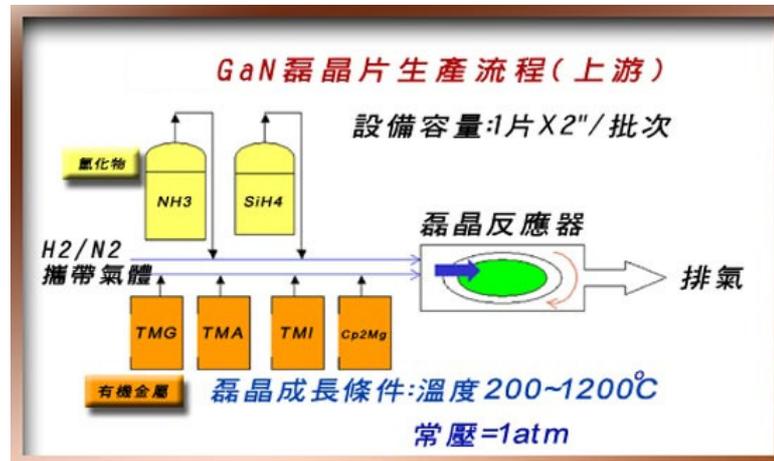


LED Process - Epitaxial



LED Process - Epitaxial

Growth temperature: 450(GaN buffer)~ 1000°C

Precursors : Ga : TMGa (Ga(CH₃)₃) or TMAI

Dopant : SiH₄, CP2Mg

Purge gas : N₂ + H₂

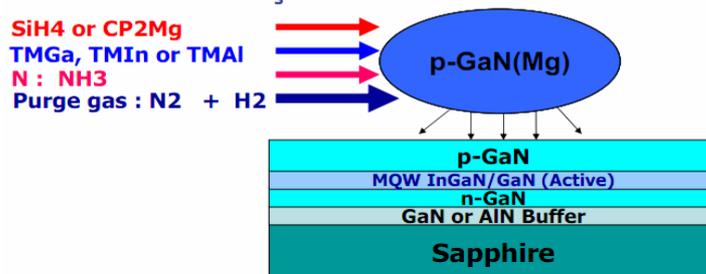
N : NH₃

SiH₄ or CP2Mg

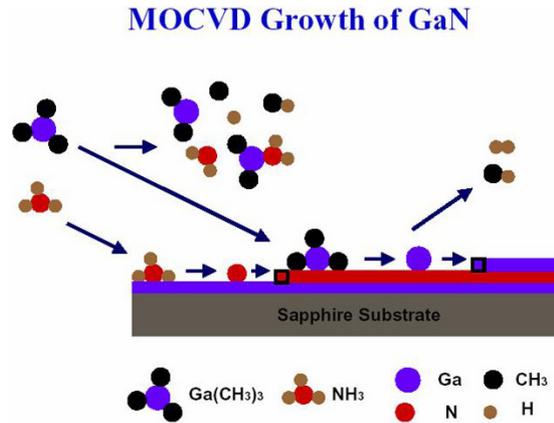
TMGa, TMI or TMAI

N : NH₃

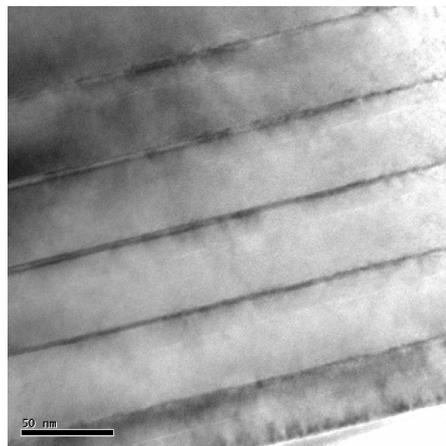
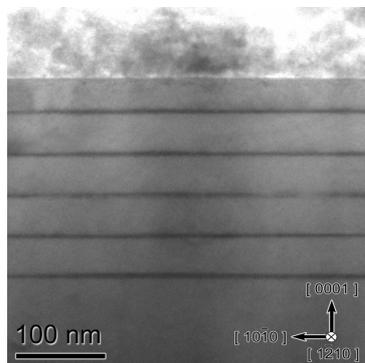
Purge gas : N₂ + H₂



LED Process - Epitaxial

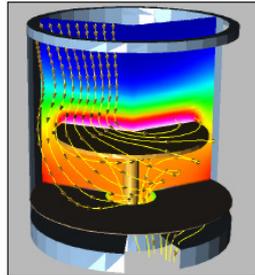


LED Process – Epitaxial (MQW)

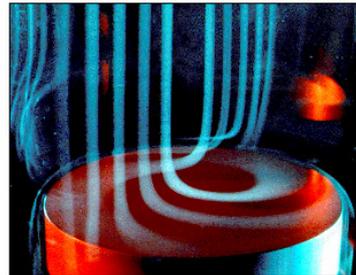


LED Process - Epitaxial

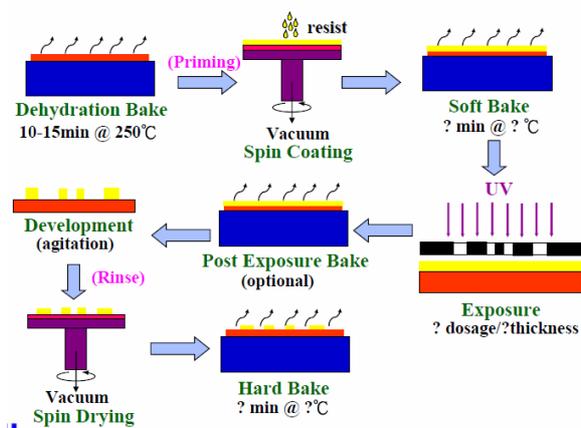
Computer Generated Flow Patterns
in Rotating Disc System



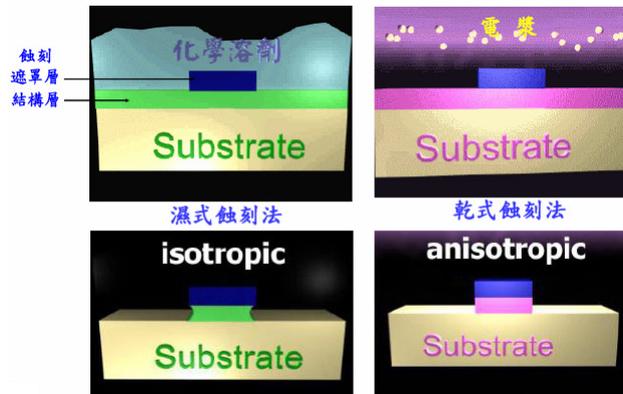
Smoke Flow Patterns
in Rotating Disc System



LED Process – Lithography



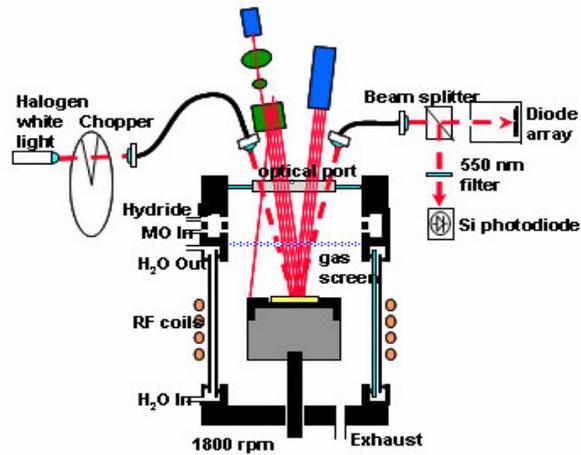
LED Process – Etching



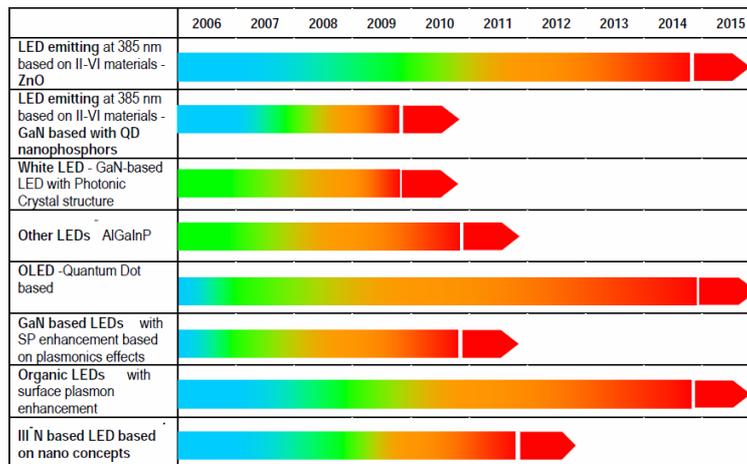
MOCVD

- 有機金屬氣相磊晶法(Metal Organic Vapor Epitaxy, MOCVD)用於生產**高亮度LED**，其亮度約在6000-8000mcd；以GaN為材料所生產的藍、綠光LED，則稱為氮化物LED，一般以藍寶石(Sapphire)為基板，美國大廠CREE則發展出以碳化矽(SiC)為基板的製程。以AlGaInP四種元素為發光層材料在砷化鎵基板上磊晶者，發出紅、橙、黃光之琥珀色系，通稱為四元LED。
- MOCVD 就是 metal-organic chemical vapor deposition, 有機金屬氣相沉積技術的簡寫, 有氣體流動, 熱傳, 質傳, 化學反應的熱力學及動力學, 還有最後變成固體薄膜材料, 所有固態材料科學的知識是必要的. CVD的薄膜只是成品中的一部份, 最後可用成品往往還需要許多步驟才完整. 至於LED這個產品, 上游也就是這些III-V族材料的製備, 尤其是用MOCVD生長薄膜的部份。
- MOCVD, 2009年全球出貨228臺, 其中中國大陸僅佔12%, 韓國42%, 臺灣地區35%; 2010年全球出貨增至800臺, 中國大陸上升至32%, 韓國和臺灣地區分別為33%和26%, 估計2011年出貨量為約1000臺, 中國大陸將佔據60%, 韓國下降至10%, 臺灣地區23%。
- 德商Aixtron與美商Veeco現於全球LED用有機金屬化學氣相磊晶MOCVD設備市場, 各居第1與第2地位, 其合計佔有率約9成。

MOCVD

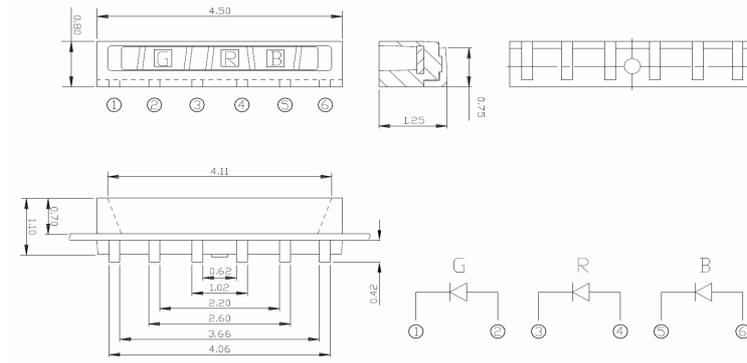


LED R&D roadmap



LED Spec.

Part No.	Lens Color	Source Color
LTW-008RGB-PH	Water clear	InGaN Blue
		InGaN Green
		AlInGaP Red



LED Spec.

Parameter	Symbol	Rating			Unit
		R	G	B	
Power Dissipation	P_o	75	120	120	mW
Peak Forward Current ¹	I_{FP}	100	100	100	mA
Continuous Forward Current	I_F	30	30	30	mA
Reverse Voltage	V_R	5			V
Operating Temperature Range	T_{opr}	-40 ~ +80			°C
Storage Temperature Range	T_{stg}	-40 ~ +100			°C
Soldering Condition ^{1,2}	T_{sol}	260°C For 5 Seconds			

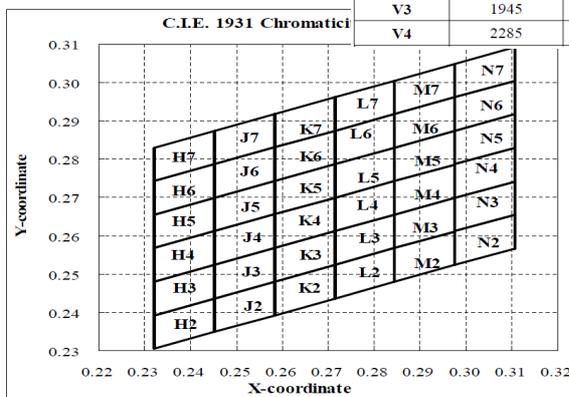


Parameter	Symbol	Values			Test Condition	Unit	
			R	G			B
Luminous Flux ¹	IV	Min	400	900	100	R: I _F = 20mA G: I _F = 25mA B: I _F = 15mA	mcd
		Typ.					
		Max.	800	1800	200		
Luminous Flux	Φ _v	Min	1.12	3.17	0.31	R: I _F = 20mA G: I _F = 25mA B: I _F = 15mA	lm
		Typ.	1.63	3.90	0.41		
		Max.	2.00	5.54	0.52		
Viewing Angle	2θ _{1/2}	Typ.	130			R: I _F = 20mA G: I _F = 25mA B: I _F = 15mA	°
Dominant Wavelength ²	λ _d	Min	618	518	455	R: I _F = 20mA G: I _F = 25mA B: I _F = 15mA	nm
		Typ.					
		Max.	628	530	464		
Peak Wavelength	λ _p	Min				R: I _F = 20mA G: I _F = 25mA B: I _F = 15mA	nm
		Typ.	628	523	458		
		Max.					
Forward Voltage ³	V _F	Min	1.8	2.9	2.6	R: I _F = 20mA G: I _F = 25mA B: I _F = 15mA	V
		Typ.	2.1	3.2	3.0		
		Max.	2.4	3.4	3.4		
Reverse Current	I _R	Max.	10			V _R = 5V	μA
Spectrum Radiation Bandwidth	Δλ	Typ.	20	33	22	R: I _F = 20mA G: I _F = 25mA B: I _F = 15mA	nm



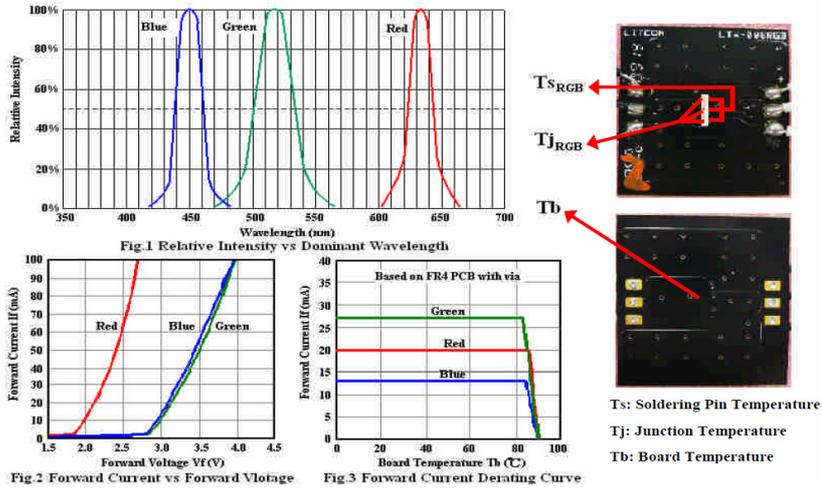
LED Spec.

Luminous Spec. Table				
Ranks	Luminous Intensity (mcd)		Luminous Flux (lm)	
	I _F : R=20mA, G=25mA, B=15mA			
	Min.	Max.	Min.	Max.
V1	1400	1660	4.60	5.40
V2	1660	1945	5.40	6.35
V3	1945	2285	6.35	7.45
V4	2285	2685	7.45	8.75

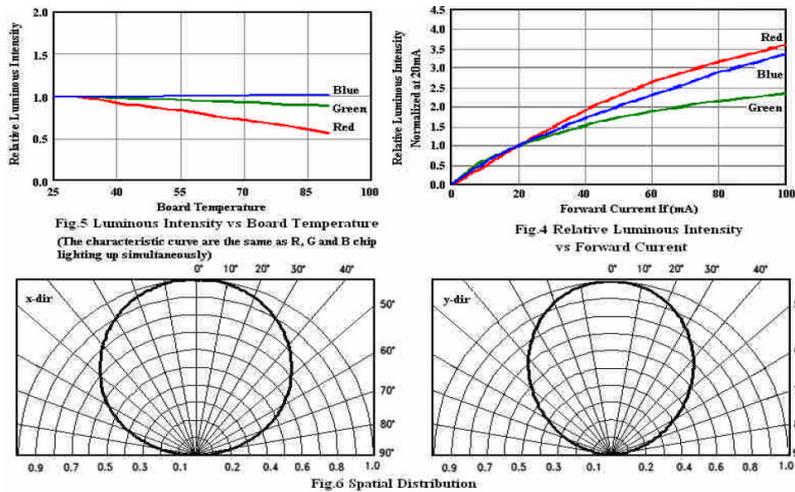


LED Spec.

Typical Electrical / Optical Characteristics Curve



LED Spec.



LED Spec.

Soldering

Recommended soldering conditions:

Reflow soldering		Soldering iron	
Pre-heat	120~150°C	Temperature	300°C Max.
Pre-heat time	120 sec. Max.	Soldering time	3 sec. Max.
Soldering Temp.	260°C Max.		(one time only)
Soldering time	30 sec. Max.		

Drive Method

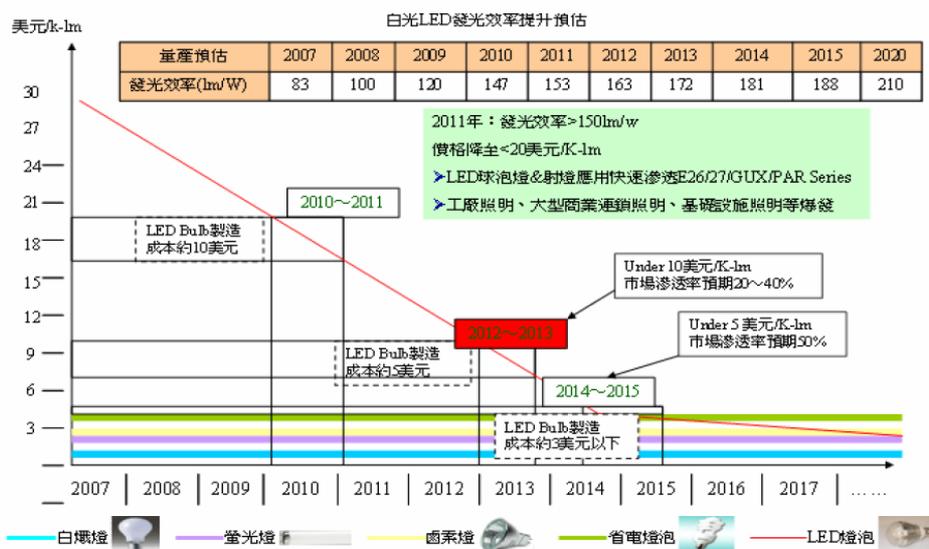
An LED is a current-operated device. In order to ensure intensity uniformity on multiple LEDs connected in parallel in an application, it is recommended that a current limiting resistor be incorporated in the drive circuit, in series with each LED as shown in Circuit A below.



(A) Recommended circuit.

(B) The brightness of each LED might appear different due to the differences in the I-V characteristics of those LEDs.

LED照明技術提升及照明爆發時點推估

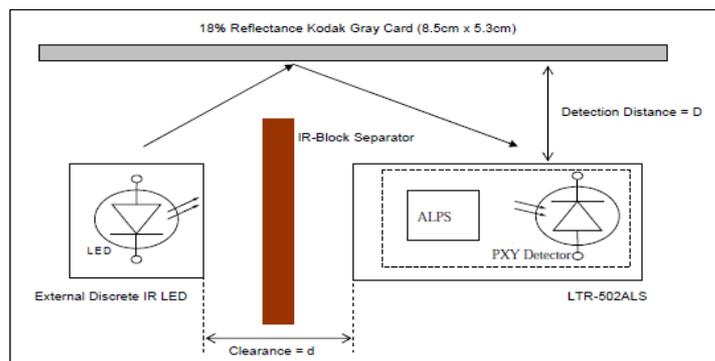


Object to be Detected

- Kodak Gray Card Plus
- The card comprised of a large 18% neutral gray area, bordered by 3% and 90% black and white patches

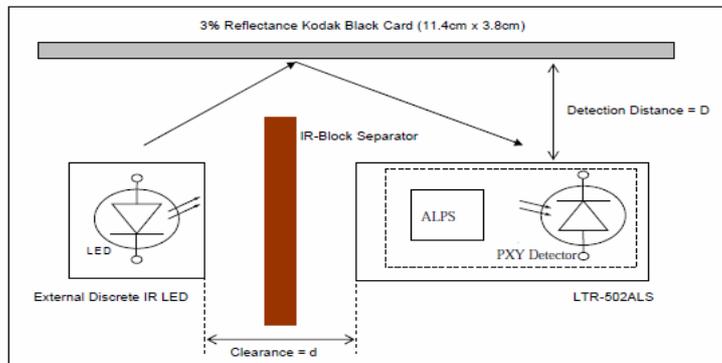


18% Reflectance Gray Card



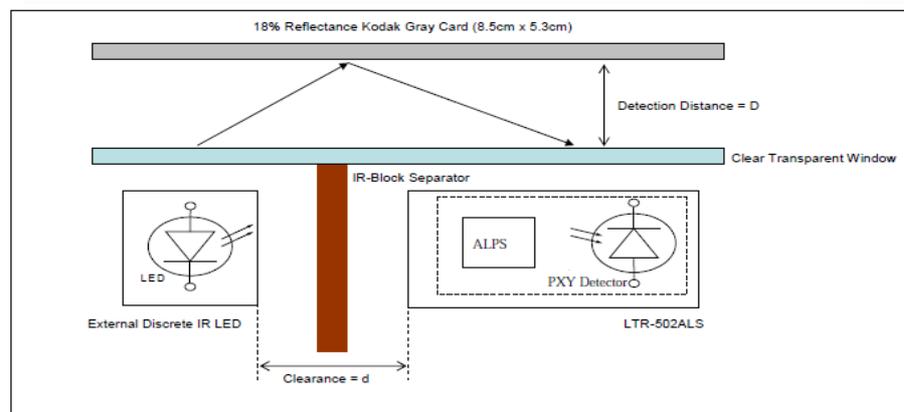
- Clearance, $d = 2\text{cm}$
- Typical Detection Distance, $D = \text{up to } 6\text{cm}$
- Note that this data is prelim and could be subjected to change until LTC releases this product

3% Reflectance Black Card



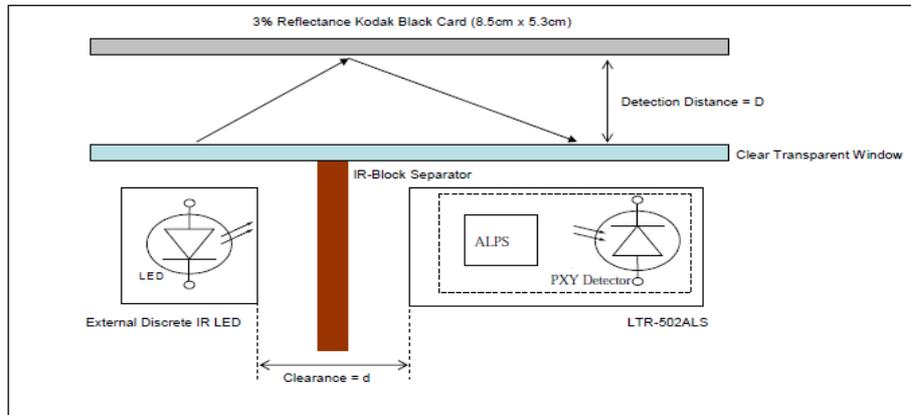
- Clearance, $d = 2\text{cm}$
- Typical Detection Distance, $D = \text{up to } 3\text{cm}$
- Note that this data is prelim and could be subjected to change until LTC releases this product

18% Reflectance Gray Card



- Clearance, $d = 2\text{cm}$
- Typical Detection Distance, $D = \text{up to } 5.5\text{cm}$
- Note that this data is prelim and could be subjected to change until LTC releases this product

3% Reflectance Black Card



- Clearance, $d = 2\text{cm}$
- Typical Detection Distance, $D = \text{up to } 2.5\text{cm}$
- Note that this data is prelim and could be subjected to change until LTC releases this product

Thank you.