Phosphor-Converted InGaN vs. Direct AlInGaP for Amber Lighting Applications

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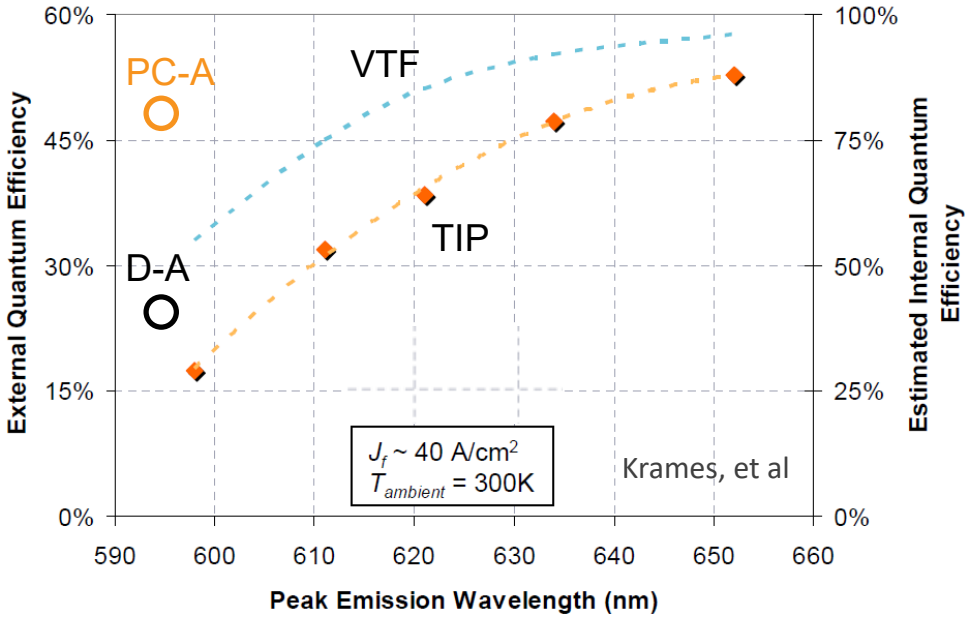
LUMILEDS

AlInGaP Efficiency Curve

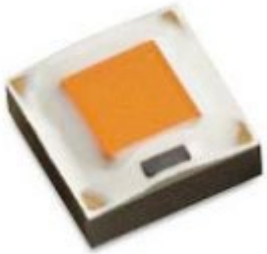
Suitable Color Applications:

- Architectural Lighting
- Low Glare Outdoor Lighting
- Signage
- Wall Wash
- Automotive Turn Signal
- Fog Lamps

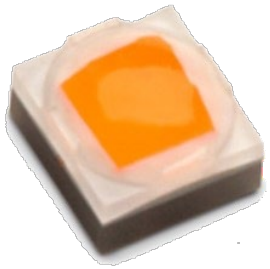


White+Amber Auto Module

Luxeon FX



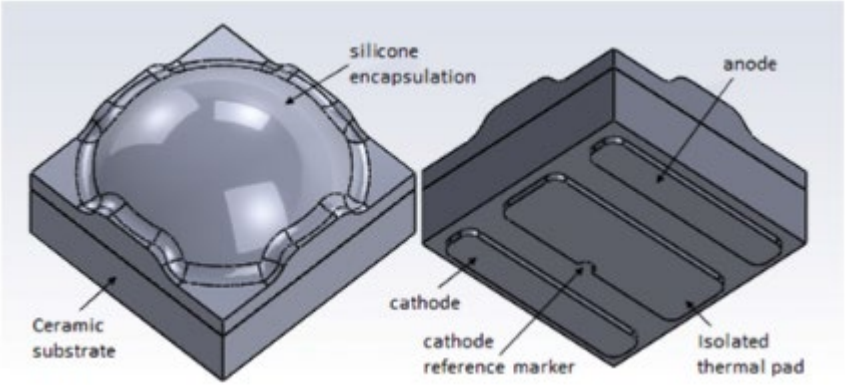
Luxeon CZ



Luxeon C

Luxeon C Lamp Elements

Direct Amber



PC Amber

Silicone Encapsulant, shallow dome

Wirebonds

AlInGaP VTF 1.1mm sq.

Metal Solder die attach

Ceramic Tile with Thermal/Electrical Pads

Silicone Encapsulant, shallow dome

BSSN* Phosphor Platelet with Sidecoating

Silicone Glue Layer

InGaN TFFC 1.0mm sq.

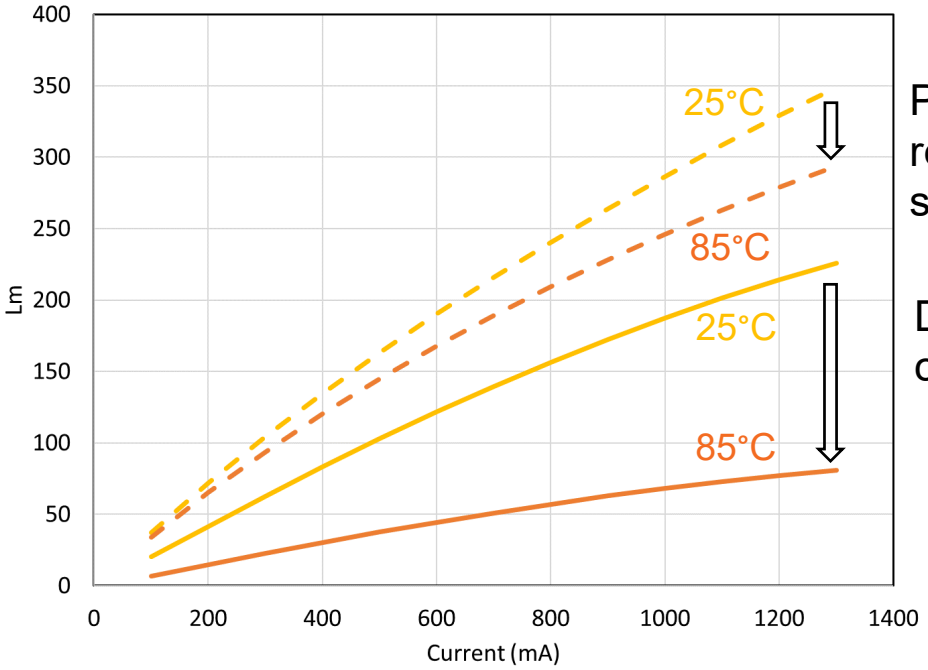
GGI bumps with underfill

Ceramic Tile with Thermal/Electrical Pads

Additional PC-A complexity results in higher manufacturing costs

*(Ba,Sr)2Si5N8:Eu

Tc=25 vs 85°C: Lm Output and Color Purity



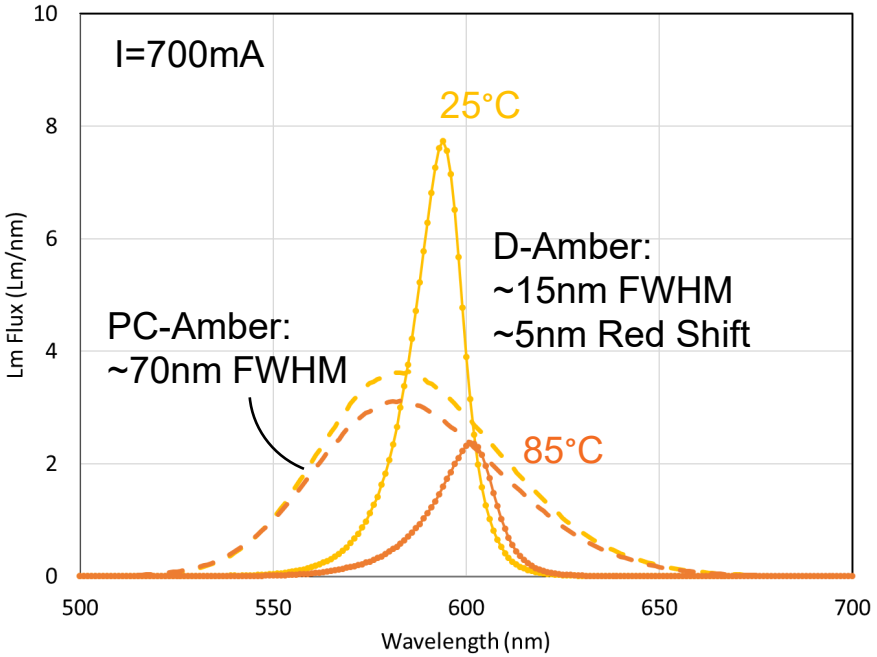
PC-Amber: 10-16% drop with temperature results from thermally enhanced phosphor saturation

D-Amber: ~60% drop is a result of carrier confinement loss and spectral Red Shift

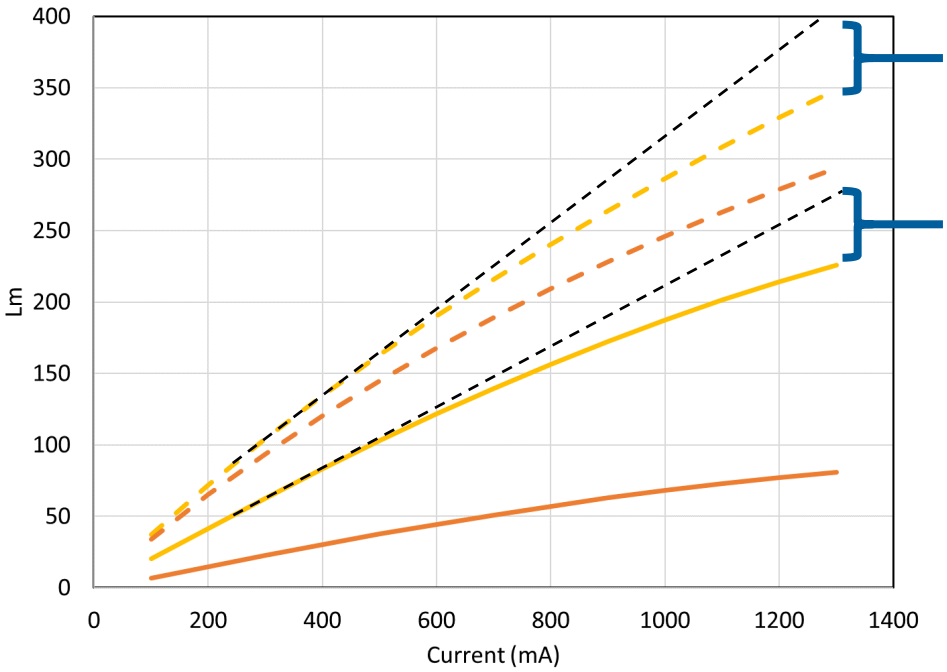
Pulsed Current, PW: 20ms

PC-Amber: Higher efficiency and greatly enhanced (3x) temperature stability

D-Amber: Greater Color Purity

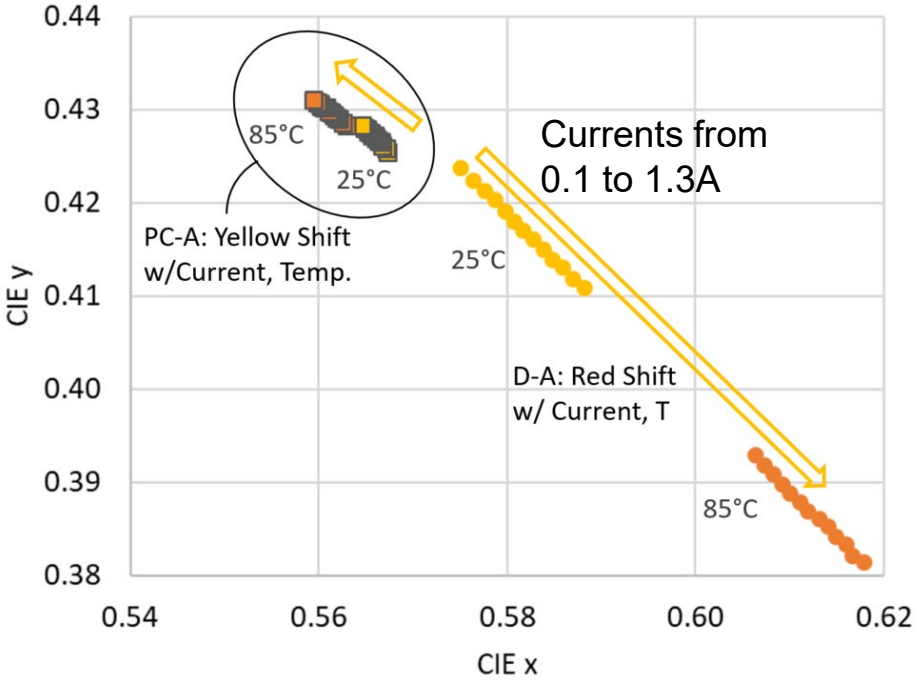


High Current Lm Droop and CIE x-y shift



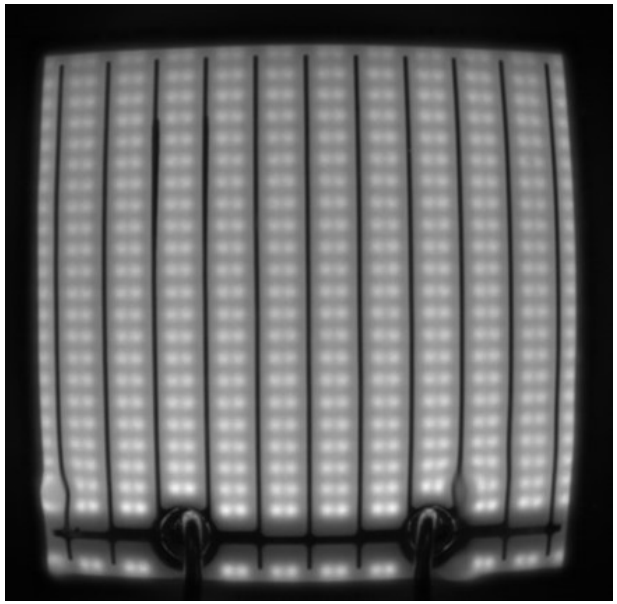
PC-Amber Droop is a combination of InGaN "droop", phosphor saturation and heating

D-Amber Droop: increasing junction temperature causes carrier confinement loss and wavelength shift

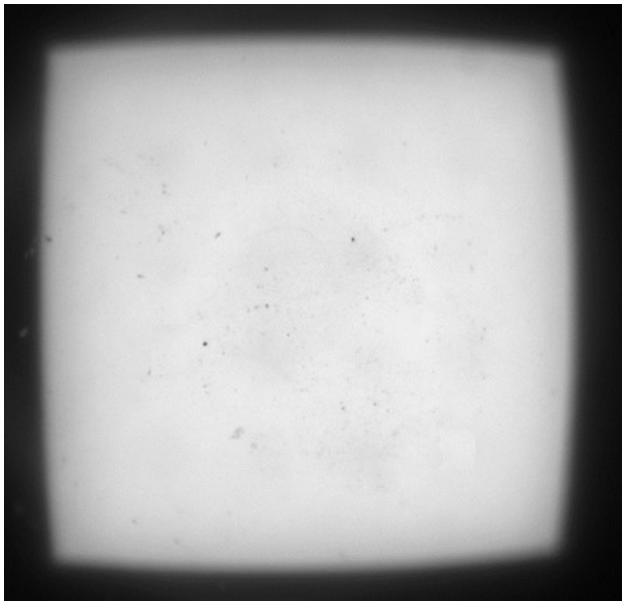


Direct-Amber requires careful thermal management and is poorly suited to varying ambient temperature

Source Image



D-Amber



PC-Amber

PCA Devices have a smooth nearfield with minor intensity variation. DA has current crowding around buried dot contacts and light blocking by topside contacts and bondpads.

Summary Comparison I=350mA

Cyan shading indicates an advantage for either PC or Direct Amber

	PC-Amber		D-Amber	
I=0.35A	25°C	85°C	25°C	85°C
Lm	119	104	73	26.4
Lm/W	118	110	100	37.7
Ldom	589.4	588.8	590.6	596.2
Vf	2.91	2.78	2.09	2.00
FWHM	77.9	79.3	13.7	15.9
Color Purity	98.1	97.6	99.9	99.9

PC-Amber is the preferred choice for most applications but cost, color purity and high Vf must be considered.

	PC-A 25-85°C	D-A 25-85°C
Lm H/C	0.87	0.36
Ldom shift	-0.6nm	+5.6nm
Imax	1.3A	1.3A
ESD	8kV	>8kV