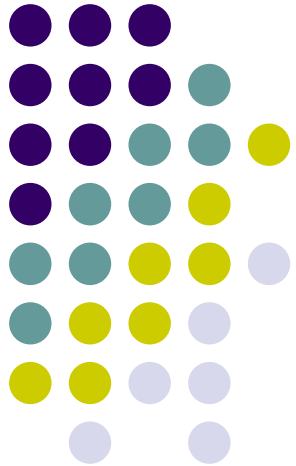
LED Fabrication Using GaN

Rodrigo Domínguez



Advantages

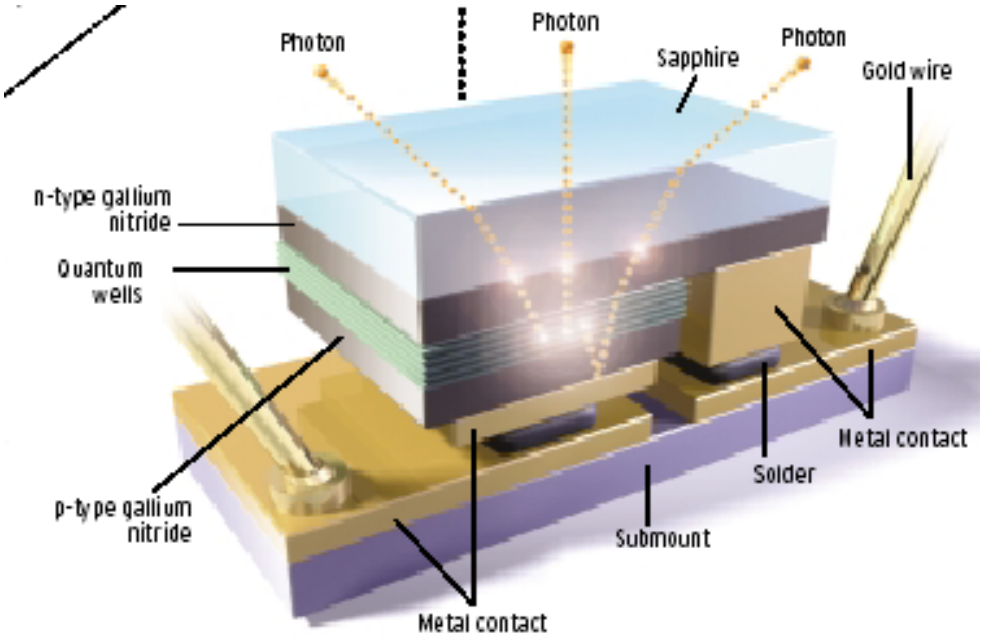
- Efficiency (25 lm/W).
- Longevity.
- Intensity.
- Colors (wavelength).
- Operating Voltage

GaN vs Others

Semiconductor (commonly used compounds)		Silicon	Gallium arsenide (AlGaAs/ InGaAs)	Indium phosphide (InAlAs/ InGaAs)[a]	Silicon carbide	Gallium nitride (AlGaN/ GaN)
Characteristic	**Unit**					
Bandgap	**eV**	1.1	1.42	1.35	3.26	3.49
Electron mobility at 300 K	**cm2/Vs**	1500	8500	5400	700	1000-2000
Saturated (peak) electron velocity	**X10^7 cm/s**	1.0 (1.0)	1.3 (2.1)	1.0 (2.3)	2.0 (2.0)	1.3 (2.1)
Critical breakdown field	**MV/cm**	0.3	0.4	0.5	3.0	3.0
Thermal conductivity	**W/cm•K**	1.5	0.5	0.7	4.5	>1.5
Relative dielectric constant	ε_τ	11.8	12.8	12.5	10.0	9.0

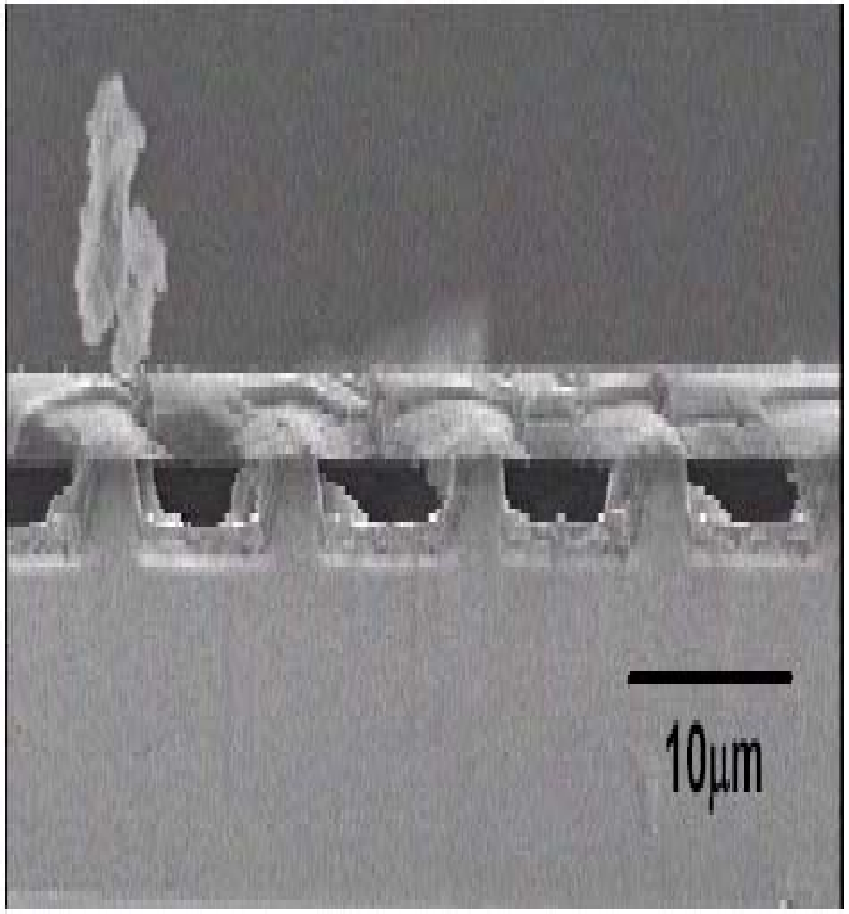
[a] The compounds are loosely known as indium-based.

Principles



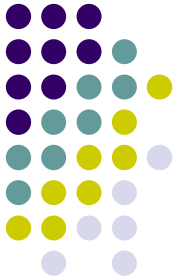
- p-type + n-type GaN
- Quantum wells
- MOCVD

Cantilever Epitaxy



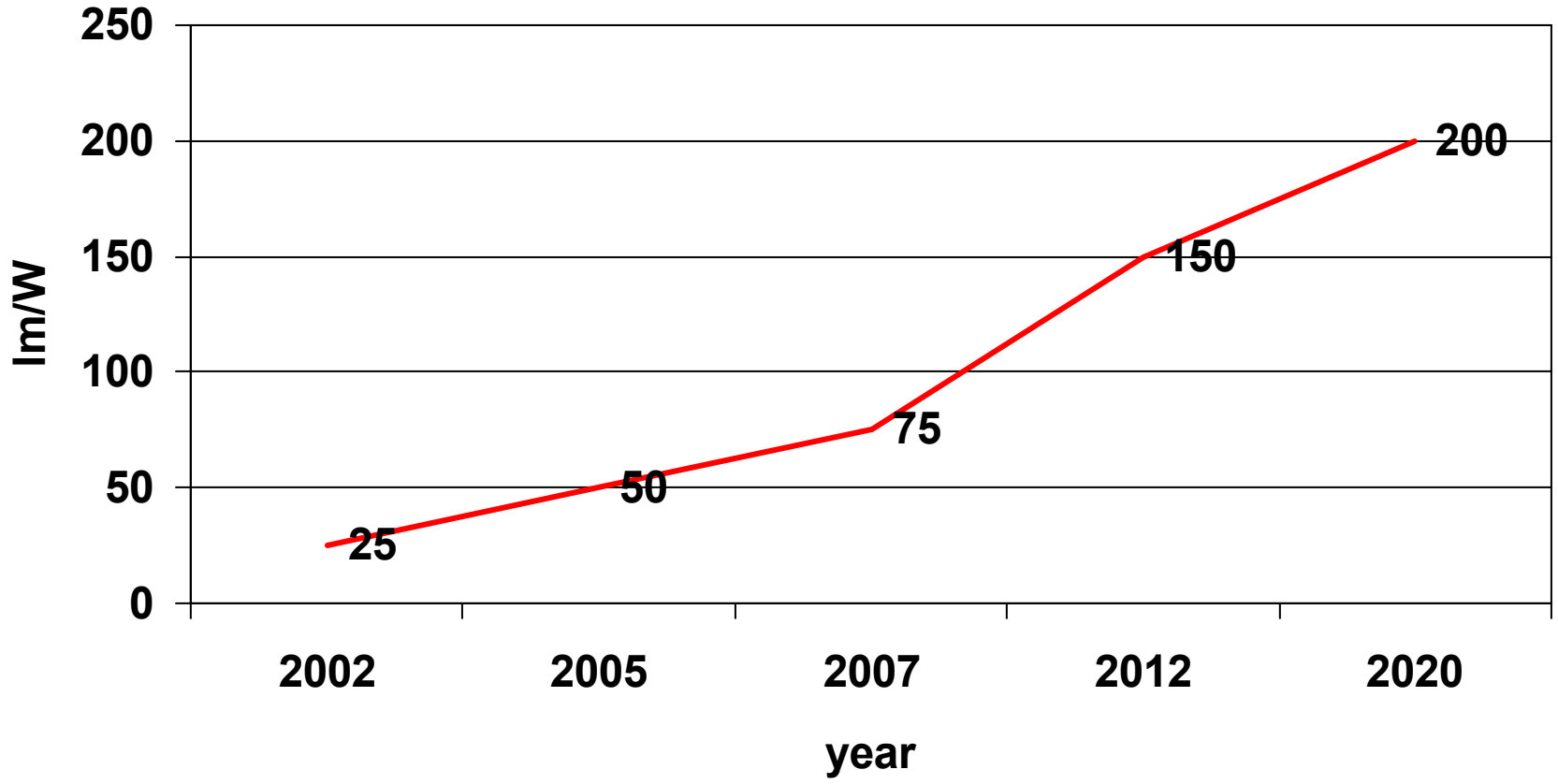
- Variation of Epitaxial Layer Overgrowth (EOL).
- One hundredth reduction in defects.
- 1500% increase in brightness

Challenges



- Growing GaN.
- Reduce the dislocations between GaN and the substrate (sapphire or SiC).
- Internal quantum efficiency.

Roadmap


250
200
150
100
50
0
lm/W
25
50
75
150
200
2002
2005
2007
2012
2020
year

GaN LED Today's Applications

Thank you!