2017

BluGlass Annual General Meeting

MONDAY 13 NOVEMBER 2017

CHAIRMAN ADDRESS:
THE BLUGLASS VISION

DR. WILLIAM JOHNSON

OUR VISION

Creating a brighter future, through the impacts of lower temperature RPCVD

OUR VISION

OUR VISION IS TO ESTABLISH THE RPCVD TECHNOLOGY AS A KEY PART OF THE MANUFACTURING SOLUTION FOR HIGH PERFORMANCE OPTO-ELECTRONIC & POWER ELECTRONIC DEVICES TO HELP DRIVE THE INNOVATIONS OF THE FUTURE.

OUR MISSION

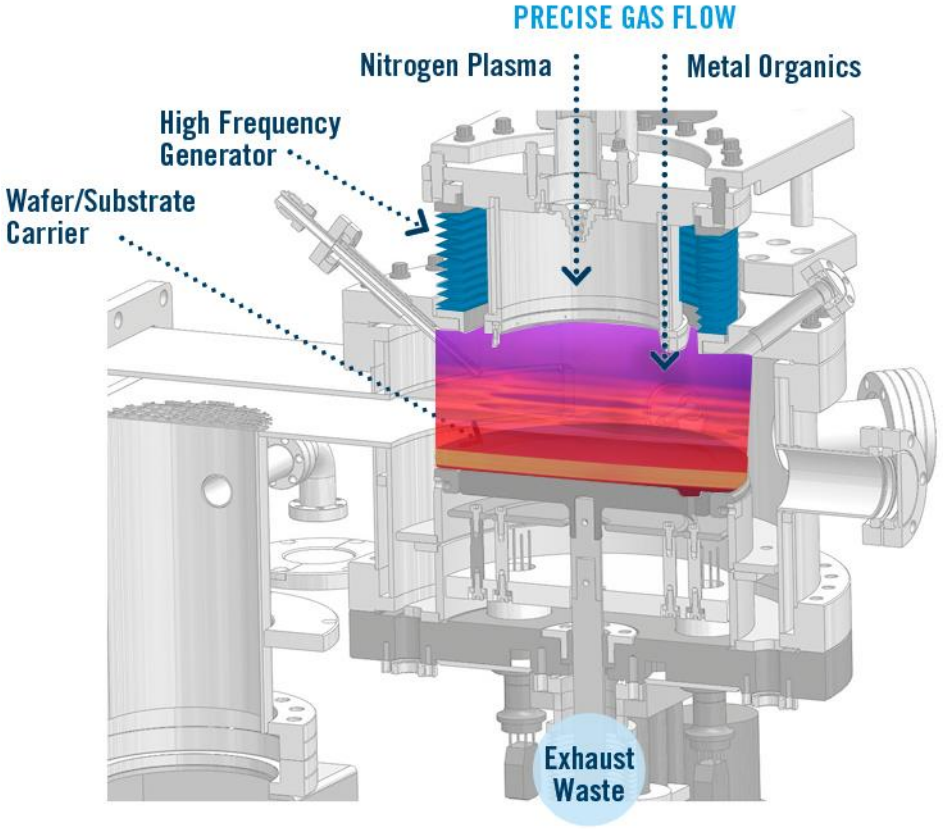
OUR MISSION IS TO SEE RPCVD EMERGE AS THE PERFORMANCE ENHANCING TECHNOLOGY OF CHOICE FOR THE LED & POWER ELECTRONICS INDUSTRIES.

THE RPCVD BREAKTHROUGH

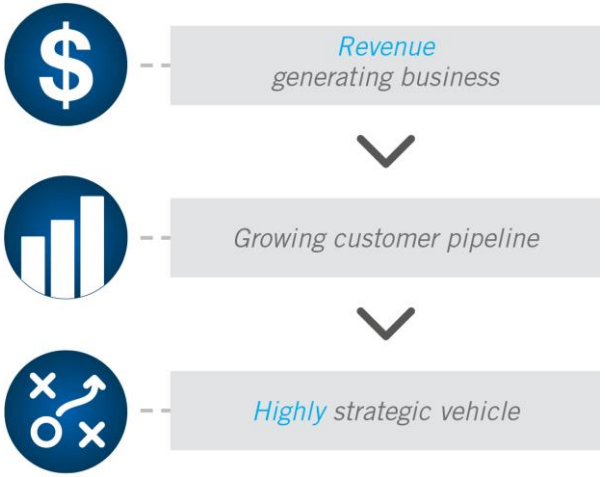
RPCVD – Remote Plasma Chemical Vapour Deposition

BENEFITS

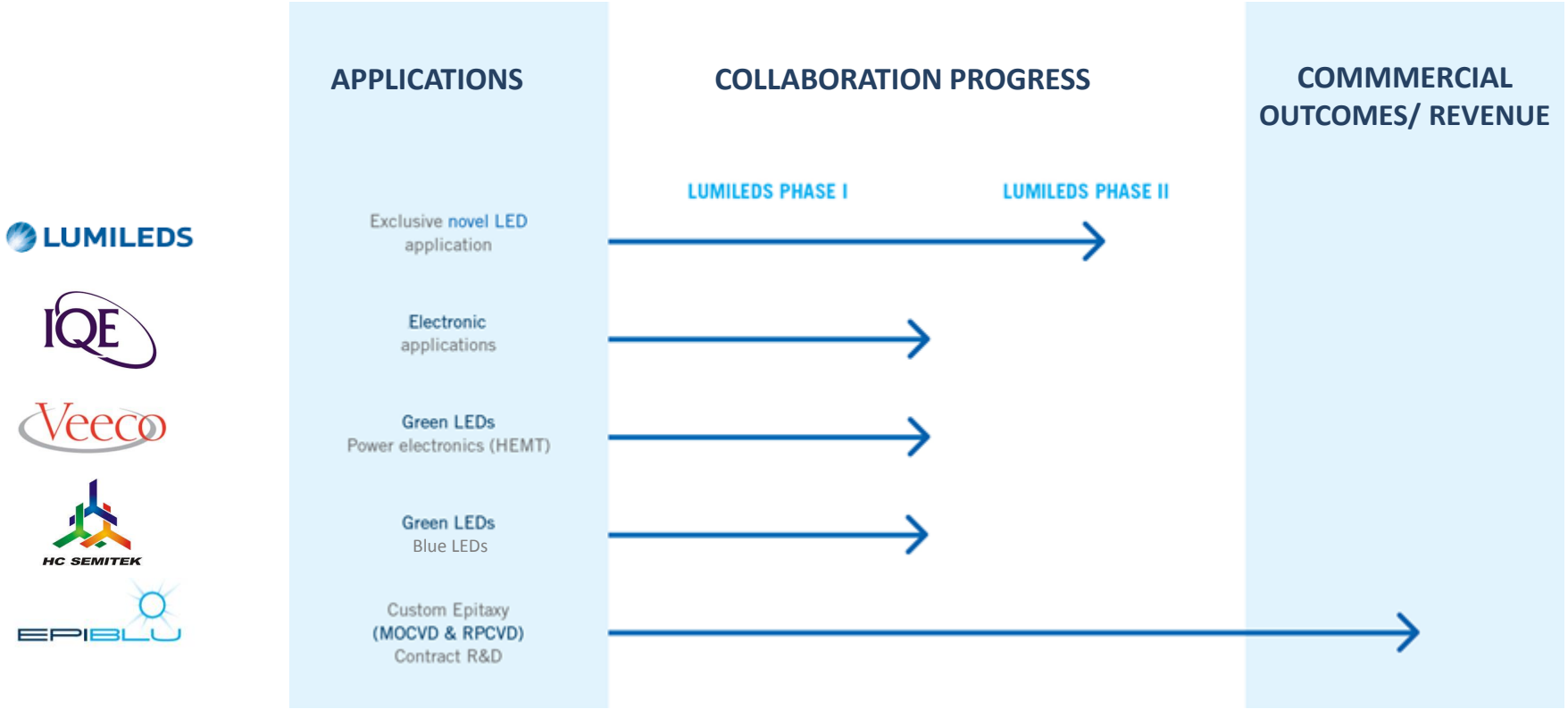
- ***Lower temperature*** *manufacturing processes*
- *Lower **cost** inputs*
- *Higher **performing devices***
- ***More Environmentally*** *friendly & sensitive*



INTRODUCING EPIBLU

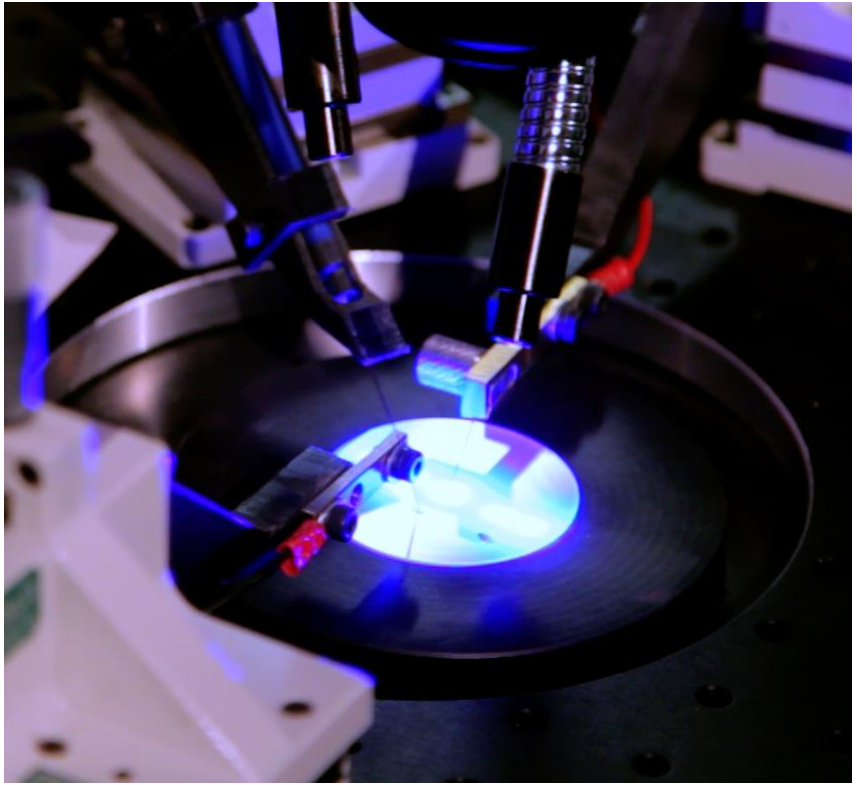


PROGRESS TOWARDS COMMERICALISATION



THE YEAR AHEAD

- *Complete industry evaluations*
- *Select more partners/collaborators*
- *Generate and protect more IP*
- ***Achieve commercial outcome***

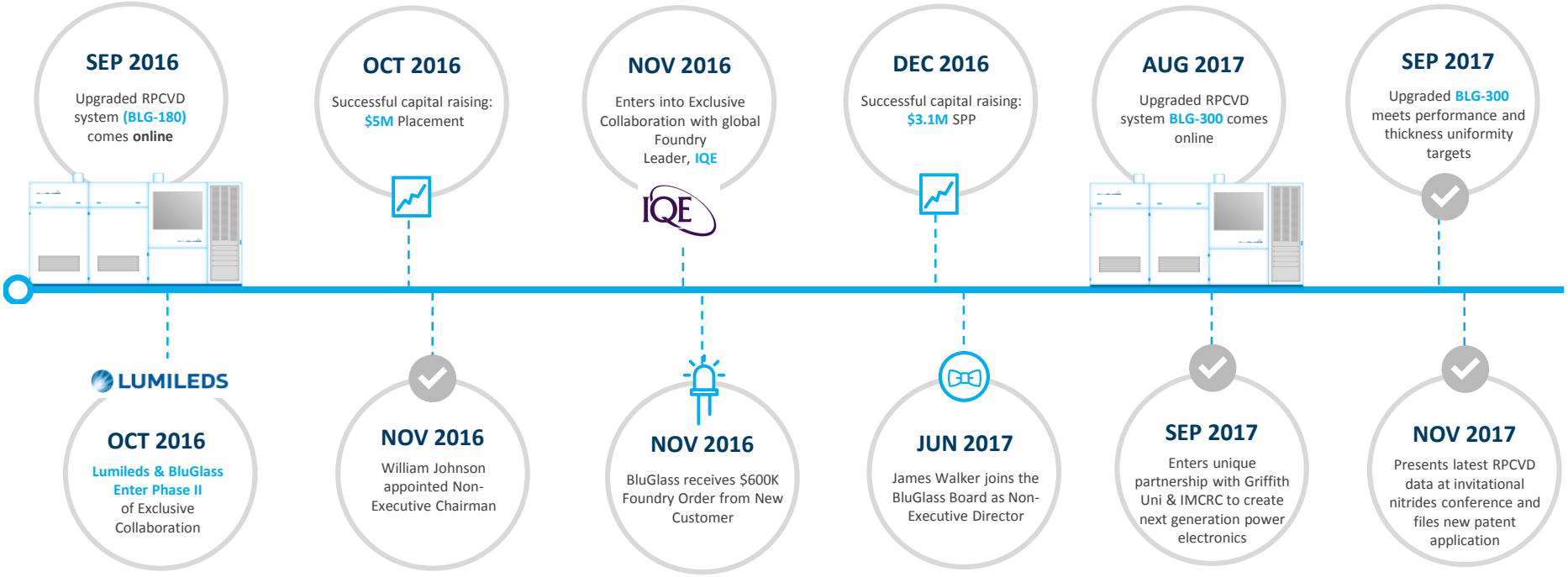


MANAGING DIRECTOR ADDRESS: 2017 HIGHLIGHTS & THE YEAR AHEAD

GILES BOURNE

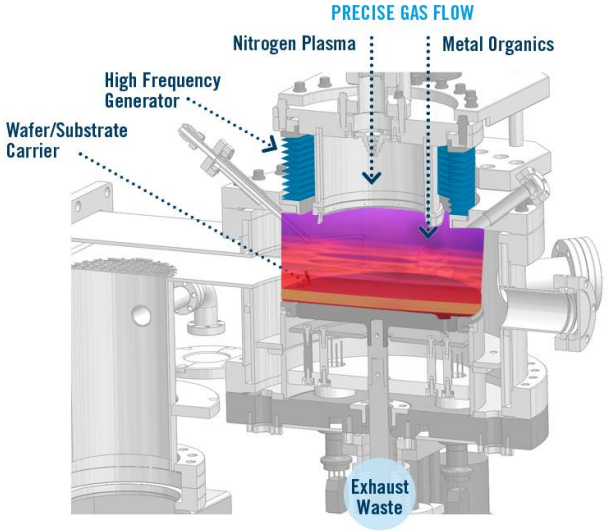
2017 HIGHLIGHTS

BluGlass has made significant technical progress in bringing RPCVD towards commercialisation



IP PORTFOLIO

Hardware & Process Patents



47

GRANTED PATENTS
in key markets; China, Japan, USA & Europe

18

PATENT APPLICATIONS

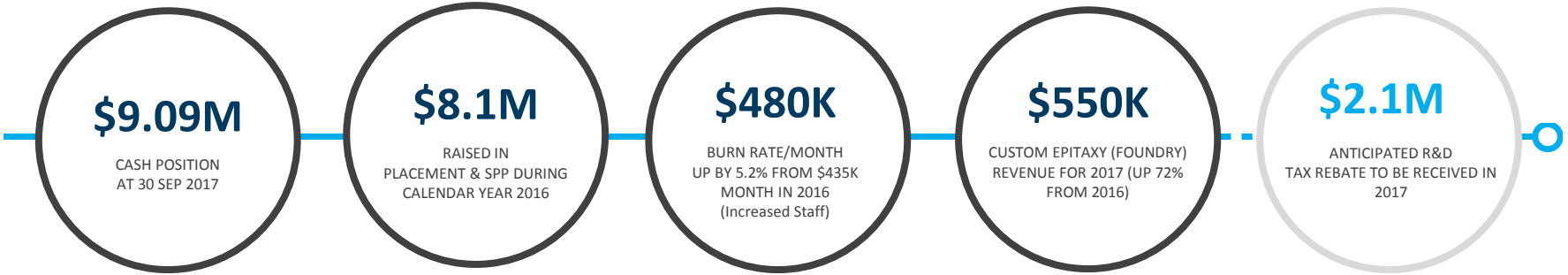
6

PATENT FAMILIES

FINANCIAL PERFORMANCE

CURRENT POSITION

FORECAST POSITION



BluGlass has a robust cash position to deliver initial commercialisation outcomes

2.5YRS CASH RUNWAY

“THE LUMILEDS / BLUGLASS PROJECT IS MAKING GOOD PROGRESS. WE REMAIN FULLY COMMITTED TO THIS KEY PROJECT”

— LUMILEDS

LUMILEDS COLLABORATION - PHASE II PROGRESS

Exclusive collaboration agreement with market leader—device manufacturer

LUMILEDS

PARTNERSHIP WITH WORLD LEADING LED COMPANY TO DEVELOP NOVEL LED APPLICATIONS

RPCVD EVALUATION	STATUS
Collaboration is focused on a **novel application of RPCVD for LEDs**	Phase I Complete Phase II progressing well
Phase II is working to integrate BluGlass' RPCVD technology into certain Lumileds LED applications	Lumileds and BluGlass are both pleased with the progress of Phase II and are confident in the project achievement

IQE COLLABORATION

Strategic Partnership with world leading foundry manufacturer of advanced semiconductor wafer products to the global semiconductor industry

PARTNERSHIP WITH WORLD LEADING FOUNDRY TO DEVELOP A RANGE OF ELECTRONIC APPLICATIONS

*Exclusive Collaboration Agreement to co-develop nitride films for a **range of electronic devices** on both silicon and IQE's cREO™ technology using BluGlass' unique low temperature RPCVD technology*

***IQE products are used by major global chip companies** to produce the high performance components that enable a wide range of high-tech applications including for the wireless industry*

Positive collaboration is ongoing and both companies remain committed to achieving the technology goals

VEECO & HC SEMITEK EVALUATIONS – RECENTLY RECOMMENCED

Veeco

RPCVD EVALUATION WITH WORLDS LARGEST MOCVD EQUIPMENT MANUFACTURER

RPCVD EVALUATION	STATUS
LED → Power Electronics	Positive initial 2 inch trials for green LEDs Recently upgraded BLG-300 with uniformity over 4 & 6“ wafers has enabled this evaluation to recommence

HC SEMITEK

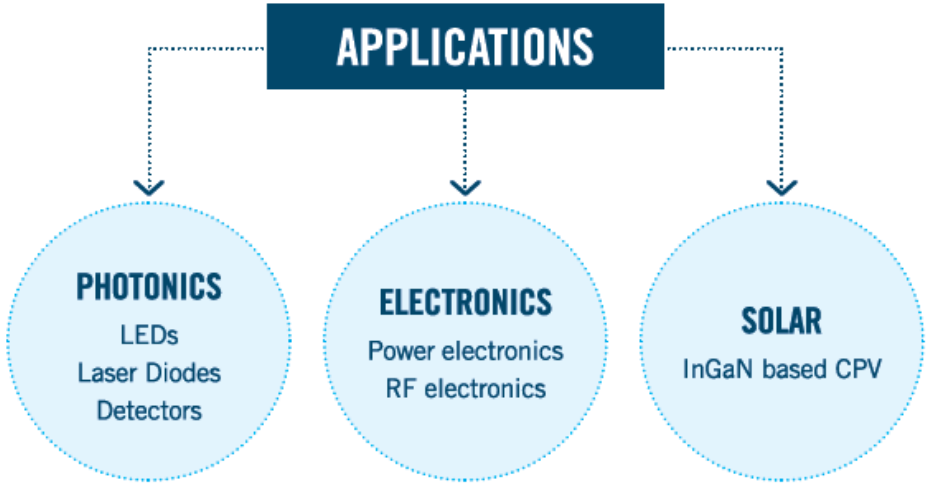
LEADING CHINESE LED COMPANY EXPLORING RPCVD FOR MULTIPLE APPLICATIONS

RPCVD EVALUATION	STATUS
LED	*Targeting enhanced performance and lower cost LEDs using RPCVD* Recently upgraded BLG-300 with uniformity over 4 & 6“ wafers has enabled this evaluation to recommence

EPIBLU – CUSTOM EPITAXY SERVICE BUSINESS

EPIBLU

- *Multiple customers*
- *Growing pipeline of new customers*
- *Providing both MOCVD & RPCVD services*
- *Conducting services for green and blue LEDs, power electronics, and laser diodes*



END MARKETS LED

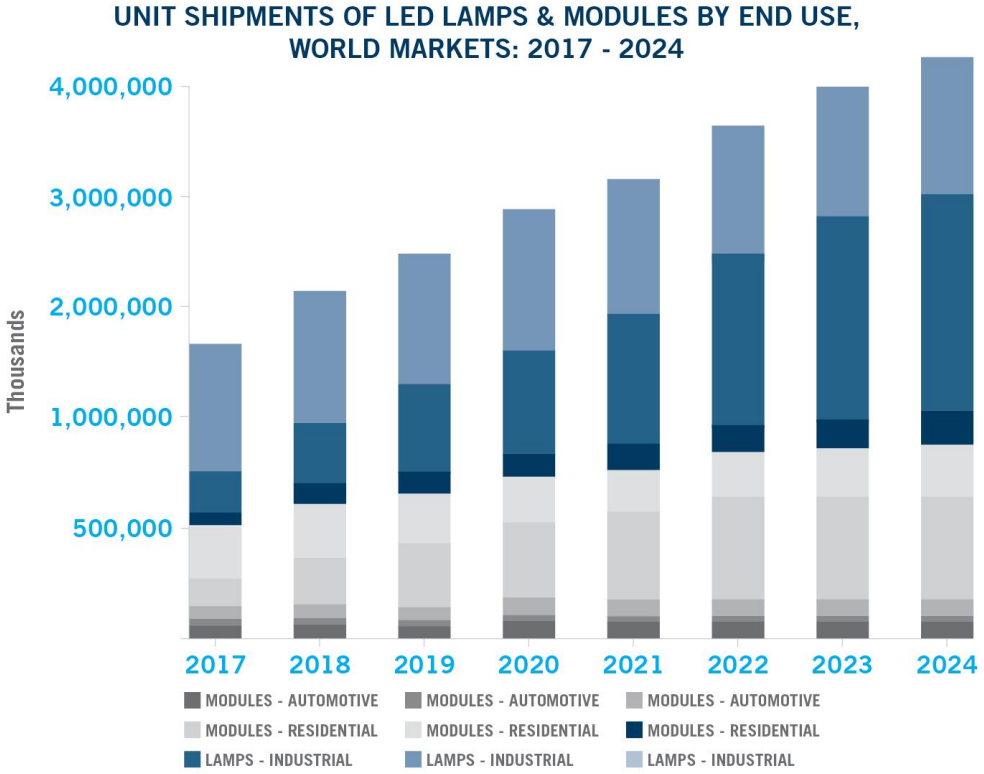
10.4%

The LED market is expected to experience ***CAGR of 10.4%*** through to 2025

$63.2B

LED revenues are expected to reach ***$63.2 billion*** by 2025

Source: Research and Markets Report *Global Light-Emitting Diodes (LED) Market Analysis & Trends - Industry Forecast to 2025*; and Navigant Research



SOURCE: Navigation Research, LED Lighting: Global Outlook Report September 2015

END MARKETS POWER ELECTRONICS

The Power Electronics markets also presents a growing opportunity for the RPCVD technology

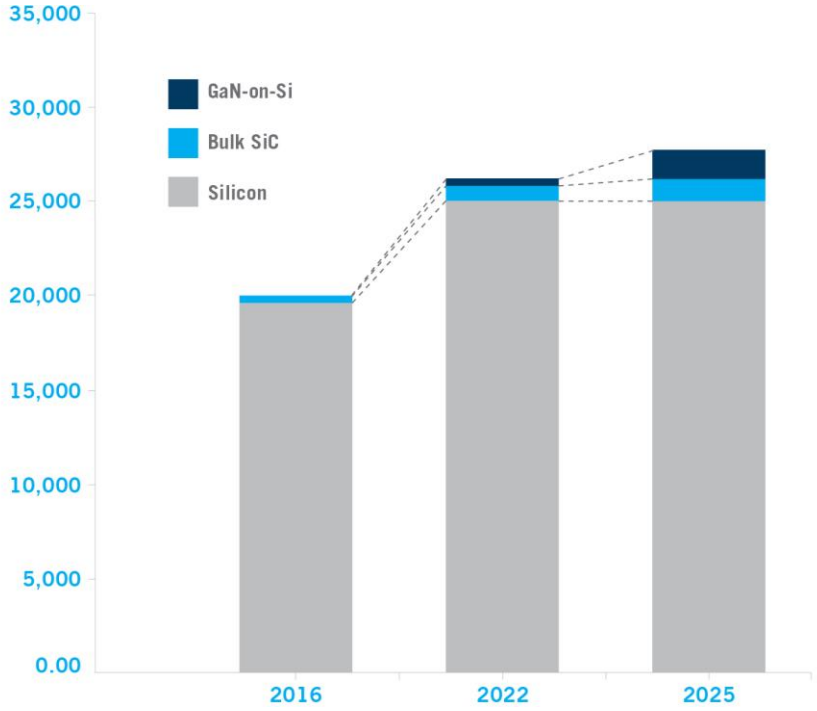
$2.6B

The GaN and SiC power electronics market is expected to be worth $2.6B by 2022

GaN for power semiconductors is expected to grow at

~90% CAGR

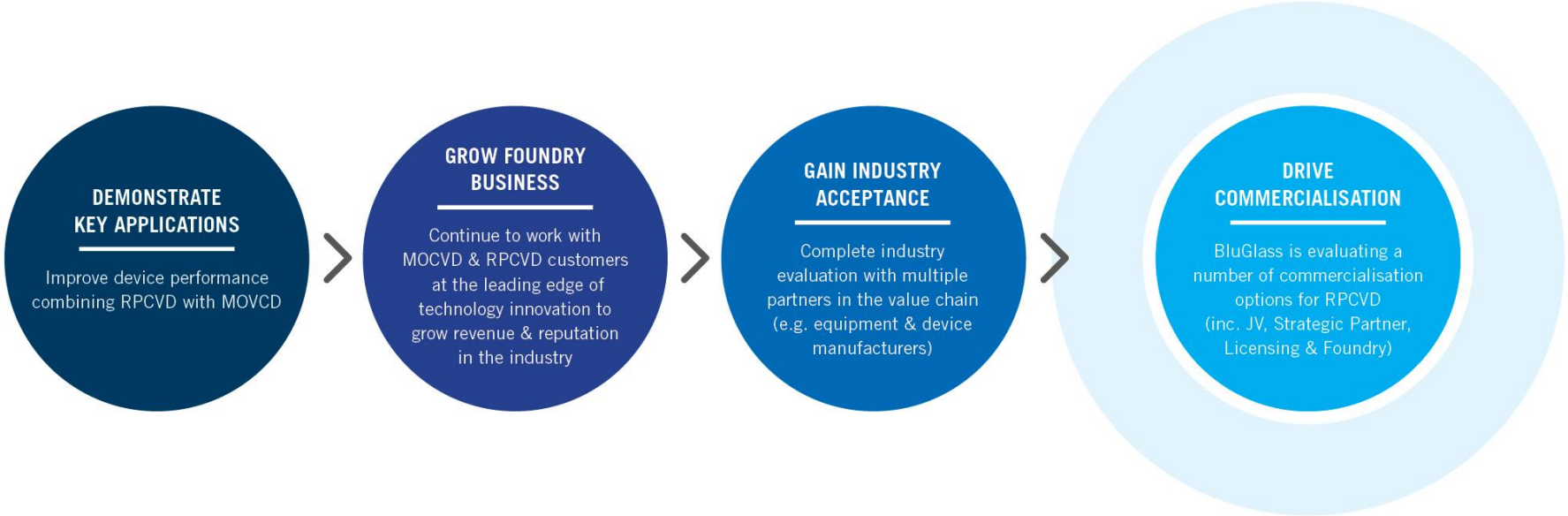
to 2022



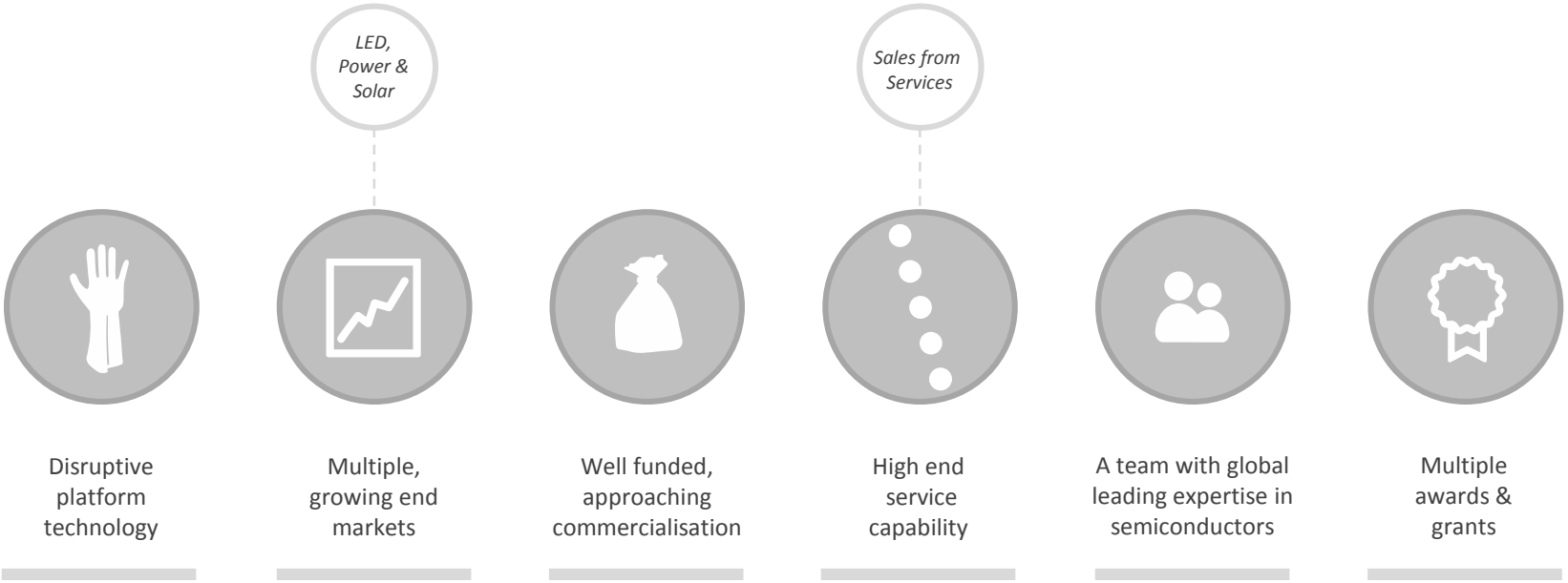
Source: Stifel, Sep 2017; and Research and Markets

PATH TO MARKET

BluGlass continues to be active in all four segments of its path to market



CONCLUSION INVESTMENT HIGHLIGHTS

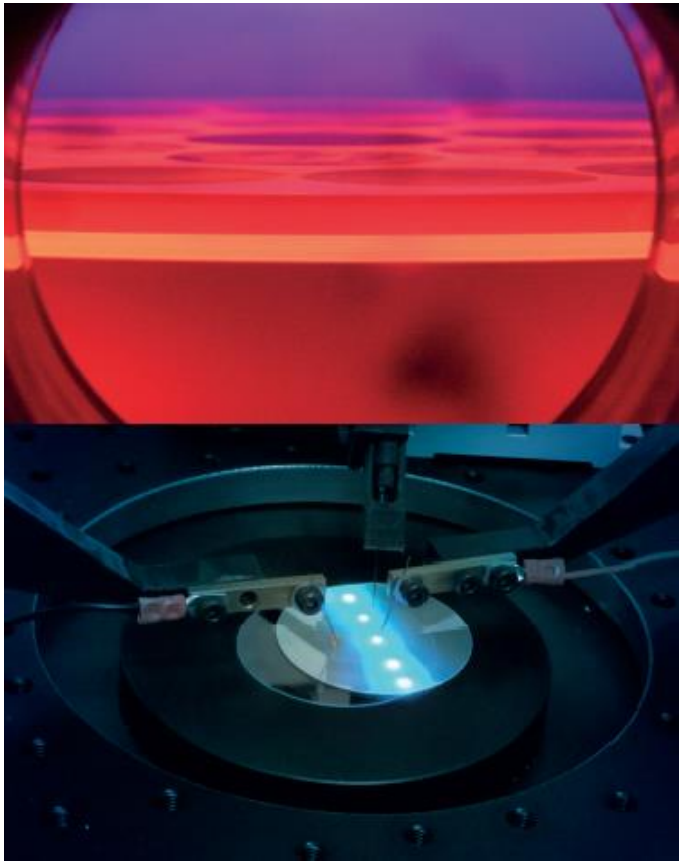


CHIEF OPERATIONS & TECHNOLOGY OFFICER ADDRESS: SIGNIFICANT TECHNICAL PROGRESS IN 2017

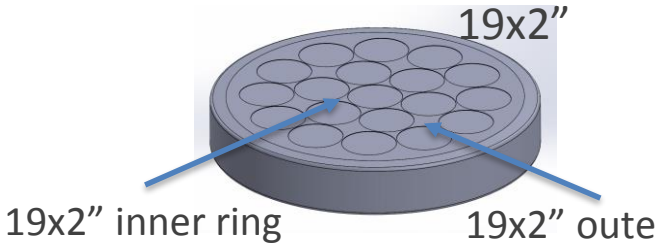
DR. IAN MANN

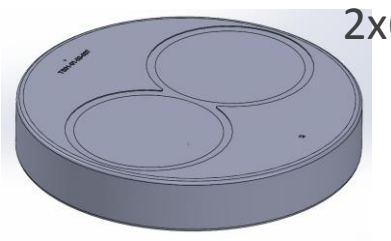
LUMILEDS PHASE II AND OTHER INDUSTRY COLLABORATIONS

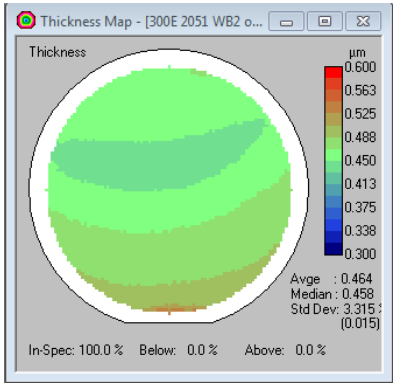
- Lumileds pleased with progress and are committed to project
- A number of iterations of BluGlass wafers have been fabricated **at Lumileds**
- Both RPCVD systems with the latest chamber design are delivering on technical roadmap for Lumileds project
- **HC Semitek, IQE, and Veeco collaborations are all recommencing with the success of the upgraded BLG-300 RPCVD capability**
- **BluGlass has filed a patent**

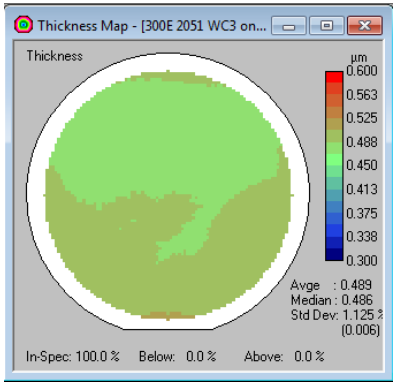


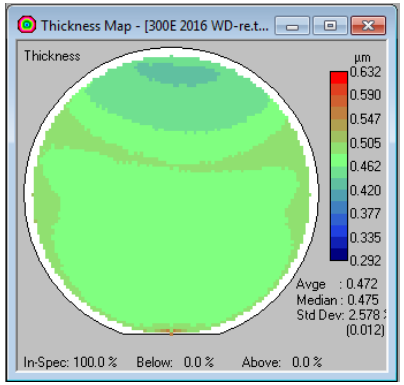
BLG-300 RPCVD CHAMBER UPGRADE – THICKNESS UNIFORMITY IMPROVEMENT

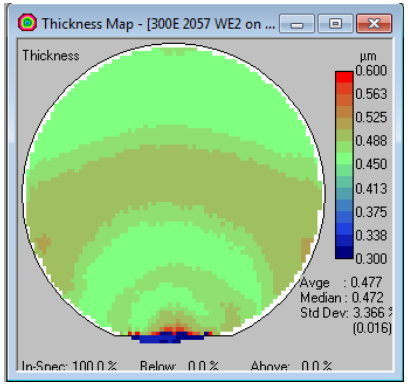












WAFER DIAMETER	2” (OUTER)	2” (INNER)	100 mm	150 mm
2017 CHAMBER (THICKNESS STD DEV %)	**1.1**	**3.3**	**2.6**	**3.4**
2016 CHAMBER (THICKNESS STD DEV %)	6.8	7.8	10.9	--

BLUGLASS CUSTOM EPITAXIAL SERVICES

- Targeting strategic customers requiring both RPCVD and MOCVD combined
- BluGlass has repeat customers developing applications in both LEDs and Laser Diodes
- BluGlass has enhanced several demonstrators using our in-house RPCVD and MOCVD capabilities to market to the industry
- Recently showcased several **Key Demonstrators** at the recent semiconductor conference

RPCVD TECHNOLOGY DEVELOPMENT AREAS

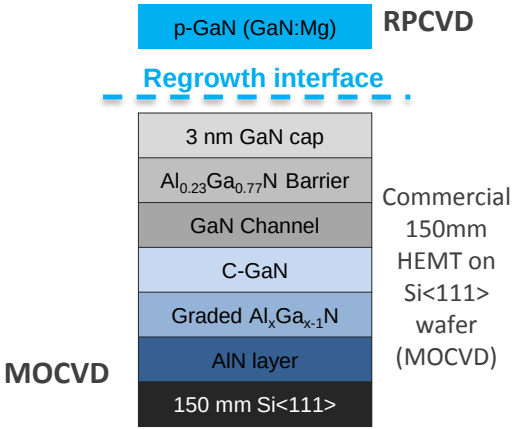
RPCVD DIFFERENTIATOR	BLUE LEDS	GREEN LEDS	LASER DIODES	RGB MICRO - LEDS AND SOLAR	UV LEDS	POWER ELECTRONICS	ELECTRONICS APPLICATIONS
p-GaN	●	●●	●●	●		●●	
p-AlGaN	●	●	●●	●	●		
InGaN	●	●	●	●			
AlN / Silicon							●●
AlN / sapphire	●●				●		

●● BluGlass active collaborations and/or customers

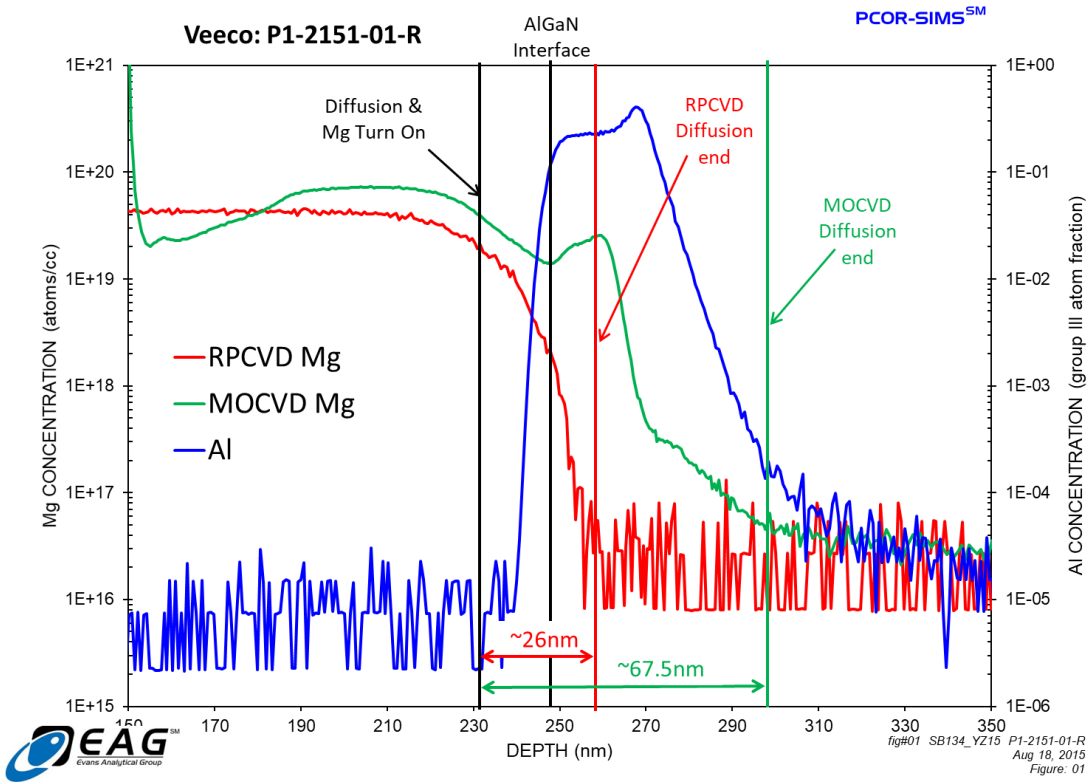
● BluGlass actives areas in discussions with potential collaborators and/or customers

RPCVD p-GaN FOR E-MODE HEMTs – COLLABORATION WITH VEECO

RPCVD VS. MOCVD p-GaN: Mg DIFFUSION IN HEMTs



Note the Mg SIMS trace for the MOCVD growth is overlayed on the RPCVD p-GaN on HEMT SIMS trace for ease of comparison. The Al traces from the 2DEG (common to both structures) was used for alignment purposes.



KEY DEMONSTRATOR: RPCVD p-GaN + MOCVD FOR GREEN LEDs

KEY DEMONSTRATOR: RPCVD p-GaN + MOCVD FOR GREEN LEDs

2016 AGM DATA

MOCVD* EL DATA	20 mA
Light Output (mW)	1.3
V_f (V)	3.5
Peak Wavelength (nm)	525
FWHM (nm)	35

RPCVD* EL DATA	20 mA
Light Output (mW)	1.6
V_f (V)	3.9
Peak Wavelength (nm)	525
FWHM (nm)	33

% Performance improvement of RPCVD compared to MOCVD [Light Output / (I x Vf)]	+10%

* MOCVD data from best results for complete LED structure grown without any interruption and using a p-AlGaN EBL. RPCVD data taken from best results overgrown on equivalent MOCVD-grown MQWs. RPCVD samples do not contain an EBL. All measurements taken at wafer level using indium dot contacts.

2017 DATA**

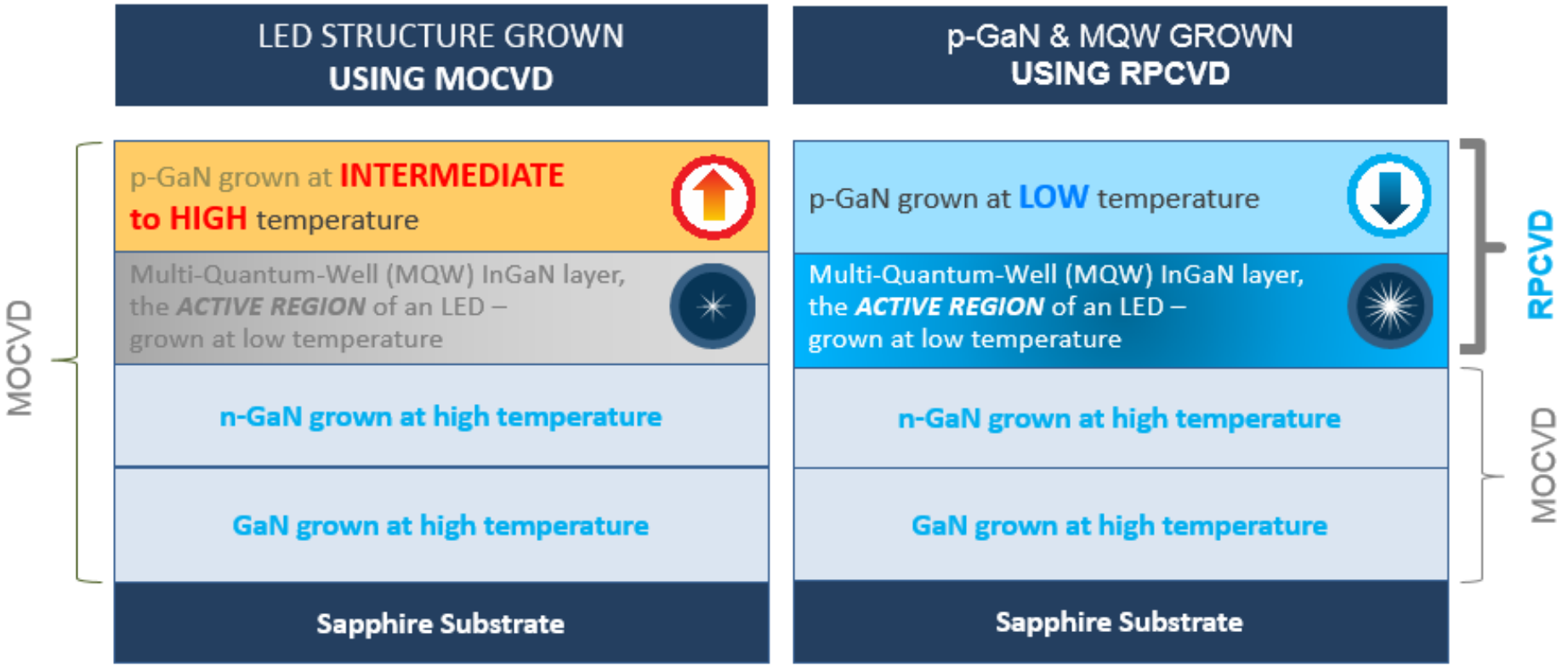
MOCVD EL DATA	20 mA	50 mA	100 mA
Light Output (mW)	1.3	3.3	6.2
V_f (V)	3.1	3.7	4.6
Peak Wavelength (nm)	514	511	508
FWHM (nm)	28	31	33

RPCVD EL DATA	20 mA	50 mA	100 mA
Light Output (mW)	1.9	4.5	8.1
V_f (V)	3.0	3.6	4.5
Peak Wavelength (nm)	515	512	510
FWHM (nm)	30	30	33

% Performance improvement of RPCVD compared to MOCVD [Light Output / (I x Vf)]	+47%	+39%	+35%

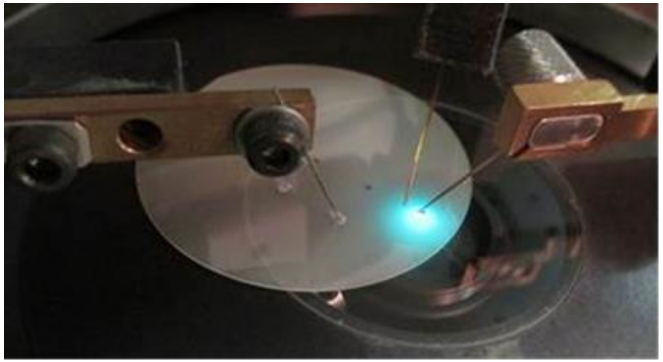
** Both RPCVD and MOCVD data obtained from p-GaN overgrown on the same partial LEDs grown by MOCVD up to and including the EBL. All measurements taken at wafer level using indium dot contacts.

KEY DEMONSTRATOR: RPCVD p-GaN + RPCVD MQWs FOR RGB LEDs



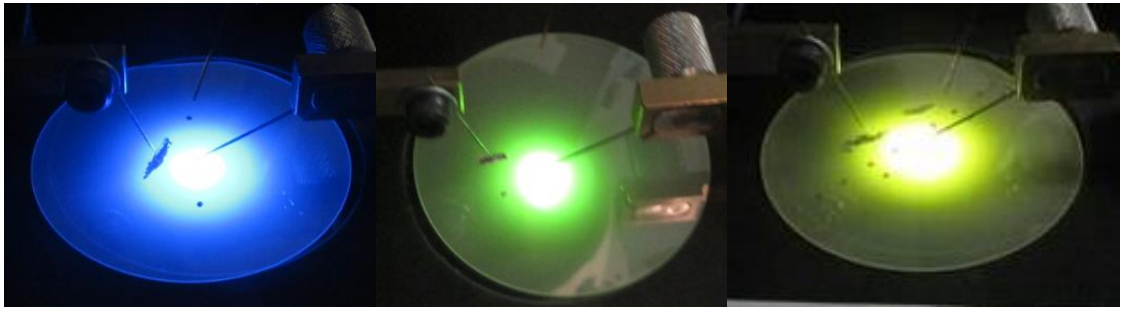
KEY DEMONSTRATOR: RPCVD MQWs for RGB LEDs

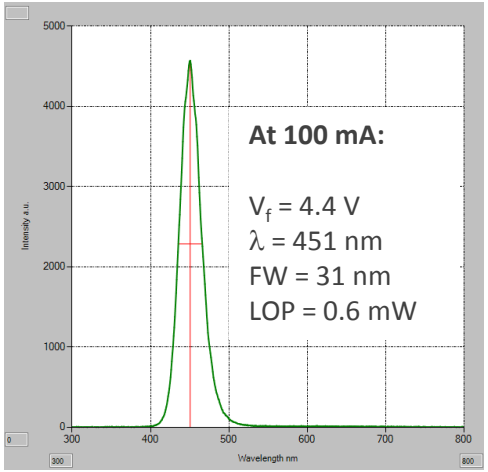
RPCVD MQW BASED LED 2016



- To attract further industry interest BluGlass continues to enhance the RPCVD capability
- Low temperature RPCVD is favourable for In rich InGaN MQWs useful for longer wavelength LEDs

RPCVD MQW BASED LEDs 2017





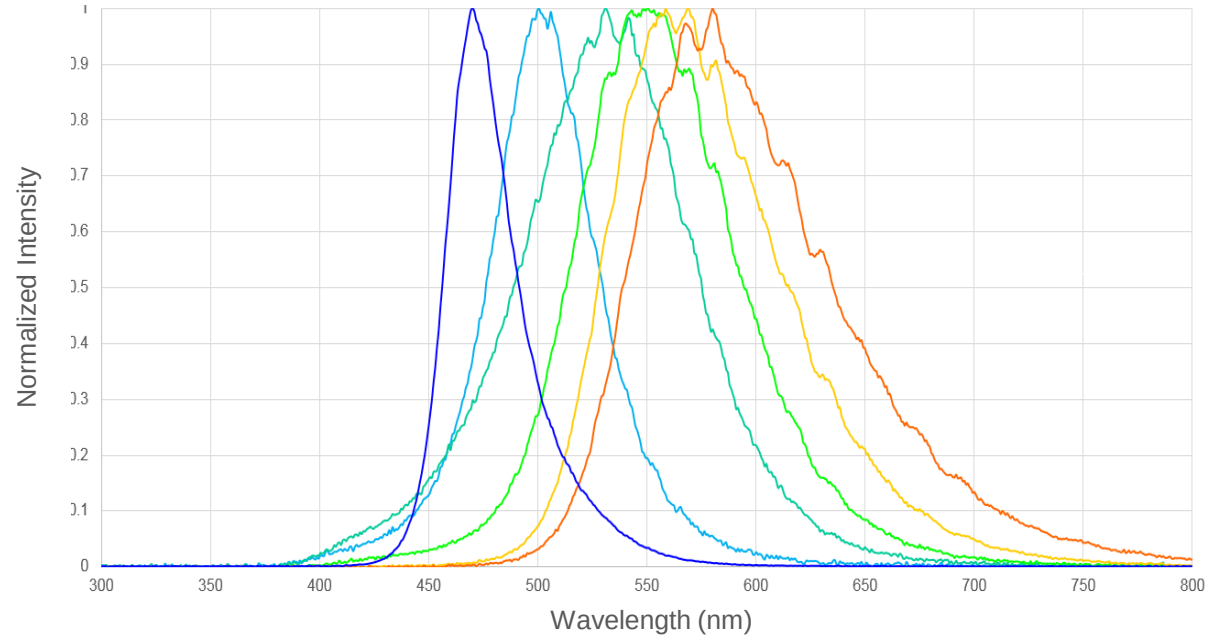
- **Micro-LED** players have shown interest in RPCVD capability for blue, green, yellow and red LEDs for display and other applications

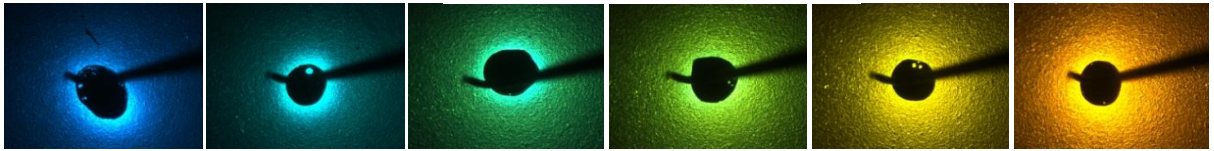
KEY DEMONSTRATOR: RGB RPCVD FOR MICRO-LEDS AND SOLAR APPLICATIONS

Preliminary RPCVD demonstration of RGB LED capability

RPCVD MQW capability is also a key step to the realisation of high efficiency solar cells through multi junction architecture

EL SPECTRA OF LEDs GROWN USING RPCVD MQWS





THANK YOU

bluglass.com.au