

28 August 2018

## BLUGLASS FY 2018 REVIEW OF OPERATIONS

During the 2018 Financial Year BluGlass continued to develop the technology and opportunities for its proprietary Remote Plasma Chemical Vapour Deposition (RPCVD) technology, delivering a number of key achievements that furthered the capability of the technology and the supporting intellectual property portfolio of RPCVD. Some highlights include the Company publishing its best material performance data to date, filing new patent applications and advancing its strategic projects with our US and European based partners, as well as selecting additional strategic collaboration partners.

These achievements provide a robust foundation for the company as we work to deliver successful commercial outcomes in our industry evaluations and collaborations.

### Strengthening our global expertise

Increasing project demands and an expanding global marketing and commercialisation focus meant that during the year strengthening our leadership and expanding our team become a priority for the Company. BluGlass is built on a highly talented and expert team of professional directors, specialist scientists and engineers, and commercial staff; and augmented by world leading industry consultants - all committed to bringing to market the Company's breakthrough technology.

To this end, BluGlass undertook a Board restructure with the departure of long-standing Non-Executive Directors, Greg Corneleson and Chandra Kantamneni. Both Greg and Chandra retired after 12 years of significant contribution, both on the Board and a number of sub-committees during their tenure. Greg and Chandra each played an instrumental role in the steering and development of the Company since its listing in 2006.

To meet the growing international commercialisation focus, BluGlass appointed two technology commercialisation specialists; with James Walker and Stephe Wilks joining the BluGlass Board as Non-Executive Directors. Both James and Stephe bring strong track records in successfully delivering new technologies into emerging and international markets.

To further our global presence and develop additional strategic opportunities BluGlass appointed Brad Siskavich as the Global Vice President of Business Development. Brad is leading the expansion of the BluGlass service business, EpiBlu. Brad brings more than 20 years' experience in developing, marketing and commercialising new technologies in start-up and high-growth environments in the compound semiconductor, photovoltaic (solar), laser, photonics and opto-electronics industries.

BluGlass has also appointed Dr. Mike Krames as an Advisor to the Company to provide expert guidance on the market and technology development and commercialisation plans of RPCVD. Mike is a recognised world authority on LEDs and their applications for lighting and displays. He was previously Executive Vice President at Philips Lumileds, and

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subsequently, Chief Technology Officer at Soraa, Inc., an LED company founded by Nobel Prize winner Shuji Nakamura.

Both Brad and Mike are based in the US.

We also grew our Silverwater technology team with the addition of an experienced process engineer to assist in the operation of the BluGlass deposition systems.

## Facility Upgrade

BluGlass currently has only two RPCVD platforms available to dedicate to our strategic developments and growing project pipeline, limiting our capacity to make hardware and process refinements. There was an urgent need to expand our development capacity and significantly upgrade our facility to install additional RPCVD deposition equipment.

In June this year, BluGlass undertook a significant capital raise to facilitate this upgrade. The Company raised \$9.2 million from institutional, professional and sophisticated investors at AUD\$0.37 per share in an Institutional Placement and raised a further \$2M at the same price in a Share Purchase Plan (SPP) to existing investors.

Funds raised from the Institutional Placement and SPP are being used to:

- Acquire additional MOCVD equipment to build and demonstrate applications by retrofitting with RPCVD on commercial platforms;
- Undertake a major facilities upgrade to expand current infrastructure to house the new RPCVD equipment that will assist in the acceleration of RPCVD development; and
- To strengthen the Company's balance sheet to exploit market opportunities and help fund the planned increase in activity.

## Technology Update

Technical excellence is at the heart of what we do. The majority of the RPCVD development is concentrated on carefully selected strategic collaborations and partnerships, and as such we are bound by confidentiality agreements with respect to those specific developments of the RPCVD technology.

### 2017 GREEN LED 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 / ( $I_f \times V_f$ )]

**+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 Electron Blocking Layer (EBL). All measurements taken at wafer level using indium dot contacts. These wafers were not processed.

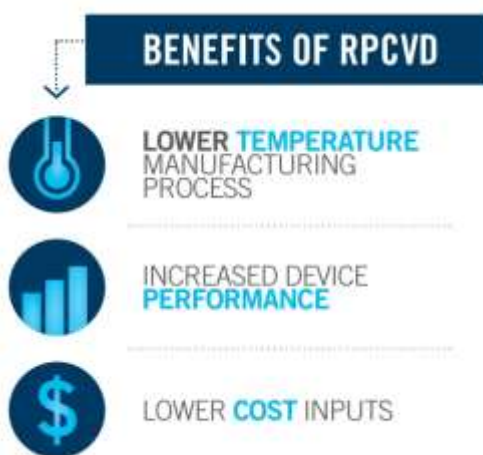
Despite this, during the year BluGlass published its best RPCVD performance data to date, presenting the new technical data at the invite-only Workshop for Ultra-Precision Processing for Wide Band-Gap Semiconductors (WUPP) in the USA. BluGlass was invited to present at the 5th International WUPP workshop, which gathers a focused group of leading research institutions and companies in the nitrides community to discuss various topics ranging from LEDs, Laser Diodes and power electronics. In the data BluGlass presented greater than 30% performance improvement in RPCVD p-GaN based green LEDs compared to BluGlass' MOCVD green LEDs measured at the wafer level. Further work is ongoing to demonstrate RPCVD p-GaN on fully processed devices.

This performance improvement was largely enabled by another key achievement during the year where BluGlass successfully delivered a major hardware upgrade to improve the uniformity and demonstrate the scalability of the RPCVD technology with the successful installation and commissioning of the upgraded BLG-300, the larger of the two RPCVD platforms. The new design was based on the earlier upgraded BLG-180, and developed to demonstrate a scalable modular design which, as successful will form the basis of further scalability demonstrations.

The new BLG-300 quickly set a new benchmark for RPCVD, achieving a significant milestone for the Company, and demonstrating good thickness and improved performance uniformity over 2, 4 and 6-inch wafers suitable for BluGlass' commercial demonstrations across the various existing collaborative projects.

BluGlass' Chief Technology and Operations Officer, Dr. Ian Mann has been invited to present at SPIE Photonics WEST in the US in February 2019. Photonics West is the world's largest photonics technology event attracting more than 23,000 visitors annually.

### Benefits of RPCVD



*Competitiveness in the HB-LED industry is largely driven by efficiency (light output) and manufacturing costs. Efficiency improvements can also lower cost.*

*An industry benchmark states that each 1% improvement in LED efficiency can translate to a 3-5% reduction in chip costs. This means higher LED efficiency results in smaller chip sizes, leading to more chips per wafer and lower chip manufacturing costs.*

*BluGlass' unique low-temperature RPCVD technology has inherent advantages that may increase LED performance and help reduce epi-wafer manufacturing costs, and this is what we are working to demonstrate with a number of our collaboration partners.*

### Building our strategic partnerships

BluGlass' future success is underpinned by our ability to commercialise the RPCVD technology solution to a highly engaged customer base in a broad range of applications. By working closely with our future customers on the development of RPCVD in a collaborative effort helps ensure that the RPCVD technology will deliver real solutions that meet the demands and needs of our partners and the industries that we serve.

BluGlass has several important Strategic Partnerships in place and during the year also broadened our strategic horizons, announcing two additional partnerships. An update on key partnerships is provided below.

#### Lumileds – High Brightness LED collaboration

The most immediate market opportunity for BluGlass remains in high-brightness LED applications. Our continuing partnership with Lumileds, a global leader in automotive LED lighting products, remains one of our top priorities. In March 2018, BluGlass agreed with Lumileds to extend the Phase II collaboration. The extension was specifically designed to accelerate the development including shortening turnaround times of experimental iterations.

BluGlass and Lumileds are collaborating to develop a novel application of high-brightness LEDs. The Phase II collaboration is focused on the integration of BluGlass' RPCVD technology into certain LED applications.

The expedited development schedule has already led to significantly greater effort by both parties. BluGlass is pleased with the continued progress towards the Phase II Milestones.

## **IQE - cREO for range of electronic applications collaboration**

Another key strategic partner for BluGlass is global foundry manufacturer of advanced semiconductor wafer products, IQE. BluGlass and IQE are collaborating to develop specific enabling technology for high quality nitride films deposited by low temperature RPCVD on both silicon wafers and on specially engineered substrates: cREO™ on silicon. This would have commercial application in a wide range of electronic devices.

IQE remains an important collaboration partner for BluGlass.

## **Griffith University and IMCRC – power electronics collaboration**

During the year BluGlass also entered into a unique partnership with Griffith University and the Innovative Manufacturing Cooperative Research Centre (IMCRC) to develop next-generation GaN transistors, called High Performance Normally OFF GaN High Electron Mobility Transistors or normally OFF (HEMT)s.

This two-year, \$600,000 co-funded research project combines two Australian enabling technologies - BluGlass' RPCVD technology and Griffith University's Atomically Smooth SiC on large Si (SiC on Si) wafers.

Normally OFF GaN transistors are another significant market opportunity where RPCVD has a demonstrated performance potential over traditional MOCVD devices. This application also draws on the significant pre-established p-GaN development work that BluGlass conducted for its proof of concept milestone in LEDs and is a natural extension of this work.

BluGlass wanted to work with a partner to develop full devices for product demonstration, over epi-wafer demonstrations, as a more attractive commercial proposition for the transistor market.

Griffith University's extensive expertise in this area and the commercial backing of the IMCRC make this an ideal partnership to demonstrate the power electronics of the future.

## **Growing our service business**

In November 2017 BluGlass launched our custom epitaxial brand, EpiBlu. The service business continues to provide a growing source of revenue for BluGlass, as well as a pipeline of future collaborators and customers.

Not only is this service arm a revenue generating opportunity for BluGlass, providing additional commercialisation opportunities, but it is also a valuable part of our broader RPCVD commercialisation strategy.

EpiBlu is able to introduce our customers, at the cutting edge of the opto-electronics industry, to the unique benefits of the RPCVD technology into a broad range of applications through its fee-for-service prototyping and custom epitaxial offerings.

### ***The microLED opportunity***

*BluGlass currently provides development services to multiple microLED companies that are interested in a combination of MOCVD and RPCVD capabilities to develop and prototype their innovative devices.*

*These customers are each developing unique microLED technology and are looking to exploit the potential benefits of RPCVD. The primary interest is for high performance green LEDs.*

*BluGlass is very interested in the microLED market segment, which builds on our established LED know-how. Additionally the inherent advantages of RPCVD lends itself even further to the requirements of micro-displays. Low temperature RPCVD could be key to unlocking high performance of longer-wavelength LEDs (green and red LEDs) and be part of an enabling technology solution.*



*The rapidly growing microLED industry is anticipated to grow from its present R&D base to be valued at US \$19.9B by 2025.*

*In March this year, BluGlass announced that it had entered into a customer Collaboration Agreement with a well-funded microLED company to develop novel RGB microLED applications. The two companies are working together to demonstrate a unique red, green and blue (RGB) microLED display application.*

*The microLED market is an enormous opportunity for RPCVD within one of the fastest growing LED market segments, with applications in wearables (watches), mobile displays, next generation TV displays, virtual reality (VR) and augmented reality (AR).*

Bard Siskavich leads the EpiBlu business development and we will continue to expand the business based on our growing reputation and continued positive results from existing customers.

BluGlass and EpiBlu have featured at a number of key industry events as speakers, exhibitors and sponsors over the year.

### **Intellectual Property Update:**

To maximise our commercialisation potential, our Intellectual Property Portfolio is one of the most important aspects to BluGlass' asset base. As a result, BluGlass is significantly increasing its investment in its IP development and patent protection.

While we continue to work with our Australian Patent Attorneys and our external expert Patent Manager, BluGlass has also recently appointed an IP firm in the US to assist in the further strengthening of our portfolio.

***BluGlass currently has 48 internationally granted patents in key semiconductor markets, with an additional 14 expected to grant on 29 August (with the Official Decision to Grant having now been received). This will bring our total granted portfolio to a total of 62 internationally granted patents from that date.***

### **The Year Ahead:**

As we head into the 2019 Financial Year, BluGlass' immediate focus is on completing the significant upgrade to our Silverwater facility, while minimising any disruption to our existing operations and collaboration projects.

The majority of the facility upgrade is separated from our existing laboratories and is expected to cause minimal impact on our operations. The plan will see us expand out new cleanrooms into the warehouse space of our facility. BluGlass looks forward to updating the market on the facility upgrade and the design, installation and commissioning of new large scale RPCVD chambers.

The upgrade is expected to take a number of months to complete, with the first of the new RPCVD chambers to come online in the second quarter of 2019.

BluGlass primary objective for the upcoming year is to deliver successful outcomes in one or more of our current industry partnerships. These discussions and collaborations are in different stages of development, but each one of them has significant market potential once realised.

Following the recent launch of our service brand, EpiBlu, the Company will also continue to grow this revenue generating business; while also working with potential future collaborators and customers of the RPCVD technology, in particular following the installation of our additional capacity and next generation of RPCVD deposition systems.

The BluGlass Board and Management look forward to delivering on the strategic and commercial goals of the Company - for our shareholders and our breakthrough technology - in the year ahead.

The full Audited Annual Financial Statements can be downloaded from our website at [www.bluglass.com.au/reports](http://www.bluglass.com.au/reports)

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### About BluGlass:

BluGlass Limited (ASX: BLG) is a global leader commercialising a breakthrough technology using Remote Plasma Chemical Vapour Deposition (RPCVD) for the manufacture of high-performance LEDs and other devices. BluGlass has invented a new process using RPCVD to grow advanced materials such as gallium nitride (GaN) and indium gallium nitride (InGaN). These materials are crucial to the production of high-efficiency devices such as power electronics and high-brightness light emitting diodes (LEDs) used in next-generation vehicle lighting, virtual reality systems and device backlighting.

The RPCVD technology, because of its low temperature and flexible nature, offers many potential benefits over existing technologies including higher efficiency, lower cost, substrate flexibility (including GaN on silicon) and scalability.

BluGlass was spun off from Macquarie University in 2005 and listed in 2006.

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