

## NITRIDE UPDATE

OCTOBER 20TH 2005

## OKI GAN ON SILICON HEMTS

Dear Reader

Welcome to a project in response to the number of enquiries I get about 'Gallium Nitride News'. As I constantly mention there is no such thing as GaN-Net Newsletter... or at least there wasn't until now!

This will be an occasional publication which I shall post onto the website with that name: 'GaN-Net' aka Nitride News. It will be fairly thorough and up to date but will only be published when there is enough news relating to nitrides etc.

Some of the news will be taken from my subscription newsletters such as *Microelectronics Review*. But that comes out as a special service for paying customers. This GaN News will be free at least for the meanwhile. You don't have to do anything to get it—just pop back to this website every now and again and download the new one. Each time an issue is published the old one will not be archived online... well, it might somewhere if I can find the space and depending on demand.

For the moment we hope you like this enough to perhaps write in to my email and say so—maybe with your own news. Please make it relevant to nitride semi's in some form, however peripheral stuff will not be included. I intend to cover SiC and competing stuff like OLEDs as well plus a look at Blu-ray/HD etc., nitride layers for memories, LED driver chips etc. And anything else I personally find interesting and think you might too.

Roy Szweda

Oki Electric Industry Co., Ltd. announced the development of a power transistor with dramatically improved amplifying characteristics at the 208th Meeting of the Electrochemical Society. This GaN-HEMT is formed on a large diameter silicon substrate, achieving a world record for transconductance rating of 350mS/mm and maximum oscillation frequency (fmax) of 115GHz. Because this GaN-HEMT is achieved on a silicon wafer - not on conventional SiC - it can reduce costs by approximately 50%. This will help wireless communication systems become lower power consumption, smaller and lower cost.

"Succeeding in improving amplifying characteristics for power transistors is an exciting achievement for Oki, as the market has been in need of smaller and lower power consumption wireless communication systems," said Harushige Sugimoto, Senior Vice President and Chief Technology Officer of Oki Electric. "By enhancing higher output of transistors based on this technology, we can contribute to the acceleration of WiMAX and next generation wireless communication systems. Volume shipment of such products are planned to start from 2007."

In addition to a 115GHz figure for fmax and 350mS/mm figure for transconductance, which is an indicator of amplification performance, the transistor achieved a 56GHz current gain cut-off frequency. This is a significant improvement from previous GaN-HEMT on silicon substrate devices, which had a range of 70 to

80 GHz fmax, and achieves a performance equivalent to GaN-HEMT on SiC substrates.

Conventionally, power transistors using GaN were developed on a SiC substrate due to its advantage of easy crystal growth. However, there have been problems with SiC boards for its low quality, difficulty to shift to larger diameters, and expensive substrate costs. The newly developed device is a HEMT, which grows the AlGaN/GaN structure on the silicon substrate with very few defects and is fifty to a hundred times lower cost than SiC.

By improving the crystal growth technology for gallium nitride on silicon substrate, Oki was able to gain high electron mobility in a high-quality thin film. Oki achieved such high ratings by developing a technology to form the gate electrode on a recessed structure, reducing gate length to 0.2µm, developing a recessed structure for the ohmic electrodes, and optimizing the device structure.

This device was jointly developed with the Research Center for Micro-Structure Devices at the Nagoya Institute of Technology, and with support from The Research Promotion Bureau of Japan's Ministry of Education, Culture, Sports, Science and Technology.

Oki announced this at the 208th Meeting of the Electrochemical Society, held in Los Angeles, U.S.A., from October 16th to 21st. [WS: http://www.oki.com/](http://www.oki.com/)

**ON THE WEB: Blu-ray Disc vs. HD DVD**

The DVD Writer: HD Camcorders—Writable Blu-ray Disc vs. HD DVD By Hugh Bennett "We all know that writable Blu-ray Discs (BD) store a lot more information than HD DVDs. But does it really matter? When it comes to employing them in next-generation high-definition (HD) camcorders, it certainly does".

[WS: http://www.emedialive.com/Articles/ReadArticle.aspx?ArticleID=10635](http://www.emedialive.com/Articles/ReadArticle.aspx?ArticleID=10635)

In March 2006, Sony will release its XDCAM HD camcorder which will record high definition footage directly to a Blu-ray disc. [WS: http://hometheater.about.com/gi/dynamic/offsite.htm?site=http://www.tgdaily.com/2005/10/12/sonyxdcam/](http://hometheater.about.com/gi/dynamic/offsite.htm?site=http://www.tgdaily.com/2005/10/12/sonyxdcam/)

**Papers On the Web: Development of High Power Green Light Emitting Diode Chips by Christian Wetzel, T. Detchprohm from Future Chips Constellation and Department of Physics, Applied Physics and Astronomy.** Abstract: The development of high emission power green light emitting diodes chips using GaInN/GaN multi quantum well heterostructures on sapphire substrate in our group is being reviewed. We analyze the electronic bandstructure in highly polarized GaInN/GaN quantum wells to identify the appropriate device structures. We describe the optimization of the epitaxial growth for highest device performance. Applying several optimization schemes, we find that lateral smoothness and homogeneity of the active region as characterized by AFM is a most telling character of high yield, high output power devices emitting near 525 nm. In un-encapsulated epi-up mounted (400 µm)<sup>2</sup> die we achieve 2.5 mW at 20 mA at 525 nm. We describe die performance, wafer yield, and process stability, and reproducibility for our production-scale implementation of this green LED die process.

[Web: http://nsr.mij.mrs.org/10/2/](http://nsr.mij.mrs.org/10/2/) [CW: http://www.rpi.edu/~wetzels/](http://www.rpi.edu/~wetzels/)

## LED MARKETS—STRONG GROWTH AHEAD

The market for LEDs for display and communications applications is projected to grow 7% annually on average to 614.7 billion yen (\$5.5 bil) in 2008, up 30% over the 2004 level. As the brightness of white LEDs is expected to increase from 701m/W in 2005 to 1,001m/W in 2008, they will be used in wider applications ranging from automobile headlights to general lighting products. The Japanese makers will continue to account for more than 90% of the global white LED market.

WS: [http://www.japancorp.net/Article.Asp?Art\\_ID=10987](http://www.japancorp.net/Article.Asp?Art_ID=10987)

## CREE UNDER INVESTIGATION

U.S. immigration officials reportedly detained 35 employees at a plant in Durham, N.C., owned by semiconductor company Cree Inc. claiming the workers are illegal immigrants, according to an Associated Press report.

Cree recently gained a USD15 m R&D project in SiC for RFIC development hence the heightened sensitivity. Plus in the US anyone affiliated with potential terrorist activity and defence infrastructure etc is being placed under closer scrutiny.

"Cree, Inc. is not a subject of the investigation. The management of Cree has been more than cooperative in the investigation. Cree has one of the most stringent hiring processes and background checks that ICE has encountered"

The case remains under investigation and so we hope to read that this is not the case and Cree is able to get back to work. The company has a prestigious position in the semiconductor community especially in its pioneering of wide bandgap semiconductors for LEDs, lasers and related devices.

WS: <http://www.eet.com/news/latest/showArticle.jhtml?articleID=172302314>

WS: [http://communitydispatch.com/artman/publish/article\\_2508.shtml](http://communitydispatch.com/artman/publish/article_2508.shtml)

## SILICON CARBIDE LENSES

Physicists at the University of Texas at Austin have made a "super lens," a plane-shaped lens that can image a point source of light down to a focal spot only one-eighth of a wavelength wide. This is the first time such super lensing has been accomplished in a functional device in the mid-infrared range of the electromagnetic spectrum. The micron-sized Texas lens, reported at the Frontiers in Optics meeting of the Optical Society of America, consists of a silicon carbide membrane between layers of silicon oxide.

WS: <http://www.aip.org/pnu/2005/split/750-3.html>

## SATCON TO PRESENT SILICON CARBIDE PAPER AT EESAT, RECEIVES NEW SIC SBIR AWARD

SatCon Technology Corporation, a developer and manufacturer of power electronics and motors for the alternative energy markets, today announced that Dr. Leo Casey from the Applied Technology division will present a paper entitled "High Power Silicon Carbide Inverter Design - 100kW Grid Connect Building Blocks" at the 2005 Electrical Energy Storage Applications and Technologies Conference (EESAT) in San Francisco on October 18th. "As our society moves towards higher levels of electrification the performance of today's power conversion technology becomes increasingly limiting," said Millard Firebaugh, SatCon President and Chief Operating Officer. "SatCon is committed to developing advanced power conversion technology that goes beyond today's Silicon based technology with Silicon Carbide being one example. Silicon Carbide should allow smaller, lighter and more robust power converter packages, which is important for all applications and is certainly true for Utility Scale Energy Storage Systems where round-trip efficiency, system reliability, volume and weight benefit directly."

The EESAT paper describes a 100kW SiC Inverter Module being developed under a DOE sponsored SBIR program. SatCon brings to the program the combination of a strong background in SiC applications R&D along with extensive experience in modular and grid connected power electronics, including utility scale energy storage experience with both batteries and flywheels. This DOE SBIR program is on-going and is focused on circuit and system design.

## NEWS NOTES

**Toshiba America Electronic Components, Inc. announced the expansion of its constant-current white LED driver product line** with a new driver IC that powers the multi-segment white LEDs used to backlight the new, larger colour LCD panels in small portable devices such as cell phones and PDAs. Designated TB62752AFUG, the high-precision, high-performance switching white LED driver IC can drive 2 to 8 LEDs serially, has high output power for up to 800 mW LED loading and features a built-in surge-protection function.

**OSRAM Opto Semiconductors** announces its broad participation at the Intertech Light-Emitting Diode (LED) 2005 conference and exposition. Intertech LED 2005 is the largest and most comprehensive business and technology forum dedicated to high-brightness LEDs. This three-day conference brings together leading industry professionals to discuss recent market developments and technology advancements critical for the adoption of LEDs in solid-state lighting, displays, illumination, health and automotive applications.

**New Wave Research has introduced StageLaze**, an accessory kit for the QuikLaze laser-cutting product family. Available in motorized and manual configurations, this accessory kit creates a comprehensive micro-machining solution that is exceptionally cost effective, reliable and accurate. The laser can be specified in single and multiple wavelength configurations, including IR, green and UV. Multiple wavelengths, combined with user-selectable repetition rates, provide the ability to cut a wide range of materials.

<http://www.newwave.com/>

**AIXTRON AG has completed the installation and commissioning of a Thomas Swan 19x2" Close Coupled Showerhead (CCS) GaN production reactor at Blue Photonics, Inc. (BPI)** in Walnut, California. The new system will be used to produce high quality GaN based epitaxial materials for a

Meanwhile, at the more fundamental level of device packaging for Silicon Carbide, SatCon received a Phase I SBIR award from the US Army last week under a Project title of "High-Temperature Packaging Technology for Semiconductors". "The Government, through both the DOE and the DOD, recognize the significance of semiconductor technologies that allow us to go beyond Silicon," said Dr. Firebaugh, "SatCon is privileged to be in the position to use its experience and knowledge to help advance technology in this critical area".

SatCon Technology Corporation is a developer and manufacturer of electronics and motors for the Alternative Energy, Hybrid-Electric Vehicle, Grid Support, High Reliability Electronics and Advanced Power Technology markets. For further information, please visit the new SatCon website at

WS: <http://www.satcon.com>

## PERMLIGHT INTRODUCES DIMMABLE, LONG-LIFE UNDER-CABINET LIGHT FEATURING CREE XLAMP POWER LEDS

Permlight Products Inc. has begun shipping its Enbryten Under ENBU Series of dimmable LED under-cabinet lighting fixtures for residential applications. The ENBU Series features highly efficient and durable LEDs from Cree, Inc., and it is ideally suited for complementary use in granite or earth tone marble kitchen counter applications bringing out the richness of the stone.

The ENBU Series is the first production product to use Permlight's newly introduced (July 2005) phase control dimmable technology that operates on line voltage (120VAC) and works with any off-the-shelf dimmer.

"By using conventional dimming technologies the cost of installing and controlling an LED luminaire can be near the price to operate a conventional incandescent or fluorescent lighting system," commented Manuel Lynch, President and CEO of Permlight. "Combining Cree's robust XLamp technology and Permlight's patented thermal management architecture results in a low cost fixture comparably priced to those used in production homes today."

"Permlight's ENBU LED under-cabinet lighting is an exciting introduction for the home lighting design and construction market," notes Norbert Hiller, Cree Lighting vice president and general manager. "Permlight products are designed to make adoption of LED lighting for the home lighting market quick and easy and Cree is excited to be supplying the power LEDs for these modern, adaptable and extremely useful new lighting fixtures."

### US PATENTS FROM OCTOBER

**Sharp:** #6,956,882 by T Okumura, "Gallium nitride semiconductor light emitting device having multi-quantum-well structure active layer, and semiconductor laser light source device"

**Cree:** #6,955,977 by HS Kong, et al., "Single step pendeo-and lateral epitaxial overgrowth of group III-nitride epitaxial layers with group III-nitride buffer layer and resulting structures", see also #6,952,024 by JA Edmond, et al., "Group III nitride LED with silicon carbide cladding layer" & #6,949,774 by P Parikh & U Mishra "Gallium nitride based diodes with low forward voltage and low reverse current operation"

**Nitronex:** #6,956,250 by R Borges, et al., "Gallium nitride materials including thermally conductive regions"

**Toyoda Gosei:** #6,955,936 by T Uemura, et al., "Methods and devices related to electrode pads for p-type Group III nitride compound semiconductors"

**North Carolina State University:** #6,955,858 by NA EIMasry, et al., "Transition metal doped ferromagnetic III-V nitride material films and methods of fabricating the same"

**Technologies and Devices :** #6,955,719 by VA Dmitriev, et al., "Manufacturing methods for semiconductor devices with multiple III-V material layers"

**Cornell Research Foundation:** #6,953,740 WJ Schaff et al., "Highly doped III-nitride semiconductors"

**Trustees of Boston University:** #6,953,703 by TD Moustakas "Method of making a semiconductor device with exposure of sapphire substrate to activated nitrogen"

Even though these were submitted a couple of years ago it seems that more or less all the majors are still hard at work perfecting the challenging process technology which goes into making LEDs and lasers, etc. To view full patents please go to: <http://patft.uspto.gov>

variety of electronic and opto-electronic products including high-power transistors, blue laser diodes, high efficiency blue, green and white light emitting diodes, and solar-blind photo-detectors, etc. The addition of the new 19x2" MOCVD production tool will complement BPI's other research tools, such as an existing 6x2" CCS research MOCVD system.

Building on the success of its industry-standard R•O•M Robinson Shutters and halogen-based Adjustable Compartment Lighting System, **R•O•M Corporation has introduced the LED Compartment Lighting System** for emergency vehicle compartments. The LED System is available as a stand-alone light bar or can be integrated with the roll-up door track for new or retrofit applications. WS: <http://www.romcorp.com/>

**Light Waves Concept, Inc.**, a New York-based LED manufacturer, is working with the Department of Defense on an evacuation system using LED technology. The project, set to go forward this winter, covers somewhat new territory for LED applications in the marketplace. The system is comprised of LED rope lights connected to DMX controllers. The ropes will covertly line the hallways of a given structure. In the event of an emergency, the controllers will illuminate the ropes in a series of different flashing patterns and colours.

WS: <http://www.lightwavesconcept.com/>



**Texas Instruments announced a high-power, white LED power conversion chip** for next-generation camera phones and PDAs. The IC will enable brighter flashes and ultimately, better quality pictures. See: [www.ti.com/sc05219](http://www.ti.com/sc05219).

Toshiba America Consumer Products, L.L.C. will demonstrate the next generation of blue laser based DVD products - HD DVD, also known as high definition DVD. Toshiba's HD DVD player will be displayed and demonstrated for the first time to consumers anywhere at a retail location in the United States.

Forrester Research declared **Blu-Ray as the winner in a battle over next-generation DVD technology**. "Two groups are competing for control of high-definition DVD formats to be launched in the spring of 2006. After a long and tedious run up to launch, it is now clear to Forrester that the Sony-led Blu-ray format will win," said Forrester Research analyst Ted Schadler in a report. [It ain't over till the fat lady sings...Ed].

Meanwhile, in a recent speech at Howard University, Microsoft Chairman **Bill Gates shared his vision for the Xbox 360** and speculated on the future of next-gen optical disc formats HD DVD and Blu-Ray. [No surprises there since MS recently declared its allegiance to Sony's rival format HD]. "HD versus Blu-ray, that's simply the last physical format we'll ever have. Even videos in the future will either be on a disk in your pocket or over the Internet and therefore far more convenient for you."

Featuring only six Cree XLamp LEDs in Permlight's modular PX architecture not only results in a low cost fixture but also offers a serviceable technology that can be repaired and upgraded with a Philips screwdriver. The ENBU Series features a three-year warranty from Permlight with an expected lifetime in residential applications of 15-20 years.

The slimline 18-inch long by 4.5 inches wide by 1.5 inches deep powder coated fixture mounts easily under kitchen cabinets and attaches to incoming Romex on the back wall of the kitchen back splash in the same way fluorescent fixtures mount today.

The ENBU series is rated at a maximum of 10Watts consuming less power than conventional fluorescents and much more energy efficient than its warm white halogen or xenon competition.

"The energy efficiency, full dimming capability, and similar styling and cost to existing fluorescent fixtures is why the Enbryten Under is already scheduled for installation in production homes in Southern California this fall," added Lynch.

The Enbryten Under ENBU Series can be custom configured online at <http://www.enbrytenLED.com> a Permlight brand with prices from \$50-75 depending on LED colour (offered in any color lighting), intensity, and dimming options.

Permlight, a premier provider of energy efficient LED lighting solutions, designs and manufactures LED Lighting Systems and power supplies for indoor and outdoor applications. With its patented thermal management technology, the company provides products that are rated as the brightest and most cost effective systems in the industry. Permlight's patented dispensing and peel and stick installation systems also make it the easiest system to install. More information may be obtained by visiting its website at <http://www.permlight.com>

**COMPETING TECHNOLOGIES: A key goal of developers of organic light emitting diode (OLED) materials is the combination of high efficiency, long lifetime and solution processability which permits scaling of the technology to large panel sizes by, for example, ink jet printing.**

Cambridge Display Technology (CDT) says it has made a significant step towards this goal with the announcement of excellent progress in development of its dendrimer technology. Using dendrimer-polymer hybrids, CDT reports solution-processed red devices with 250,000 hours lifetime from an initial luminance of 100 cd/m<sup>2</sup>. The previously announced lifetime for such a material was 150,000 hours in May 2005, and just 15,000 hours in 2004.

Efficiencies for these phosphorescent devices were measured at 5.6 cd/A, another significant improvement on previous performance, and an important factor in the production of displays with low power consumption. This progress combines the high efficiency of phosphorescent emitters with the lifetime performance associated with fluorescent materials.

WS: <http://www.cdtltd.co.uk/>

**MARKET REPORTS:** OIDA Executive Director Dr. Michael Lebbly shared the organization's vision for growth in the optoelectronics market and opportunities for start-ups at ECOC 2005, held September 25-29 in Glasgow, Scotland. In his presentation, Lebbly forecast strong growth in the area of consumer entertainment and computers. He also provided guidance to companies seeking venture capital support. "High brightness LEDs and image sensors displayed the greatest amount of growth in 2004, growing by 37% and 34% respectively," said Lebbly.

WS: <http://www.oida.org/pr101405.html>

**ON THE WEB: BLUE LEDS AID DENTISTS**—To help cut the incidence among dentists of carpal tunnel syndrome and related hand/wrist injuries, Rocky Mountain Orthodontics recently introduced an ergonomically advanced pistol grip blue LED curing light.

WS: <http://www.ergoweb.com/news/detail.cfm?id=1207>

**Silicones in LED Packaging:** Dow Corning Corporation will present a technical paper on the use of silicones in LED packaging applications during Intertech's Light Emitting Diodes 2005 Conference being held later this month in San Diego, Calif. As manufacturers look to develop brighter, hotter and longer-lasting LEDs, silicones are fast becoming the material of choice for LED applications, often replacing the use of epoxies or cyclo olefin copolymers (COCs).

WS: [http://www.commsdesign.com/press\\_releases/prnewswire/showPressRelease.jhtml?&CompanyId=1&HeadlineId=X378531](http://www.commsdesign.com/press_releases/prnewswire/showPressRelease.jhtml?&CompanyId=1&HeadlineId=X378531)

WS: <http://www.dowcorning.com/electronics>

CW GaN Laser Diodes Grown by MBE see: <http://www.photonics.com/spectra/tech/XQ/ASP/techid.1720/QX/read.htm>