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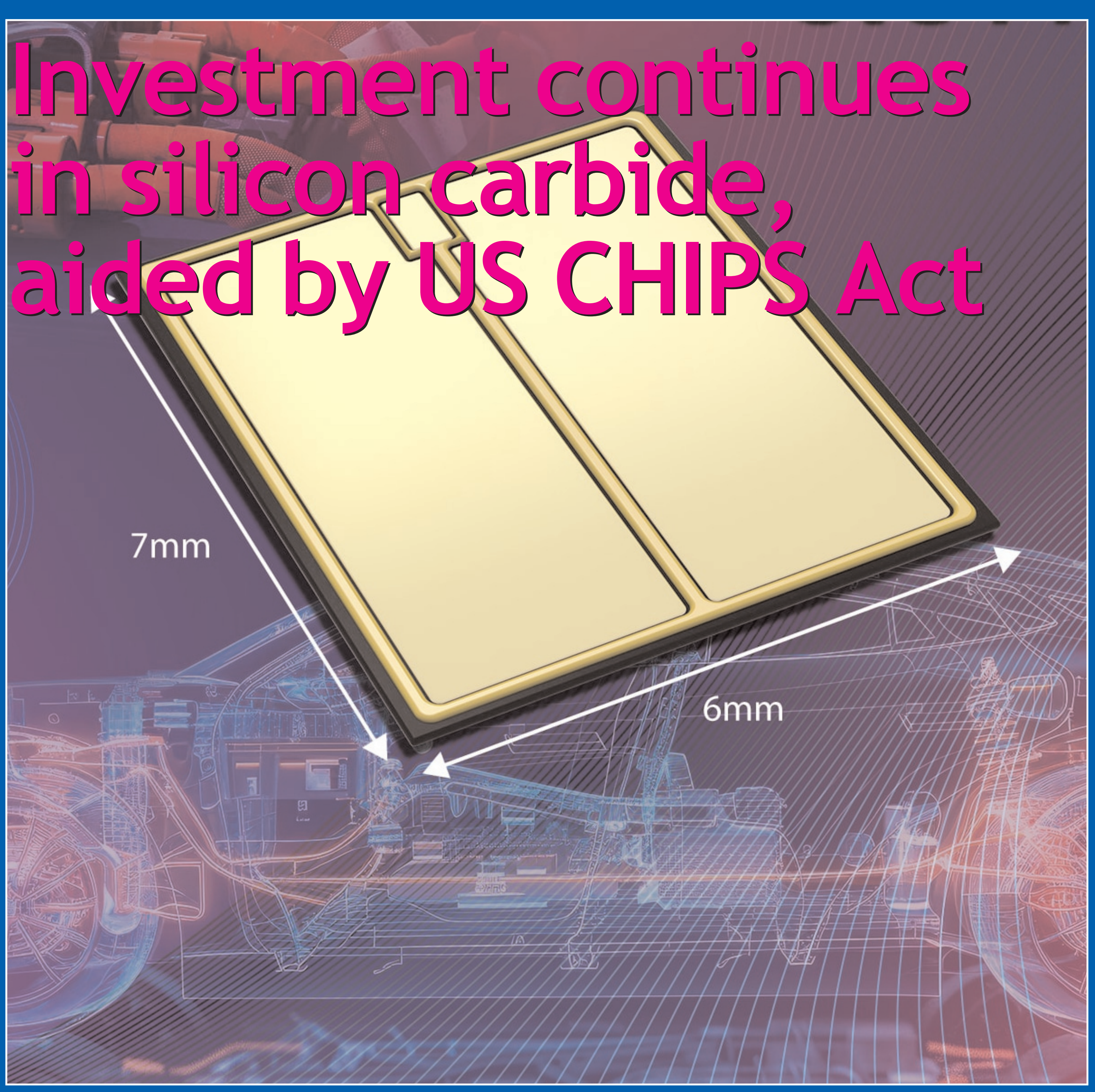

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IQE expanding in Greensboro • Aixtron opens Innovation Center

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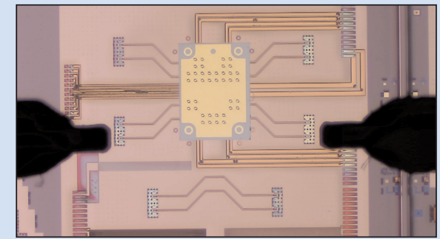
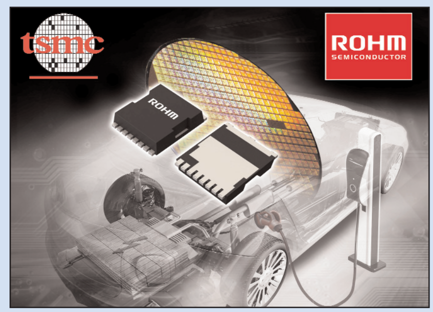
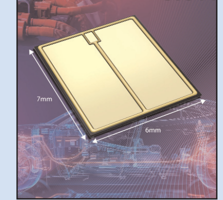


p17 Imec has integrated InP chiplet on a 300mm RF silicon interposer, yielding 0.1dB insertion loss at 140GHz.



p29 ROHM and TSMC are collaborating on the development and volume production of GaN power devices for electric vehicles.

p56 Aixtron's new Innovation Center has been opened by North Rhine-Westphalia's Minister for Economic Affairs.



Cover image: Toshiba has developed new 1200V SiC MOSFETs with a check pattern of embedded Schottky barrier diodes that delivers both low on-resistance and high reliability, suiting automotive applications such as traction inverters. **p21**

editorial

US CHIPS funding awards accelerate

Last month we summarized the funding awarded to semiconductor firms under the US CHIPS and Science Act since it was enacted in August 2022. Since then, nearing January's change in US Presidency, the announcement of awards has accelerated — both for new awardees and the finalization of existing awards after the completion of due diligence.

Apart from the leading-edge silicon manufacturers that account for most of the CHIPS Act's $39bn allocation, several compound semiconductor manufacturing operations have recently been assigned awards. Proposed in February but confirmed in late November, New York-based GlobalFoundries' $1.5bn funding covers not only the upgrade and expansion of silicon fabrication plants in Malta, NY, but also the creation of high-volume manufacturing of gallium nitride devices on 200mm silicon wafers at its modernized and upgraded fab in Essex Junction, Vermont (see page 32). In addition, US Department of Defense's Trusted Access Program Office has now awarded an extra $9.5m specifically for the GaN-on-Si project.

Also finalized (a year after its proposal) is a $35.5m CHIPS Act award to BAE Systems to modernize its DoD-accredited 150mm GaAs and GaN HEMT wafer foundry at its Microelectronics Center in Nashua, NH (page 12).

Meanwhile, MACOM is to lead a CHIPS Act-funded development project to establish GaN-on-SiC process technologies for RF & microwave applications (page 35). MACOM will work with North Carolina State University (NCSU), NCSU spin-off Adroit Materials Inc, and the US Naval Research Laboratory (NRL) as a member of the NCSU-led Commercial Leap-Ahead for Wide Bandgap Semiconductors (CLAWS) Microelectronics Commons Hub, which has just been awarded $23.7m as part of the extra $160m in CHIPS Act funding awarded to Microelectronics Commons Hubs (page 9).

Also, UK-based epiwafer foundry IQE has been assigned CHIPS Act funds supporting the $305m expansion at its plant in Greensboro, North Carolina, with existing MBE equipment for defense & aerospace applications to be joined by MOCVD equipment for EV-related applications (page 52).

Other new CHIPS Act awards include $33m for Coherent to expand its fab in Sherman, Texas to establish the first 150mm indium phosphide (InP) manufacturing line, and $50m for X-Fab to expand and modernize the USA's only silicon carbide (SiC) foundry, in Lubbock, Texas (see page 10). Also, automotive supplier Bosch has been allocated $225m in funding (plus a $350m loan) to support the $1.9bn conversion of its silicon fab in Roseville, California, to produce SiC power semiconductors, comprising over 40% of all US-based SiC device manufacturing capacity (page 18).

Apart from CHIPS Act funding, the US Department of Energy's Advanced Technology Vehicles Manufacturing (ATVM) Loan Program Office has now confirmed (after proposal in February) a $544m loan to SK Siltron CSS LLC of Auburn, MI (a subsidiary of South Korean wafer manufacturer SK Siltron) to expand US manufacturing of SiC wafers for EV power electronics (page 24).

Growth in the EV market has slowed recently, and Digitimes Asia notes that prices for SiC substrates have plunged as Chinese manufacturers have ramped up their capacity (see page 8). However, mid- to high-end Chinese EV makers continue to favour SiC devices from international IDMs, it adds. Also, demand for SiC devices is burgeoning for use in the AC-DC stage in power supply units of AI data-center infrastructure. So, regardless of any shifts in the EV market, investments in SiC manufacturing capacity are set to still have an expanding addressable market in other application sectors.

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***Semiconductor Today* covers the R&D and manufacturing of compound semiconductor and advanced silicon materials and devices** (e.g. GaAs, InP and SiGe wafers, chips and modules for microelectronic and optoelectronic devices such as RFICs, lasers and LEDs in wireless and optical communications, etc).

Regular issues contain:
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US Geological Survey reckons China ban on gallium and germanium exports could cost $3.4bn in US GDP

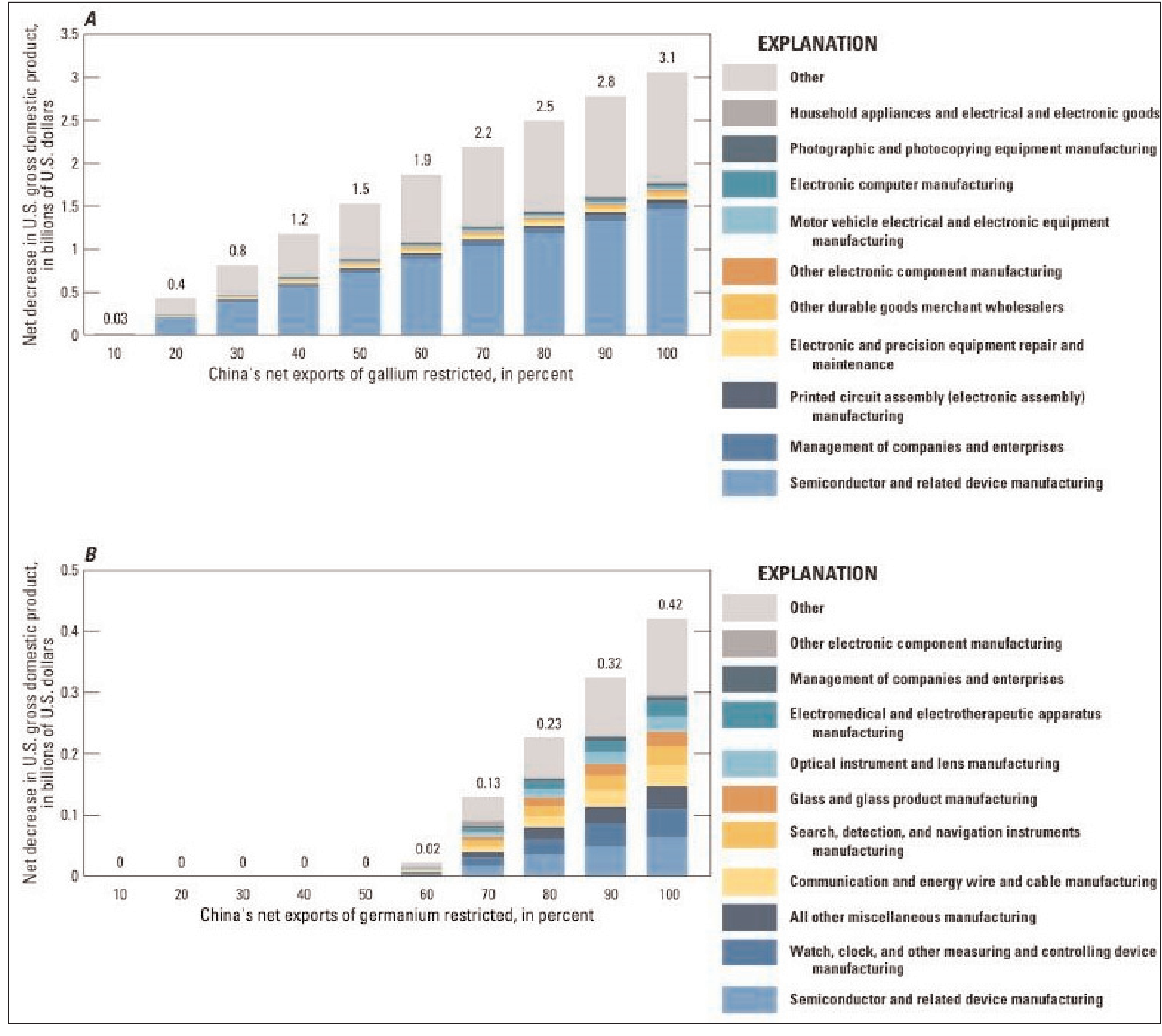
Total ban could raise prices of gallium by more than 150% and germanium by 26%

US Geological Survey (USGS) researchers have developed a new model to assess how disruptions of critical mineral supplies may affect the US economy. Using the model, the researchers estimate that there could be a $3.4bn decrease in US gross domestic product (GDP) if China implements a total ban on exports of gallium and germanium.

Export bans are a risk, given that China imposed export licensing controls on mineral commodities containing gallium and germanium in 2023, requiring state approval for all exports and establishing a pathway to progressive export restrictions, says the USGS. China is the leading producer and exporter of both minerals and the 2022 List of Critical Minerals showed that gallium had the highest supply risk of the minerals analyzed.

The new research paper 'Quantifying Potential Effects of China's Gallium and Germanium Export Restrictions' by Nedal Nassar and USGS colleagues estimates the impact of varying levels of Chinese export restrictions for either or both minerals on US GDP.

Economic losses to the US from decreased gallium and germanium imports would be concentrated in the semiconductor device manufacturing industry, which would account for more than 40% of the net loss. Additional losses would be spread across multiple industries including downstream producers dependent on semiconductors. Based on the results of the new model, gallium prices could rise by more than 150% and germanium prices by 26% in the case of a total



Estimated net decrease in US GDP at different levels of restrictions of China's net exports of A, gallium or B, germanium, by industry.

ban, but the decreased economic activity would be primarily driven by reduction in supplies.

"Losing access to critical minerals that make up a fraction of the value of products like semiconductors and LEDs can add up to billions of dollars in losses across the economy," notes lead author Nedal Nassar. "The USGS has the expertise and the responsibility to help assure access to minerals and supply chain resilience."

Another major driver of the impacts is the lack of significant production outside of China. "We do account for currently available production capacity outside of China and the short-term substitution potential," says Nassar. "Our model projects the impacts in the near term, and in many cases developing new supply sources or substitute materials takes far longer."

The estimates also help policy-makers and industry to make informed decisions on:

- maintaining or expanding stock-piles of gallium, germanium and other mineral commodities;
- investing in new plants to recover gallium and germanium from active and legacy mine waste; and
- investing in post-consumer recycling of e-waste to recover gallium and germanium from discarded products.

Through modeling studies like this one, the USGS says it is supporting supply chain resilience. The USGS provides scientific expertise and technical advice to numerous US government organizations, including the intelligence agencies, the National Defense Stockpile, the Federal Reserve Board, the US International Development Finance Corporation and the US Departments of Commerce, Defense, Energy, Homeland Security and State.

In addition to identifying mineral supply risks and projecting the impact of supply chain disruptions, the USGS, through its Mineral Resources Program, is the Federal government's primary provider of scientific information and research on mineral potential, production, consumption and interaction with the environment. This work includes developing the whole-of-government List of Critical Minerals, assessing the USA's mineral resource potential and, through the Earth Mapping Resources Initiative (Earth MRI), partnering with state geological surveys to modernize the USA's data and mapping of mineral resources.

https://pubs.usgs.gov/publication/ofr20241057

US Department of Energy announces $10m funding for Critical Materials Innovation Hub

Federal funding to accelerate early-stage technology R&D for critical materials including gallium

The US Department of Energy's (DOE's) Critical Materials Innovation Hub (CMI Hub) has announced up to $10m in federal funding to accelerate the early-stage technology R&D necessary to reduce material criticality for energy innovations requiring critical materials – rare-earth elements, gallium, and copper.

Founded in 2013, the CMI Hub (formerly the Critical Materials Institute) is a DOE Energy Innovation Hub led by Ames Laboratory focused on eliminating and reducing reliance on critical materials that are subject to supply disruptions and price fluctuations.

"The continued investment into innovative R&D critical materials projects is key to securing domestic, reliable and resilient supply chains," says Chris Saldaña, director of the DOE's Advanced Materials and Manufacturing Technologies Office. "DOE and the CMI Hub are putting a specific emphasis on industry partnerships to facilitate adoption and bring these solutions to market."

The request for proposals (RFP) solicits proposals for projects across the following topic areas:

- environmentally benign rare-earth metal and alloy production;
- efficient gallium byproduct recovery, separation and concentration;
- new compounds to reduce gallium content in gallium nitride semiconductors;
- improved processes for gallium semiconductor manufacturing that minimize waste generation;
- improved copper sulfide leaching to unlock copper resources from mine waste.

These topics are informed by the CMI Hub roadmap and represent complementary research areas to the existing CMI Hub project portfolio. The selected projects will bring new membership to the CMI Hub, expanding focus and expertise on gallium, which is used to manufacture LED light bulbs, communications chips in smartphones, and high-efficiency power supplies. Other projects will explore new research areas related to copper, which is essential for renewable energy, energy storage, and electric vehicles, and expand the CMI Hub's long-standing efforts on rare-earth elements.

Concept papers were due by 20 December. The Hub anticipates making up to eight awards, with all projects receiving a maximum of $1.5m in federal funds including a required 20% cost share for funds that go to industry partners. Projects will have a period of performance of up to 30 months.

www.energy.gov/eere/ammto/critical-materials-innovation-hub-cmi
www.ameslab.gov/cmi/rfp2024

Silicon carbide prices plunge as Chinese silicon carbide manufacturing capacity ramps

...but mid- to high-end Chinese EVs continue to favor silicon carbide components from international IDMs

Silicon carbide (SiC) once thrived amid substrate shortages. However, according to DIGITIMES Asia, 2024 saw a significant shift where Chinese manufacturers dramatically ramped up production, resulting in a collapse of prices for mainstream 6-inch substrates and a steep decline in 8-inch prices.

China holds a dominant position in the two major application areas for SiC — electric vehicles (EVs) and solar panels. The Chinese government is aggressively pursuing semiconductor self-sufficiency, raising concerns about the future viability of non-Chinese systems, says DIGITIMES Asia. Taiwanese companies, which have been slower to develop, may navigate this crisis of excess SiC material, but they face a mixture of opportunities and challenges, particularly with the looming threat of large-scale, low-cost competition from China.

Doris Hsu, chairperson of Sino-American Silicon Products (SAS) and GlobalWafers, admitted that the changes in the SiC industry this year were unexpected, particularly due to substantial capacity increases from Chinese manufacturers driving prices to unprecedented lows.

Hsu analyzed the landscape through two lenses: geopolitics and the characteristics of the SiC industry. She believes that this is a pivotal moment for Taiwanese manufacturing to assert its advantages. Geopolitically, the USA, Europe and Japan are actively seeking to reduce reliance on Chinese suppliers, making it less likely that SiC will follow the trajectory of solar energy. These regions are looking for allies to create a more balanced ecosystem, and they see potential in Taiwan, she adds.

Taiwanese companies have stable quality and reliability, and their established presence in silicon-based semiconductor markets is well-recognized globally. The manufacturing standards seen in these sectors can be applied to SiC, it is reckoned. In terms of product performance and cost-effectiveness, Taiwanese firms generally outshine their European, American, and Japanese counterparts, though the latter maintain advantages in specific applications, suggesting a complementary approach could yield optimal results, the report states.

From an industrial perspective, Hsu emphasized that the SiC sector differs from solar energy and LED sapphire. In solar modules, if one cell malfunctions, the remaining cells can still function, resulting in reduced power output. Conversely, SiC primarily serves medium- to high-voltage power demands, making its role crucial as power grids adjust to increasingly volatile electricity inputs. Safety is paramount in automotive applications, and any compromises are unacceptable. Errors in industrial-grade power networks can lead to significant economic losses from sudden outages, while automotive standards prioritize driver and pedestrian safety, exposing tier-1 suppliers and automakers to substantial liabilities.

Consequently, many mid- to high-end Chinese EVs continue to favor SiC components from international integrated device manufacturers (IDMs), even while adhering to government policies. These manufacturers must prioritize safety and reliability, requiring effective testing and validation before incorporating SiC components into vehicles. No auto-maker or utility would willingly accept the substantial risks associated with a single SiC component threatening their operations.

In summary, says DIGITIMES Asia, the SiC industry must focus not only on material prices but also on meeting customer expectations for quality and reliability. Currently, SiC substrates are experiencing temporary irrational low prices due to supply-demand imbalances. Despite this, Hsu recognizes the scale and cost-competitive strengths of Chinese SiC manufacturers, predicting that other supply chains, including Taiwan's, will struggle to match their cost-effectiveness. As SiC substrate prices continue to fall, the range of application sectors is set to expand, moving beyond just electric vehicles and solar modules, it concludes.

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US Microelectronics Commons Hubs gain extra $160m in CHIPS Act funding

Commercial Leap Ahead for Wide Bandgap Semiconductors (CLAWS) Hub gets $23.7m

The US Department of Defense (DoD) has invested an additional $160m of funds from the Biden–Harris Administration's 'Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act' to advance US microelectronics capabilities through the Microelectronics Commons, a collaborative national network of technology hubs.

Following the award in September of $269m for 33 new technical projects and the award of just under $240m released a year previously to initially launch the eight hubs, the latest funding in October represents a milestone for the CHIPS Act's mission to strengthen the USA's global leadership in microelectronics and semiconductor manufacturing.

Focused on building infrastructure, supporting operations, and accelerating workforce development across the eight established hubs, the bulk of the new funding in this latest tranche of $148m will go directly to the Microelectronics Commons Hubs, comprising:

- $18.7m for the Northeast Microelectronics Coalition (NEMC) Hub, led by the Massachusetts Technology Collaborative.
- $16.6m for the Silicon Crossroads Microelectronics Commons (SCMC) Hub, led by the Applied Research Institute in Indiana.
- $27m for the California Defense Ready Electronics and Microdevices Superhub (CA DREAMS) Hub, led by the University of Southern California.
- $23.7m for the Commercial Leap Ahead for Wide Bandgap Semiconductors (CLAWS) Hub, led by the North Carolina State University.
- $18.7m for the Southwest Advanced Prototyping (SWAP) Hub, led by the Arizona Board of Regents on behalf of Arizona State University.
- $12.3m for the Midwest Microelectronics Consortium (MEMC) Hub in Ohio.
- $10.6m for the Northeast Regional Defense Technology (NORDTECH) Hub, led by the Research Foundation for the State University of New York (SUNY).
- $15.3m for the California–Pacific-Northwest AI Hardware Hub (NWAI), led by the Board of Trustees of the Leland Stanford Junior University in California.

An additional $10m will support a Cross-Hub Enablement Solution (CHES), enhancing shared access to critical electronic design automation (EDA) tools and cloud computing resources. October's funding also included the latest addition to the Commons prototype project list, a $2m project aligned to the SCMC Hub that came through after final negotiations with project team members.

"America's military systems are the most capable in the world, and that would not be possible without advanced semiconductor technology," says Dr Arati Prabhakar, assistant to the President for Science and Technology and director of the White House Office of Science and Technology Policy. "Thanks to President Biden and Vice President Harris' leadership, we're making the semiconductor innovation investments today that will bolster global security tomorrow."

"Semiconductors are key to the must-win technologies of the future for next generation weapons systems, including artificial intelligence and 5G," says Dr Dev Shenoy, principal director of microelectronics for the Department of Defense. "These technologies will be essential to achieving the goal of a dynamic, inclusive, and innovative national economy identified as a critical American advantage."

The Microelectronics Commons network also convened its 2024 Annual Meeting and National Semiconductor Technology Center (NSTC) Symposium from 28-–0 October in Washington DC, gathering 1000 in-person attendees and over 1000 virtual participants. Deputy Secretary of Defense Kathleen H. Hicks, who delivered the keynote address, praised the network's collaborative approach, noting, "Chips bring America together".

Throughout the event, leaders of the Microelectronics Commons provided updates on their Hubs' progress, discussing first-year achievements, prototype projects, and workforce development initiatives. Discussions underscored the importance of ongoing investments in lab-to-fab pathways — initiatives that streamline the transition from research laboratories to semiconductor fabrication facilities.

"The Microelectronics Commons aims to enable lab-to-fab prototyping, evolving microelectronics laboratory prototyping to fabrication prototyping in domestic facilities," says Shenoy. "More specifically, the goal is a national network of regional innovation hubs distributed across the US that will foster a pipeline of domestic talent and innovative ideas, reduce barriers to innovation, and mature emerging microelectronics technologies."

The CHIPS and Science Act and the Microelectronics Commons program represent a monumental investment in the US semiconductor industry. As the Commons network gains momentum, stakeholders are optimistic about America's potential to lead in an era where advanced microelectronics and resilient supply chains are critical to national security.

www.microelectronicscommons.org

Coherent, SkyWater and X-Fab all agree preliminary terms for US CHIPS Act funding

Funding to enhance indium phosphide, silicon and silicon carbide production in Minnesota and Texas

The US Department of Commerce has signed three separate preliminary memoranda of terms (PMT) under the CHIPS and Science Act to provide proposed direct funding of the following projects:

- Coherent (Sherman, Texas): up to $33m for the modernization and expansion of a manufacturing cleanroom in Coherent's existing 700,000ft2 facility in Sherman, Texas to establish the world's first 150mm indium phosphide (InP) manufacturing line by adding advanced wafer fabrication equipment for large-scale production of InP optoelectronic devices, for applications such as datacom and telecom transceivers (including for AI infrastructure), advanced sensing for consumer electronics, and medical and automotive applications. Increased production of Coherent's InP devices, which are increasingly growing in demand, would allow the US to advance supply chain resiliency and technological leadership and create about 70 jobs.
- SkyWater Technology Foundry Inc (Bloomington, Minnesota): up to $16m for the modernization of its existing facility in Bloomington, Minnesota to improve the quality of production and wafer services by replacing equipment, upgrading the facility's cleanroom and space and IT systems, and to increase overall production capacity of 90nm and 130nm wafers by about 30%. The facility enables aerospace & defense, automotive, biomedical and industrial customers to prototype and scale differentiated technology to volume production. As the firm is a US Department of Defense (DoD) Trusted Foundry; the funding would enable it to improve productivity and enhance operational sustainability to support DoD missions as well as grow its commercial business. The investment would build on the firm's 40-year history in Bloomington and is expected to create about 70 jobs. SkyWater's community workforce development efforts include its ongoing partnership with Hennepin Technical College, Greater Minneapolis Saint Paul Regional Economic Development Partnership, and the University of Minnesota Twin Cities and working with the Minnesota CHIPS coalition to support its short- and long-term workforce development goals. In addition, the State of Minnesota's Forward Fund would provide $19m in dedicated funding to support the proposed project.
- X-Fab (Lubbock, Texas): up to $50m for the expansion and modernization of what is the only high-volume Silicon Carbide (SiC) foundry in the USA. The proposed funding would bolster supply resiliency for critical infrastructure markets that were adversely impacted by foundry capacity shortages and supply chain disruptions during the COVID-19 pandemic. The proposed terms provide support for workforce development efforts including X-Fab's existing partnerships with Texas Tech College of Engineering, South Plains College, Western Technical College, Lubbock Area United Way, SEMI Foundation, and the Lubbock Economic Development Alliance. The investment would create an estimated 150 jobs.

The demand for silicon carbide technologies will be strong for the long term, and we are proud to provide solutions that support the transition to electric mobility and renewable energy sources. The proposed CHIPS funding will support the future success of X-FAB Texas and will contribute to the establishment of a domestic supply chain for silicon carbide

"The demand for silicon carbide technologies will be strong for the long term, and we are proud to provide solutions that support the transition to electric mobility and renewable energy sources," says X-FAB Texas' CEO Rico Tillner. "The proposed CHIPS funding will support the future success of X-FAB Texas and will contribute to the establishment of a domestic supply chain for silicon carbide."

Coherent, SkyWater and X-Fab all plan to claim the Department of the Treasury's Advanced Manufacturing Investment Credit (CHIPS ITC), which is 25% of qualified capital expenditures.

As was explained in its first Notice of Funding Opportunity, the Department of Commerce may offer applicants a PMT on a non-binding basis after satisfactory completion of the merit review of a full application. The PMT outlines key terms for a potential CHIPS incentives award, including the amount and form of the award. The award amounts are subject to due diligence and negotiation of award documents and are conditional on the achievement of certain milestones. After a PMT is signed, the Department of Commerce begins a comprehensive due diligence process on the proposed projects and continues negotiating or refining certain terms with the applicant.

www.chips.gov
www.commerce.gov/bureaus-and-offices/nist

X-FAB launches next-gen silicon carbide process platform for power MOSFET designs

Streamlined SiC processes for faster custom MOSFET development

As its next-generation XbloX platform, analog/mixed-signal, MEMS and specialty foundry X-FAB Silicon Foundries SE of Tessenderlo, Belgium has launched XSICM03 (available now for early access), advancing silicon carbide (SiC) process technology for power metal-oxide-semiconductor field-effect transistors (MOSFETs). A significantly reduced cell pitch enables increased die per wafer and improved on-state resistance without compromising reliability, the firm says.

XbloX is X-FAB's streamlined business process and technology platform designed to accelerate the development of advanced SiC MOSFET technology. It integrates qualified SiC process development blocks and modules for planar MOSFET production, simplifying the onboarding process and significantly reducing design risks and product development time. By combining proven process modules with robust design rules, control plans and failure mode and effects analysis (FMEAs), XbloX is said to enable faster prototyping, easier design evaluation, and shorter time to market. This approach is claimed to give customers a competitive edge, allowing designers to create a diverse product portfolio while achieving production timelines up to nine months faster than traditional development methods.

The next-generation platform provides active area design cell size reduction while maintaining robust process controls, as well as leakage and breakdown device performance. The XSICM03 platform with robust design rules allows customers to create SiC planar MOSFETs with a cell pitch that is over 25% smaller than the previous generation, increasing the die per wafer by up to 30%. Leveraging proven process blocks, the platform is said to ensure exceptional gate oxide reliability and device robustness. The enriched PCM library and enhanced design support allow fast customer tape-out, resulting in faster product development.

"With its streamlined approach, our next-generation process platform addresses the increasing demand for high-performance SiC devices in automotive, industrial and energy applications," notes Rico Tillner, CEO of X-FAB Texas. "We enable existing and new customers in creating application-optimized product portfolios through accelerated prototyping and design evaluation, significantly reducing time to market."

www.xfab.com

US CHIPS Incentives Program award finalized for BAE

$35.5m in New Hampshire to expand production of chips critical for US national security

After completing due diligence, the US Department of Commerce has finalized a direct funding award under the CHIPS Incentives Program's Funding Opportunity for Commercial Fabrication Facilities (following the preliminary memoranda of terms, announced on 11 December 2023) of up to $35.5m for BAE Systems Electronic Systems (a business unit of BAE Systems Inc, which develops and services electric propulsion technology at its facilities in Endicott, NY, USA and Rochester, UK).

The funds support modernization of its 110,000ft^2 Microelectronics Center (MEC) in Nashua, New Hampshire. This is one of few US-based defense-centric six-inch gallium arsenide (GaAs) and gallium nitride (GaN) high-electron-mobility transistor (HEMT) wafer foundries and is also accredited by the USA's Department of Defense (DoD), developing semiconductor technologies beyond those available commercially in order to meet demanding military requirements. The CHIPS funding will enable the firm to quadruple its production capacity for monolithic microwave integrated circuit (MMIC) chips (which are critical components for advanced military aircraft and commercial satellite systems) and replace aging tools with the latest technology and equipment (mitigating the risk of an operational disruption). The investment will also cut the firm's modernization timeline in half, bolstering the facility's ability to serve mission-critical defense programs.

"From satellites in space to defense systems on the ground, our most advanced defense and commercial technology rely on mature-node and compound semiconductors to operate," says Under Secretary of Commerce for Standards and Technology and National Institute of Standards and Technology director Laurie E. Locascio. "By finalizing these awards, we are strengthening America's domestic semiconductor supply chain resilience and broadening our manufacturing capabilities."

"America's space and military systems are the most capable in the world, and that would not be possible without advanced semiconductor technology," says Arati Prabhakar, assistant to the President for Science and Technology and director of the White House Office of Science and Technology Policy. "We're making the semiconductor supply chain investments today that will bolster American global competitiveness and security tomorrow," she adds.

"This investment marks a significant step forward for the modernization of our Microelectronics Center, enhancing our national security," comments Cheryl Paradis, VP & general manager of FAST Labs at BAE Systems Inc. "We remain committed to driving innovation, developing a highly skilled workforce, and ensuring that the US maintains its edge in the critical aerospace and defense industry," she adds.

As stated in the CHIPS Notice of Funding Opportunity for Commercial Fabrication Facilities, CHIPS for America is disbursing direct funding to recipients for capital expenditures based on the completion of project construction, production and commercial milestones. The program will track the performance of each CHIPS Incentives Award via financial and programmatic reports, in accordance with the award terms and conditions.

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Soitec and GlobalFoundries partner on RF-SOI production

GF's 9SW platform to use Soitec's latest-generation 300mm RF-SOI

Engineered substrate manufacturer Soitec of Bernin, near Grenoble, France has committed to deliver 300mm radio frequency silicon-on-insulator (RF-SOI) substrates to New York-headquartered GlobalFoundries (GF, which has manufacturing plants in the USA, Europe and Singapore) for the production of GF's RF-SOI technology platforms, including its most advanced RF solution 9SW.

Building on the longstanding relationship between the two companies, this commitment should ensure the supply of RF-SOI engineered substrates required for 5G, 5G-Advanced, Wi-Fi, and other smart mobile device radio frequency front-end (RFFE) modules.

To support advanced connectivity, GF's 9SW RF-SOI platform —with what are claimed to be superior switching, low-noise amplifiers (LNAs) and logic processing capabilities — offers what are said to be significant advantages and value for premium smartphones by delivering enhanced RF performance, improved power efficiency and scalability. These features are critical for high-end devices.

Soitec says that its new RF-SOI 300mm substrate offers advances including: reduced off-capacitance due to optimized silicon thickness, enhanced and sustained power efficiency enabled by an optimized oxide layer, and superior RF performance made possible by Soitec's RFeSI product family.

Manufactured using Soitec's latest-generation 300mm RF-SOI wafers, GF's 9SW platform delivers significant reduction in active and standby power consumption and enables 10% smaller products than previous platforms, for an efficiency enhancement of more than 20% through lower on-resistance and off-capacitance figures of merit.

"GF continues to deliver highly differentiated, industry-leading technologies required for essential 5G, IoT, infrastructure and automotive applications," says Faisal Saleem, senior VP of End Markets at GlobalFoundries. "This collaboration with Soitec shows our commitment to ensure a continuous supply of high-performance RF-SOI solutions that meet our customers' fast-evolving needs" he adds.

"Soitec has established the world's largest production capacity to meet growing demand for advanced RF-SOI substrates supporting 5G and WiFi technologies in smartphones, as well as future AR-VR and IoT devices," says Jean-Marc Le Meil, Soitec's executive VP for Mobile Communications. "We are delighted to extend our longstanding relationship with GlobalFoundries in developing the next generation of 300mm RF-SOI technologies. The transition from 5G to 5G-Advanced, and eventually 6G, requires ever-higher performance and energy efficiency, as well as increasing compactness for next-generation devices," he adds.

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Qorvo quarterly revenue falls 5% year-on-year as Android smartphone mix shifts from mid- to entry-tier

Advanced Cellular Group focuses on flagship and premium tiers, while Connectivity & Sensors Group and High-Performance Analog offer strongest growth

For its fiscal second-quarter 2025 (ended 28 September 2024), Qorvo Inc of Greensboro, NC, USA (which provides core technologies and RF solutions for mobile, infrastructure and defense applications) has reported revenue of $1046.5m. This is down 5.2% on $1103.5m a year ago due mainly to a hiatus in Android smartphone revenues, following ramps in first-half calendar 2024 for key models including both Samsung's S24 (involving over $5 of content) and Google's Pixel ($15 of content). However, revenue has rebounded by 18% from $886.7m last quarter. It also exceeds the $1025m guidance, driven by double-digit sequential growth in all three operating segments.

By business segment, revenue comprised:

- **Advanced Cellular Group (ACG)** $751.4m, down 11.6% on $850.1m a year ago but up 17% on last quarter's $642.3m, as Qorvo supported the seasonal smartphone ramp at its largest customer;
- **Connectivity & Sensors Group (CSG)** $146.8m, up 27.8% on $114.9m last quarter and 41.7% on $103.6m a year ago;
- **High-Performance Analog (HPA)** $148.3m, down 1% on $149.8m a year ago but up 14.5% on last quarter's $129.5m.

HPA plus CSG represented about 28% of total revenue, up sequentially and up from 23% a year ago. "In HPA, we continued to expand our defense & aerospace (D&A) business while building a broad-based business in power management. In CSG, we maintained our leadership in Wi-Fi applications while investing to grow in diverse growth businesses including an expanding portfolio of automotive solutions and SoCs for ultra-wideband and Matter," says president & CEO Bob Bruggeworth.

On a non-GAAP basis, gross margin was 47%, down from 47.6% a year ago but up from 40.9% last quarter (which is expected to be the low point in fiscal 2025), and at the high-end of the 46–47% guidance range. This is due mainly to the product mix (since inventories of low-margin, higher-cost Android 5G mass-market product — manufactured during periods of lower utilization — have now sold through) but is also aided by the impact of under-utilization halving from last quarter to about 100 basis points (then becoming negligible for the second half of fiscal 2025).

"The September quarter and, to a lesser degree, December quarter will benefit from a higher mix of customized solutions for flagship-tier phones," says chief financial officer Grant Brown. "That product mix generally includes a higher amount of externally sourced silicon and SOI [silicon-on-insulator] content. It is not impacted by internal utilization levels," he adds. "That compares to our prior two quarters where revenue was comprised of a larger mix of high-cost standard products that were burdened by prior periods of under-utilization."

Driven mainly by R&D expenses rising from $163.4m a year ago and $174.9m last quarter to $187.6m, total operating expenses have risen further, from $245.8m a year ago and $264.5m last quarter to $279.8m (above the expected $275m). However, this includes about $7m of spend associated with Qorvo's digital transformation project (a three-year initiative to modernize the firm's core systems and business processes, to increase operational efficiency, unlock internal data to leverage new software capabilities including AI, and support broad-based growth objectives in diverse dynamic markets).

Net income is down year-on-year still, from $235.5m ($2.39 per diluted share) a year ago, but has rebounded by more than doubling from $83.5m ($0.87 per diluted share) last quarter to $179.8m ($1.88 per diluted share, above the midpoint of the $1.75–1.95 guidance range).

"We exceeded the midpoint of guidance in revenue, gross margin and EPS," summarizes Brown.

Operating cash flow has rebounded from $81.1m last quarter to $127.8m. Capital expenditure has been cut from $38.2m to $33m. Free cash flow has hence more than doubled from $42.9m to $94.8m. Also during the quarter, Qorvo repurchased about $81m of stock at an average price of $110 per share. Cash and equivalents hence rose by $14.1m, from $1082.4bn to $1096.5m.

Long-term debt remains about $1549m About $412m of 2024 notes remain outstanding, which Qorvo expects to retire in December.

After supporting the seasonal ramp at its largest customer last quarter, Qorvo ended the quarter with a net inventory balance of $694m (the lowest in three years, reflecting ongoing inventory reduction efforts), down by $32m sequentially and by more than $145m year-on-year.

For fiscal third-quarter 2025 (to end-December 2024), Qorvo expects revenue to fall back to $900m±$25m. Gross margin should fall sequentially to about 45% (although this will be up year-on-year, despite revenue being lower). Operating expenses are expected to be reduced to about

$265m. This includes about $15m for Qorvo's digital transformation project (although the total for full-year fiscal 2025 is still expected to be about $40m). Diluted earnings per share should fall to $1.10–1.30.

"The Android dynamic is having an impact on us as we intentionally pivot away from the entry-tier areas that are more margin compressed and focus ourselves on the higher tiers and the areas of the mid-tiers where we see the most value for us and our customers," says Brown.

CSG will also be down quarter-over-quarter, but this just matches the seasonality of the last three years because of the profile of the largest customer.

March-quarter company revenue is expected to fall seasonally by 5–10% sequentially, but this is driven by the more-than-seasonal decline in ACG, counteracting sequential growth in both HPA and CSG. In particular, HPA is expected to grow substantially, driven by record design activity and billings.

"HPA and CSG are on pace to achieve mid-teen year-over-year growth in fiscal 2025," says Bruggeworth. "In HPA, we're investing to grow in defense & aerospace and power management. In CSG, our growth investments are focused on automotive, next-gen Wi-Fi and Matter and ultra-wideband SoCs," he adds.

However, overall full-year fiscal 2025 revenue and gross margin are expected to be slightly down on fiscal 2024 (by a few percentage points or so) due mainly to two factors affecting smartphone business.

"ACG's product roadmap is focused primarily on 5G advanced products for our largest customer [Apple] and the flagship and premium tiers of our Android customers. Our growth opportunity and the flagship remains strong," says Bruggeworth. "Our largest opportunity in ACG is with our largest customer. They represent over half of the smartphone RF TAM [total addressable market] and we are investing today to grow our share with them next year and in subsequent programs over multiple years. While challenging in the near-term, this dynamic reinforces ACG's primary strategy of investing to grow our business at our largest customer," he adds.

Initiatives to drive continuous improvement in product development, semiconductor device design, process engineering, factory planning and manufacturing efficiency

"In the near-term, the flagship and premium tiers are holding up well, but there are some unfavorable trends there in some of the variables like unit volumes, content by model, ramp profiles and other variables, across all of our customers in that tier," says Brown. "At our largest Android customer, our revenue in their highest-volume Fall models is less than it was last year and less than the design wins that we're actually looking at in the Spring launch. We do expect a low-single-digit decline in revenue there for that confluence of variables," he adds. "We remain actively engaged with our Android customers for highly integrated modules where they deliver the most value and differentiation."

Additionally, in the mass-market segment of Android smartphones, the mix has shifted away from mid-tier models (which used to be about half of the total Android 5G volumes but has declined over the last few quarters to less than a third) and towards entry-tier models (where higher price sensitivity, given competition from discrete solutions, is reducing the total addressable market and revenue opportunity as Qorvo maintains price discipline in that sub-segment).

"These factors are expected to impact our revenue and margins in the second half of fiscal 2025 and into early fiscal 2026," Brown says.

"We don't expect this mix shift in Android 5G mass market from mid-tier to entry-tier to reverse… This will pressure revenue, factory volumes and utilization into next fiscal year," says Brown. This will be only partially offset by margin-accretive drivers such as strength in highly customized placements for flagship smartphones as well as D&A and other highly differentiated product areas that enhance our business mix, he reckons.

"As a result, we are taking appropriate actions, including factory consolidation and operating expense reductions, as well as focusing on opportunities that align with our long-term profitability objectives," Brown says.

Transferring GaAs production from North Carolina fab to Oregon

"We have highlighted multiple initiatives to drive continuous improvement in product development, semiconductor device design, process engineering, factory planning and manufacturing efficiency. The transition to 8-inch BAW [bulk acoustic wave filter] is a noteworthy example that unlocked effective capacity within the same factory footprint," says Brown. "Furthermore, we have reduced capital intensity through the divestment or consolidation of multiple production facilities, including our [China] Beijing and Dezhou test & assembly locations and our fabs in Farmers Branch, Texas and Apopka, Florida," he adds.

"To further optimize our internal factory footprint, we are transferring all gallium arsenide (GaAs) production from our North Carolina fab to our Oregon fab. Currently, our North Carolina fab is a dual-use facility that manufactures wafers for both GaAs amplifiers and SAW [surface acoustic wave] filters. As we transfer GaAs production to Oregon, we are working closely with customers to manage end-of-life GaAs products built in North Carolina," says Brown.

"Our North Carolina fab will continue to manufacture SAW filter wafers, including our latest LRT [low-loss resonator technology] SAW technology. The transfer of our GaAs production to Oregon will make room for anticipated SAW filter

growth in North Carolina. This is a further example of the proactive steps we are taking and continue to evaluate in order to streamline operations and improve gross margin."

Silicon carbide business to be divested

"During the quarter, we made the decision to evaluate strategic alternatives for our silicon carbide business," says Brown. "Our highly experienced team has made considerable strides in advancing the JFET silicon carbide technology. We believe an owner who is strategically focused on this business and can leverage pre-existing sales and support overhead will be able to create more value with the asset," he adds. "For Qorvo, exiting the silicon carbide market will allow us to reduce operating expenses and avoid the capital expenditures necessary to remain engaged. The business remains and will continue to remain included in our financial non-GAAP guidance until a definitive course of action has been determined."

Beyond fiscal 2025: 50%-plus long-term gross margin still targeted

"Beyond this fiscal year, we expect HPA and CSG will continue to benefit from the intersection of multi-year secular growth opportunities with our technology capabilities and product portfolios," says Brown. "By segment, our growth targets are strong double-digit growth for CSG, and double-digit growth for HPA," he adds.

"In terms of diversification, our long-term objective is to generate 50% or more of total revenue from HPA plus CSG [boosting margins]," continues Brown.

For ACG, mid to high single-digit revenue growth is expected. "We continue to be enthusiastic about the breadth of our opportunities at our largest customer [Apple] and we're engaged on more programs today than ever in investing to increase our content. So we're competing for products that we've supplied before and some placements that are new for us," notes Brown.

"On gross margin in the December and March quarters and into early fiscal 2026, we do expect to see the headwind associated with the mix shift and the entry tier for those Android devices. It will cause the utilization and gross margin to come down a bit versus our prior comments," warns Brown. However, China-based Android revenue is now under $100m (down by over 75% from the peak, with Android revenue in general down 50%) and is expected to trend lower during fiscal 2026, so exposure to that has diminished. There is hence no change to the guidance given at the firm's Investor Day in mid-June of about 50%-plus long-term gross margin.

www.qorvo.com

onsemi acquiring Qorvo's United Silicon Carbide subsidiary and SiC JFET technology for $115m

Acquisition to enhance power portfolio for AI data centers, expanding market opportunity by $1.3bn within five years

onsemi of Scottsdale, AZ, USA has agreed to acquire the silicon carbide junction field-effect transistor (SiC JFET) technology business, including the United Silicon Carbide subsidiary of Qorvo Inc of Greensboro, NC, USA (which provides core technologies and RF solutions for mobile, infrastructure and defense applications) for $115m in cash.

Qorvo announced its intention to divest its silicon carbide in early November, saying: "An owner who is strategically focused on this business and can leverage pre-existing sales and support overhead will be able to create more value with the asset… Exiting the silicon carbide market will allow us to reduce operating expenses and avoid the capital expenditures necessary to remain engaged".

The acquisition will complement onsemi's EliteSiC power portfolio and enable the firm to address the need for high energy efficiency and power density in the AC–DC stage in power supply units for AI data centers. Additionally, onsemi expects the acquisition to accelerate its readiness for emerging markets such as electric vehicle (EV) battery disconnects and solid-state circuit breakers (SSCBs).

SiC JFETs offer the lowest on-resistance per chip area, using less than half of any other technology, it is reckoned. They also allow for the use of typical off-the-shelf drivers, which have been deployed with silicon-based transistors for decades. Together, these benefits result in faster development, reduced energy consumption and lower system costs, providing significant value to power supply designers and data-center operators, onsemi says.

"As AI workloads become more complex and energy-intensive, the importance of reliable SiC JFETs that deliver high energy efficiency and are able to handle high voltages will continue to increase," says Simon Keeton, group president & general manager of the Power Solutions Group at onsemi. "With the addition of Qorvo's industry-leading SiC JFET technology, our intelligent power portfolio offers our customers yet another solution to optimize energy consumption and increase power density."

The transaction is subject to customary closing conditions and is expected to be finalized in first-quarter 2025.

www.qorvo.com
www.onsemi.com

Imec integrates InP chiplet on 300mm RF silicon interposer, yielding 0.1dB insertion loss at 140GHz

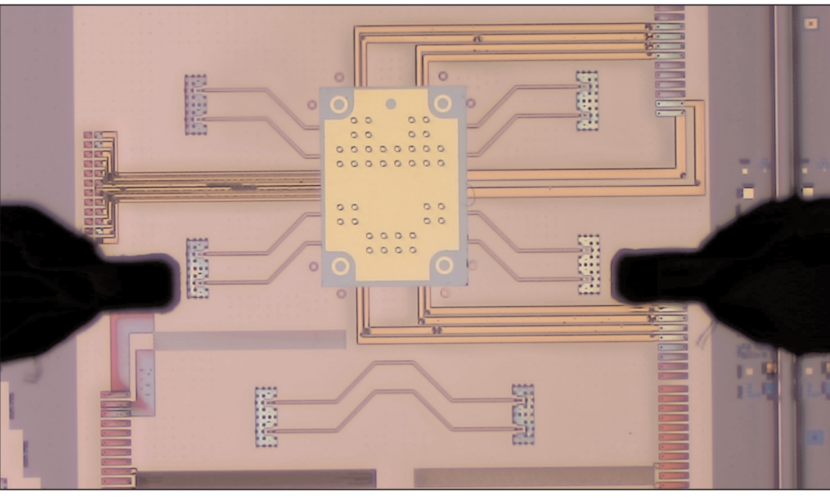
RF silicon interposer technology used to combine III–V chiplets with silicon-based wafer-scale packaging for cost-effective mmWave communication and sensing

At the 70th annual IEEE International Electron Devices Meeting (IEDM 2024) in San Francisco, CA, USA (7–11 December), nanoelectronics research center imec of Leuven, Belgium has presented results on the heterointegration of indium phosphide (InP) chiplets on a 300mm RF silicon interposer. The chiplets' integration comes with a negligible 0.1dB insertion loss at 140GHz. In addition, no performance degradation is observed upon assembly of a two-stage InP power amplifier (PA). As the first to achieve this, imec claims that its findings mark a milestone in developing compact, energy-efficient modules for above-100GHz communication and radar sensing.

To meet the demand for faster data transfer, increased bandwidth and advanced imaging, next-generation communication and (radar) sensing systems must use higher frequency bands, notes imec. This shift requires compact, cost-optimized and energy-efficient components that operate at higher speeds and deliver more output power than current technologies.

Imec sees heterogeneous III–V/Si-CMOS technology as a promising path forward, with InP showing particular potential due to its high gain and power efficiency at mmWave and sub-THz frequencies. However, existing InP technology has several drawbacks, such as the use of small-sized wafers and processing via electron-beam lithography, while a large portion of the design area is occupied by passives and gold-based backends, limiting InP's application to niche markets.

"By using InP only where its unmatched performance is essential, imec is paving the way toward scalable, cost-effective mmWave and sub-THz solutions," imec's Siddhartha Sinha, principal member of technical staff. "This is where a chiplet approach becomes essential."



Insertion loss of 0.1dB at 140GHz, with no performance degradation in InP PA

Building on its silicon interposer technology, imec has adapted its expertise in 2.5 technology to enable next-gen RF applications, delivering ultra-low loss and compact integration for mmWave and sub-THz signals.

"Silicon interposer technology has been pivotal for digital and HPC use cases," notes Siddhartha Sinha. "imec has extensive expertise in developing the underlying enablers, such as scaled micro-bumps, high-aspect-ratio TSVs [through-silicon vias], and multi-layer Cu damascene routing to meet these applications' high-density routing needs," he adds. "Leveraging this knowledge, we have now adapted silicon interposer technology to also suit RF applications by adding small, high-performance InP chiplets using CMOS-like processes."

imec says that its RF interposer adds low-loss RF layers on top of a digital interposer to route mmWave signals. Utilizing small-footprint interconnects with a 40μm flip-chip pitch, the passive interconnects between the InP chiplets and the RF interposer show a 0.1dB insertion loss at 140GHz, which is negligible. In addition, a two-stage InP power amplifier (PA) demonstrates what is said to be excellent performance with no degradation observed after assembly, validating the effectiveness of the InP chiplet approach.

Making InP compatible with CMOS processing modules and toolsets

Building on the results presented at IEDM, imec continues to explore further interposer advancements as part of a broader program to make InP compatible with CMOS processing modules and toolsets.

"In addition to developing a demonstrator for mmWave phased arrays and radar applications, we aim to further shrink the size of the InP chiplets while preserving their superior RF performance," says Siddhartha Sinha. "We also plan to add new Si RF interposer features to the platform, including passives-like inductors and MIMCAPs, as well as TSV integration and wafer thinning," he adds. "At the same time, we're making the platform available to partners for prototyping, allowing them to experiment with imec's RF interposer R&D platform."

www.ieee-iedm.org
www.imec-int.com/en/expertise/solutions-5g-and-wireless-iot-communication/beyond-5g-

Bosch allocated $225m in US CHIPS Act funding, plus $350m in loans

Funds to support $1.9bn transformation of Roseville fab for silicon carbide power device production

The US Department of Commerce has signed a non-binding preliminary memorandum of terms (PMT) to provide up to $225m in proposed direct funding under the CHIPS and Science Act to tier-1 automotive supplier Bosch. The investment would support Bosch's planned investment of $1.9bn to transform its manufacturing facility in Roseville, California, for production of silicon carbide (SiC) power semiconductors. This direct funding would support the expansion of Bosch's largest SiC device factory globally, which would significantly increase the firm's production capacity and create up to 1000 construction jobs and up to 700 manufacturing, engineering and R&D jobs in California.

"SiC chips are important components for applications in the automotive, telecommunications, and defense industries because they utilize less energy," says US Secretary of Commerce Gina Raimondo. "With this proposed investment, we are taking another important step in fulfilling that priority to ensure our supply chains are more secure while creating over a thousand anticipated jobs in the process."

As well as having a specialized semiconductor business within its portfolio, Bosch is a provider of trench-gate SiC semiconductors for the automotive industry. The SiC devices to be produced in Roseville are important for enhancing the efficiency of both electric vehicle driving and charging. When at full capacity, the project is expected to produce most of Bosch's total SiC capacity and could comprise more than 40% of all US-based SiC device manufacturing capacity.

"The Roseville investment enables Bosch to locally produce silicon carbide semiconductors, supporting US consumers on the path to electrification," says Paul Thomas, president of Bosch in North America and Bosch Mobility Americas.

Bosch expects to produce its first chips on 200mm wafers in its Roseville facility starting in 2026, performing both front-end device manufacturing and back-end testing, sorting and dicing processes.

Bosch plans to claim the Department of the Treasury's Advanced Manufacturing Investment Credit (CHIPS ITC), which is 25% of qualified capital expenditures. In addition to the proposed direct funding of up to $225m, the CHIPS Program Office would make about $350m in proposed loans (part of the $75bn in loan authority provided by the CHIPS and Science Act) available to Bosch under the PMT.

As explained in its first Notice of Funding Opportunity, the Department of Commerce may offer applicants a PMT on a non-binding basis after satisfactory completion of the merit review of a full application. The PMT outlines key terms for a potential CHIPS incentives award, including the amount and form of the award. The award amounts are subject to due diligence and negotiation of award documents and are conditional on the achievement of certain milestones. After a PMT is signed, the Department of Commerce begins a comprehensive due diligence process on the proposed projects and continues negotiating or refining certain terms with the applicant.

www.bosch.com

Japan investing ¥70.5bn in ¥211.6bn joint DENSO–Fuji Electric plan to boost SiC power semi production

Japan's Ministry of Economy, Trade and Industry has approved a ¥70.5bn subsidy for a plan totalling ¥211.6bn ($1.41bn) submitted by automotive supplier DENSO Corp and power electronics manufacturer Fuji Electric Co Ltd for the Japan-based companies to jointly invest in and produce silicon carbide (SiC) power semiconductors.

In response to the trend to increased electrification, DENSO has pursued SiC technology development projects targeting greater quality and efficiency regarding everything from wafers and device chips to modules and inverters.

Meanwhile, Fuji Electric has built up extensive capabilities encompassing all tasks ranging from the development of SiC power semiconductor chips that enable increased efficiency and more compact designs for power electronics equipment, to mass production of the related modules.

Based on the approved plan, the two companies will combine their respective automotive product development and production technology capabilities in a joint effort to expand their capacity for the efficient and stable supply of SiC power semiconductors throughout Japan.

Production sites will include DENSO's Daian Plant (SiC wafers) and Kota Plant (SiC epitaxial wafers) and Fuji Electric's Matsumoto Factory (SiC epitaxial wafers and SiC power semiconductors).

www.fujielectric.com
www.globaldenso.com

ST supplying silicon carbide power modules to Renault for Ampere's electric vehicles

Partnering on powerbox & cooling systems for electric motor inverters

As the next step in their strategic co-operation, STMicroelectronics of Geneva, Switzerland has reached a multi-year agreement from 2026 to supply its silicon carbide (SiC) power modules to France-based car maker Renault Group as part of the collaboration with Renault's firm Ampere (which designs, develops and manufactures full electric vehicles) on a powerbox for the inverter of its electric powertrain.

Ampere and ST worked together on optimizing the power module for the best performance in the e-powertrain, leveraging Ampere's expertise in EV technology and ST's expertise in power electronics.

The powerbox combines three SiC-based power modules, an excitation module (which provides the necessary electrical excitation to the motor or generator for controlling the magnetic field within the motor), and a cooling baseplate designed to dissipate heat from the back side of the power module (simplifying the thermal management and cooling process).

The powerbox is designed for optimum performance-size ratio across Ampere's line-up, on 400V battery EV vehicles and for Segment C-EVs with 800V batteries, enabling greater autonomy and faster charging (since 800V is one of the key levers to achieve the 10–80% quick charge in 15 minutes or less).

The agreement aligns with Ampere's strategy to master the entire value chain of power electronics for its EV e-powertrain, particularly by working further upstream with its partners and ensuring the best efficiency at each step.

"By working upstream together, we were able to optimize and secure the supply of key components for our electric powertrains, to offer high-performance EVs with increased range and optimized charging time," says Philippe Brunet, senior VP Powertrain & EV engineering, at Ampere.

"With the optimization of these higher-efficient products and solutions to meet Ampere's performance requirements, and our vertically integrated silicon carbide supply chain, we are supporting Ampere's strategy for its next generation of electric powertrain," says Michael Anfang, ST's executive VP sales & marketing for the Europe, Middle East and Africa region.

www.ampere.cars
www.st.com

Sanan Semiconductor adds 1700V and 2000V devices to silicon carbide portfolio

MOSFETs & diodes enable higher efficiency in high-voltage applications

Wide-bandgap power semiconductor materials, component and foundry services provider Sanan Semiconductor Co Ltd of Changsha City, Hunan, China has expanded its silicon carbide (SiC) power product portfolio by launching 1700V and 2000V devices, offering high power efficiency in applications spanning renewable energy to electric vehicle charging infrastructure.

Key highlights of the new product lineup include:

- 1700V SiC MOSFETs with 1000mΩ on-resistance;
- 1700V SiC diodes available in 25A and 50A variants;
- 2000V 40A SiC diodes, with a 20A version planned for release by the end of 2024;
- development of a 2000V 35mΩ SiC MOSFET (release date in 2025).

"By enabling higher DC voltages, these components allow for increased power output at the same current levels, or maintaining system power ratings while reducing current and energy losses dramatically," says project manager Leo Liao.

The 1700V SiC MOSFETs and diodes are particularly well-suited for applications requiring extra voltage margins beyond traditional 1200V devices. Meanwhile, the 2000V SiC diodes can be utilized in high DC link voltage systems up to 1500V DC, addressing the needs of industrial and power transmission applications.

The new SiC devices are claimed to offer superior efficiency compared with traditional silicon-based alternatives across a wide range of applications, including:

- solar string inverters and power optimizers;
- electric vehicle fast-charging stations;
- energy storage systems; and
- high-voltage power grids and energy transmission networks.

"As the world transitions to cleaner energy sources and more efficient power systems, the demand for high-performance power semiconductors continues to grow," notes Z.R. Zhang, VP of sales & marketing. "Our expanded SiC portfolio demonstrates our commitment to driving innovation in this critical sector."

The new 1700V and 2000V SiC devices are available now for sampling.

www.sanan-semiconductor.com

Vishay investing £51m in Newport Wafer Fab

Welsh Government providing £5m support

Discrete semiconductor and passive electronic component maker Vishay Intertechnology Inc of Malvern, PA, USA is investing £51m in Newport Wafer Fab in South Wales (the UK's largest semiconductor wafer fabrication facility, which it acquired from Nexperia in March for $177m, or about £142m), bringing new product range capabilities and skilled job opportunities to what is now Newport Vishay.

The investment has been supported by £5m in funding from the Welsh Government, which cites other recent progress in the South Wales compound semiconductor cluster including:

- US-owned KLA is constructing its new European headquarters at Imperial Park, Newport. With Welsh Government investment in the grid infrastructure at the site, the 215,000ft^2, $100m development is creating an innovation centre and manufacturing facility and will include cleanrooms for R&D and manufacturing. Recruitment of up to 750 staff is already underway.
- Centre 7, a facility supported by Welsh Government as part of its International Strategy, is already attracting inward investors, with Microlink Devices and CS Connected the first tenants at the 51,000ft^2 Cardiff Gate site.
- a £2.5m Net Zero research project at Swansea University's Centre for Semiconductor Materials is pioneering the reduction of building emissions for the semiconductor industry and has research agreements with industrial members such as Vishay, which counts a number of Swansea alumni amongst its executives.
- Cardiff University hosted an international technical conference in October on semiconductor power devices, and Wales will welcome an inward mission by Canadian semiconductor companies next Spring.

"Compound semiconductors are all around us – in our homes and in our phones, our trains and our turbines. They are a vital, if miniature, piece of what makes the modern world tick, with extremely strong global growth projections. And we in Wales are increasingly a world-leading nation in their production and manufacture," states Rebecca Evans, the Welsh Government's Economy, Energy and Planning Cabinet Secretary. "Today that is more evident than ever, with our international reputation attracting significant inward investment, the provision and occupation of state-of-the-art facilities, clear links with R&D, and well-paid opportunities for employment and apprenticeships," she adds. "We are now, after a decade of seeding the cluster, reaping the rewards of our commitment, which we will continue to drive forward."

www.newportvishay.co.uk
www.vishay.com

Linköping's TekSiC appoints Joachim Tollstoy as CEO

Firm to launch new products for PVT and high-temp processing, while continuing SiC wafer development

Silicon carbide wafer manufacturing technology firm TekSiC AB of Linköping, Sweden has appointed Joachim Tollstoy as chief executive officer With over 15 years of leadership experience, Tollstoy has an understanding of market dynamics that TekSiC reckons will be essential as it navigates the evolving landscape of silicon carbide manufacturing.

"As one of the founders of TekSiC in 2021 and having led our product development, I am eager to take on the role of CEO," says Tollstoy. "TekSiC has established itself as a trailblazer in silicon carbide crystal technology, and we are poised to launch a new generation of innovative products for PVT (physical vapor transport) and high-temperature processing for both industrial production and research applications," he adds. "In line with our strategic focus, we will also continue our material development for establishing silicon carbide wafer manufacturing."

In line with our strategic focus, we will also continue our material development for establishing silicon carbide wafer manufacturing

TekSiC reckons that Tollstoy's appointment comes at a pivotal moment as it strengthens its position in the world of geo-political instability and where domestic semiconductor manufacturing capability becomes crucial. His vision for the future, commitment to customer satisfaction, and dedication to fostering a collaborative and inclusive culture aligning seamlessly with TekSiC's core values.

"His proven leadership and transformative approach will undoubtedly guide TekSiC toward even greater achievements," says co-founder & chairman Kristian Flodström. "We have complete confidence in his ability to drive innovation, expand our market presence, and help TekSiC reach new milestones."

www.teksic.com

Toshiba ships early test samples of bare die 1200V silicon carbideMOSFET

Check pattern of embedded Schottky barrier diodes enables low on-resistance and high reliability for automotive traction inverters

Toshiba Electronic Devices & Storage Corp has developed new 1200V silicon carbide (SiC) MOSFETs with an innovative structure that delivers both low on-resistance ($R_{DS(ON)}$) and high reliability. The devices are particularly suited to automotive applications such as traction inverters. They are now available and shipping as early test samples in bare die format, allowing users to customize the bare die to meet their specific design needs and realize solutions for their applications.

The reliability of typical SiC MOSFETs is degraded by increased on-resistance when its body diodes are bipolar energized during reverse conduction operation. Toshiba's new SiC MOSFETs alleviate this issue by using a device structure that embeds Schottky barrier diodes (SBDs) into the MOSFET to inactivate body diodes. However, positioning the SBDs on the chip reduces the area available for channels that determine the resistance of MOSFET on-operation, increasing the chip's on-resistance.

The SBDs embedded in the X5M007E120 are arrayed in a check pattern (rather than the typically used striped pattern), which effectively suppresses bipolar energization of the device's body diodes, while improving the upper limit of unipolar operation to about twice the existing area, even when taking up the same SBD mounting area (compared with Toshiba's product using a striped pattern). Compared with the striped array, channel density is also improved, and on-resistance per unit area is reduced by 20–30%. This improved performance (low on-resistance while maintaining reliability against reverse conduction operation) can save energy in inverters used for motor control, such as automotive traction inverters.

The X5M007E120 bare die 1200V SiC MOSFET.

Reducing $R_{DS(ON)}$ in a SiC MOSFET can cause excess current flow through the MOSFET during short-circuit, reducing short-circuit durability. Enhancing the conduction of the embedded SBDs to improve the reliability of reverse conduction operation also increases current leakage during short-circuit, again decreasing short-circuit durability. The new bare die has a deep barrier structure that suppresses excessive current in the MOSFET section and leakage current in the SBD section during short-circuit operation. This improves its durability during short-circuit conditions while maintaining high levels of reliability against reverse conduction operation.

The new X5M007E120 has a drain–source voltage rating (V_{DSS}) of 1200V and is rated for a drain current (I_D) of 229A continuously, with 458A for pulsed operation ($I_{D\ Pulse}$). The on-resistance ($R_{DS(ON)}$) is as low as 7.2mΩ (typical, at V_{GS}=+18V, T_a=25°C) and 12.1mΩ (typical, at V_{GS}=+18V, T_a=175°C). Also, the device can operate with channel temperatures (T_{ch}) as high as 175°C. The devices are AEC-Q100 qualified for automotive applications.

Toshiba expects to ship engineering samples of the new X5M007E120 during 2025, and to start mass production in 2026. In the meantime, it will explore further improvement to device characteristics.

www.toshiba.semicon-storage.com/ap-en/semiconductor/product/

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US DoE awards eight winners for Phase 1 of Silicon Carbide Packaging Prize

Winners to design, build and test prototypes for high-voltage environments such as energy storage

The US Department of Energy's (DoE) Office of Electricity (OE) has announced the eight winners of the Silicon Carbide (SiC) Packaging Prize Phase 1 who will receive $50,000 each in cash prizes (from a $400,000 total prize pool). Awarded in three phases, the total $2.25m prize is part of the American-Made Challenges Program, which fosters collaboration between the USA's entrepreneurs and innovators, DOE's National Labs, and the private sector.

Prize winners will design, build and test state-of-the-art SiC semiconductor packaging prototypes to enable these devices to work more effectively in high-voltage environments such as energy storage.

The Phase 1 prize winners are:

- Board Breakers (Fargo, North Dakota), which is creating a replacement for traditional power electronic modules by using additive manufacturing to print 3D ceramic packaging.
- LincolnX (Lincoln, Nebraska), which plans to develop novel ultrafast and scalable SiC modules featuring dual orthogonal cooling to meet the prize goals and metrics.
- Marel Power Solutions (Plymouth, Michigan), which plans to make packaging improvements through thermal management, three-dimensional mechatronic design, and a scalable arrangement of power switches.
- NC Solar Inverters (Cary, North Carolina), which — using commercially available topside-cooled discrete devices — will utilize its designed symmetric layout to maximize parasitic flying capacitance and minimize parasitic inductance..
- NoMIS-Lux-QPT-UA (Albany, New York), consisting of NoMIS, Lux, QPT, and UofA, will combine their technology and products in Smart Metal Core SiC power blocks to create high-voltage chip-scale packaging.
- Stony Brook Power Packaging Team (Stony Brook, New York), which will develop high-voltage, high-current, fast-switching, and cost-effective modules and create a business entity for engineering sampling and commercialization.
- Superior SiC Power Module Team (Gainesville, Florida), which plans to develop an interdisciplinary approach for SiC power modules with high-speed, high-energy efficiency, and low EMI.
- Team Raiju — University of Arkansas (Fayetteville, Arkansas), which will embed 128 SiC die in LTCC controlled by an active dV/dt voltage balancer and cooled with integrated micro-channel bus bars.

In Phase 2, winning teams from Phase 1 will develop a physical prototype of their SiC packaging solution that meets Phase 2 metrics. In this phase, teams must send their prototypes to a national lab for testing to validate the metrics achieved. At the end of Phase 2, up to four winning teams will receive $250,000 each and become eligible to compete in Phase 3.

www.herox.com/SiCPackagingPrize

US DoE grants University of Arkansas $1m to develop prototype 15kV silicon carbide power modules

Higher voltage to yield smaller, more reliable fast-charging stations for EVs

The US Department of Energy's Office of Electricity has awarded a grant of $997,588 to Xiaoqing Song, assistant professor in the University of Arkansas' Department of Electrical Engineering and director of the Power Switch Lab, for a project to develop a prototype for high-voltage silicon carbide power modules. Alan Mantooth (Distinguished Professor of electrical engineering) and Keisha Walters (professor of chemical engineering) are co-investigators on the grant.

"The current power modules are usually limited to 10kV," says Song. "We want to bolster the voltage level to a higher level, like to 15kV or even higher."

The research could lead to smaller and more reliable fast-charging stations for electric vehicles. EV fast chargers use several lower-voltage power modules connected in series to achieve the required voltage level. "Just one module could replace many low-voltage components, so the circuit would be easier to design and the EV charger would also be smaller," Song says.

A charger with fewer components would also be more efficient and more reliable. High-voltage power modules could hence also be used to make electrical grids more efficient.

The research will be conducted in collaboration with the Oak Ridge National Laboratory in Oak Ridge, Tennessee, which has expertise in power modules. "After we develop this power module, we can send it to their lab so they can validate it in some real applications," Song says.

https://psl.uark.edu/

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SK Siltron CCS gets $481.5m US DOE loan to expand silicon carbide wafer manufacturing

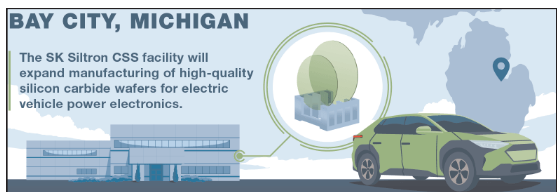
Advanced Technology Vehicles Manufacturing Loan Program targets SiC supply for EVs

Following the announcement in February of a conditional commitment, as part of the Biden–Harris Administration's Investing in America agenda the US Department of Energy (DOE) has now confirmed a $544m loan ($481.5m of principal and $62.5m of capitalized interest) to compound semiconductor wafer maker SK Siltron CSS LLC of Auburn, MI, USA (a subsidiary of South Korea-based wafer manufacturer SK Siltron, a part of South Korea's second-largest conglomerate SK Group) to expand American manufacturing of high-quality silicon carbide (SiC) wafers for electric vehicle (EV) power electronics.

Designed for high-power and high-voltage applications where efficiency and reliability are highly valuable, SiC devices are critical components of EV drivetrains, including inverters, and electrical distribution systems like on-board chargers and DC-to-DC converters. Located at SK Siltron CSS' facility in Bay City, Michigan, the project is expected to be among the top-five manufacturers of SiC wafers globally, boosting the USA's manufacturing competitiveness in clean energy technologies.

The project is expected to create up to 200 construction jobs in the build-out phase and up to 200 skilled operations jobs at full production.

Since the beginning of the Biden-Harris Administration, EV sales have more than quadrupled. More than 4.5 million EVs are now on the road in the USA. EVs contain about twice as many semiconductors as internal combustion engine vehicles. The adoption of high-voltage architectures will drive demand for SiC devices globally as the EV market is expected to grow significantly in the years to come. SiC semiconductors allow for higher efficiency and higher voltage, which can mean faster charging times and up to 10% longer range compared with traditional silicon semiconductors. However, maximizing these performance improvements requires semiconductors made from high-quality SiC wafers, for which demand is hence expected to rise with EV sales (which saw unprecedented progress in 2023). The DOE Loan Programs Office (LPO)-supported SK Siltron CCS project will help to address this critical gap, which in turn will create jobs and deliver new economic opportunities to surrounding communities.



SK Siltron CSS sells directly to device makers that make power electronics used across many industries, not just EVs and high-speed EV charging. Market demand is currently being driven by transportation, next-generation cellular (i.e. 5G), artificial intelligence and cloud computing end uses. SiC is also becoming increasingly common in other mid- to high-voltage applications such as solar photovoltaic inverters and DC converters, and industrial chargers and adapters.

The Investing in America agenda supports the onshoring and re-shoring of domestic manufacturing technologies that are critical to meeting the Administration's goal that half of all new vehicles sold in 2030 are zero-emissions vehicles. The Administration also has a strategy to build a safer, more sustainable transportation system and slash all greenhouse-gas emissions from the transportation sector by 2050. The SK Siltron CCS project is intended to help to achieve these goals by building a more resilient semiconductor supply chain and growing a diverse domestic semiconductor workforce.

As part of the Biden–Harris Administration's efforts to build an equitable and inclusive clean energy future, LPO borrowers must develop and ultimately implement a comprehensive Community Benefits Plan (CBP) that ensures meaningful community and labor engagement, improves the well-being of residents and workers, and incorporates strong labor standards during construction, operations, and throughout the life of the loan guarantee.

SK Siltron CCS will hence partner with Delta College, less than a mile from the project site, through the Michigan New Jobs Training Program to train local workers for SiC wafer manufacturing. Further, the project site is located near disadvantaged communities, as identified by the Climate and Economic Justice Screening Tool. It is expected to benefit local communities and local workers in line with the Biden–Harris Administration's Justice40 Initiative, which set a goal that 40% of the overall benefits of certain federal investments flow to disadvantaged communities that are marginalized by underinvestment and overburdened by pollution.

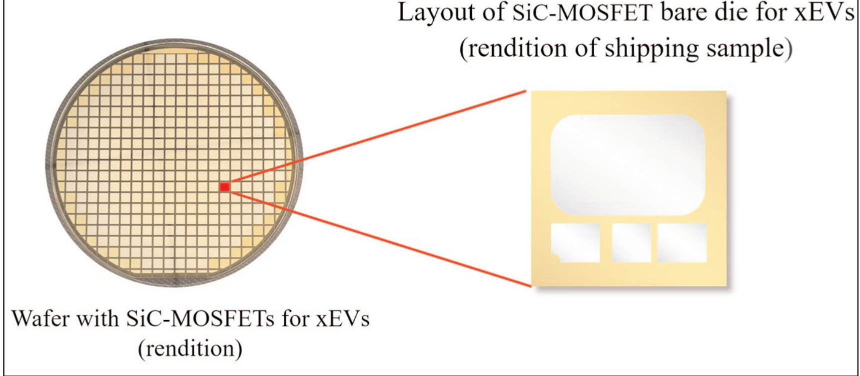
The loan is offered through LPO's Advanced Technology Vehicles Manufacturing (ATVM) Loan Program, which supports domestic manufacturing of advanced technology vehicles, qualifying components, and materials that improve fuel economy.

www.sksiltron.com
www.energy.gov/lpo/

Mitsubishi Electric to ship samples of SiC MOSFET bare die for xEVs

Standardized power semiconductor chip can extend driving range and lower power costs for xEVs

Tokyo-based Mitsubishi Electric Corp has begun shipping samples of a silicon carbide (SiC) metal-oxide-semiconductor field-effect transistor (MOSFET) bare die for use in drive-motor inverters of electric vehicles (EVs), plug-in hybrid vehicles (PHEVs) and other electric vehicles (xEVs).



(Left) Wafer with SiC MOSFETs for xEVs (rendition), and (right) layout of SiC MOSFET bare die for xEVs (rendition of shipping

The chip is offered in two models: the WF0009Q-1200AA and the WF0008Q-0750AA, with rated voltages of 1200V and 750V, respectively, and on-resistances of 9.0mΩ and 7.8mΩ. The front-side electrode is compatible with solder bonding. The back-side electrode is compatible with solder bonding and Ag sintering bonding.

The firm reckons that its first standard-specification SiC MOSFET power semiconductor chip will enable it to respond to the diversification of inverters for xEVs and contribute to the growing popularity of these vehicles. The new SiC MOSFET bare die for xEVs combines a proprietary chip structure and manufacturing technologies to contribute to enhancing inverter performance, extending driving range and improving energy efficiency in xEVs.

Mitsubishi Electric's new power semiconductor chip is a proprietary trench SiC MOSFET (where the gate electrode is embedded in a groove in the surface of the wafer) that reduces power loss by about 50% compared with conventional planar SiC MOSFETs (where the gate electrode is placed on the surface of the wafer), it is reckoned. Thanks to proprietary manufacturing technologies, such as a gate oxide film process that suppresses fluctuations in power loss and on-resistance, the new chip achieves long-term stability to contribute to inverter durability and xEV performance.

Proprietary trench SiC MOSFET extends driving range and lowers power costs for xEVs

- Advanced miniaturization technology, cultivated in Mitsubishi Electric's manufacture of silicon power semiconductor chips, helps to reduce on-resistance compared with conventional planar SiC MOSFETs.
- Oblique ion implantation instead of conventional vertical ion implantation reduces switching loss.
- Power loss is reduced by about 50% compared with conventional planar SiC MOSFETs, resulting in improved inverter performance, extended driving range and reduced power costs for xEVs.

Proprietary manufacturing technologies contribute to xEV performance

- Unique SiC manufacturing technologies, cultivated by the company during more than 20 years of researching and manufacturing planar SiC MOSFETs and SiC Schottky barrier diodes (SBDs), are used to produce the trench SiC MOSFET. For example, Mitsubishi Electric's proprietary gate oxide film process suppresses fluctuations in power loss and on-resistance caused by repeated on/off switching, resulting in more durable inverters to stabilize xEV performance over the long term.

Power semiconductors capable of efficiently converting electricity have attracted growing demand as key devices contributing to global decarbonization. Particularly in the automotive sector, vehicle electrification to reduce greenhouse-gas emissions is driving demand for diversified power semiconductors used in motor-drive inverters and other power-conversion equipment. Expectations are especially high for SiC power semiconductors due to their ability to significantly reduce power loss. Mitsubishi Electric, which was the first company to mass produce xEV power semiconductor modules in 1997, has introduced numerous power modules that contribute to improved reliability, including higher heat-cycle resistance and smaller inverters for various EVs and hybrid electric vehicles (HEVs). In March, the firm began shipping samples of its J3 Series power semiconductor for xEVs, which features a downsized design made possible by using the latest transfer-molded power module (T-PM), which is widely used in the automotive market.

Mitsubishi Electric says that, going forward, it will remain committed to providing high-quality SiC MOSFET bare dies with reduced power loss to help adoption of high-performance xEVs.

www.mitsubishielectric.com/

Gregg Lowe departs Wolfspeed as president & CEO

Chairman Thomas Werner appointed executive chairman

Wolfspeed Inc of Durham, NC, USA — which makes silicon carbide (SiC) materials and power semiconductor devices — says that its board of directors has determined and agreed with Gregg Lowe that in November he will depart from his roles as president & CEO and as a member of the board. Hence, with the support of a global executive search firm, the board is seeking to identify a permanent CEO.

The board has appointed Thomas Werner (a board member since March 2006, and chairman of the board since October 2023) as executive chairman while the board works to identify the firm's next CEO. Werner will oversee the continued execution of Wolfspeed's strategy in close alignment with its senior leadership team, the board and the board's operations and finance committees. Following Werner's appointment as executive chairman, board member Stacy Smith has been appointed as lead independent director.

"Since joining the company as CEO in 2017, Gregg has spearheaded our transition into a leading, pure-play silicon carbide company well positioned to capture the long-term opportunities ahead," comments Werner. "The board has always been focused on driving long-term value and, at this inflection point in Wolfspeed's journey, the board agreed that this is the right time for a leadership transition," he adds.

"I have started in the role of executive chairman to keep Wolfspeed focused on completing key priorities while the board conducts a search for our next CEO," Werner continues. "As we look ahead, we are firmly committed to our key strategic initiatives, which includes executing against the milestones outlined in our recent CHIPS PMT [preliminary memorandum of terms] agreement, completing our restructuring initiatives to lower our breakeven point and accelerate our path towards profitability, and delivering sales growth on a consistent basis. Wolfspeed is materially undervalued relative to its strategic value and I will focus on driving the company's priorities and working with the Finance Committee of the board to explore options to unlock value," he concludes.

"Over the past seven years, we have transformed Wolfspeed into the only pure-play and vertically integrated silicon carbide operator in the country to capitalize on the structural and long-term demand for next-generation semiconductor technology," says Lowe. "While there is work still to be done, I have every confidence that Wolfspeed will execute on its strategic priorities and extend its silicon carbide leadership in the years to come."

www.wolfspeed.com

Wolfspeed appoints Melissa Garrett as general counsel

Brad Kohn resigns to pursue another professional opportunity

Wolfspeed Inc of Durham, NC, USA — which makes silicon carbide (SiC) materials and power semiconductor devices — has appointed Melissa Garrett as senior VP & general counsel, effective 9 December. She succeeds Brad Kohn, who has resigned from the firm for another professional opportunity.

Garrett has been a senior member of Wolfspeed's legal team leading global employment and non-patent litigation matters since 2015. She has a comprehensive legal background in contracts and negotiations, litigation management, corporate governance, employment law, policy and mergers and acquisitions.

"Melissa's contributions to Wolfspeed over the last nine years have been highly valuable," comments executive chairman Tom Werner. "With her proven track record in legal, risk and compliance, coupled with her deep institutional knowledge of Wolfspeed, she is uniquely qualified to step into this role," he adds.

"We deeply appreciate Brad's tireless advocacy for Wolfspeed over the years and thank him for his dedication and many contributions to the company. He and Melissa have been working closely on all key projects, so we expect a smooth transition," concludes Werner.

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Valeo and ROHM to co-develop next-generation power modules for electric motor inverters

ROHM to provide 2-in-1 SiC molded module TRCDRIVE pack for powertrain solutions

Automotive technology firm Valeo and ROHM Semiconductor are collaborating by using their combined expertise in power electronics management to optimize next-generation power modules for electric motor inverters. As a first step, ROHM will provide its 2-in-1 silicon carbide (SiC) molded module TRCDRIVE pack to Valeo for future powertrain solutions.

Valeo is broadening access to efficient, electrified mobility across various vehicle types and markets from the smallest (ebikes), through the mainstream (passenger cars) to the biggest (eTrucks). By combining Valeo's expertise in mechatronics, thermal management and software development with ROHM's power modules, Valeo aims to drive the power electronics solution forward, contributing to the performance, efficiency and decarbonization of automotive systems.

Valeo and ROHM have been collaborating since 2022, initially focusing on technical exchanges aimed at improving the performance and efficiency of the motor inverter in the propulsion systems of electric vehicles (EVs) and plug-in hybrids (PHEVs). By refining power electronics, both firms aim to offer optimized cost/performance by delivering higher energy efficiency, reducing heat generation thanks to an optimized cooling and mechatronic integration, and increasing overall reliability with a SiC packaging.

"This partnership marks, for Valeo Power Division, a significant step forward in delivering advanced and high-efficient power electronics," says Xavier Dupont, CEO of Valeo's Power Division. "Together, we aim to set new industry standards for high-voltage inverters and accelerate the transition towards more efficient and affordable electric mobility," he adds.

Valeo's Power Inverter Platform director Nicolas Gelez (right) and Power Purchasing VP Christophe Chevalier (center) with Wolfram Harnack, president at ROHM Semiconductor GmbH (left).

"ROHM's TRCDRIVE pack provides high power density, leading to an improved power efficiency," says Wolfram Harnack, president of ROHM Semiconductor GmbH. "Together, we contribute to the development of highly efficient powertrains by fostering the collaboration with Valeo."

Valeo and ROHM have been collaborating since 2022, initially focusing on technical exchanges aimed at improving the performance and efficiency of the motor inverter in the propulsion systems of electric vehicles

These evolutions are all essential to supporting the growing demand for longer range, faster charging capabilities and, overall, a high-performance and an affordable inverter for BEVs and PHEVs, says ROHM.

Valeo will start supplying a first series project in early 2026. Valeo and ROHM will contribute to the improvement of efficiency and downsizing of Valeo's next generation of xEV inverters.

Background on TRCDRIVE pack

TRCDRIVE pack is a trademark for the SiC molded module developed for traction inverter drives. This product features high power density and a unique terminal configuration — solving the key challenges of traction inverters in terms of miniaturization, higher efficiency, and fewer person-hours. Because silicon carbide enables low-loss power conversion under high-voltage conditions, combining Valeo's component technology, casing design and thermal management expertise with ROHM's power module has a synergistic effect, says the firm.

www.valeo.com
www.rohm.com/products/sic-power-devices

ROHM launches surface-mount SiC Schottky barrier diodes with 1.3x greater creepage distance for improved insulation resistance

Models for high-voltage xEV systems available now; models for industrial applications coming in December

ROHM Semiconductor has launched surface-mount SiC Schottky barrier diodes (SBDs) that improve insulation resistance by increasing the creepage distance between terminals. The initial lineup includes eight models (SCS2xxxNHR) for automotive applications such as on-board chargers (OBCs) and DC–DC converters (available now), with plans to deploy eight additional models (SCS2xxxN) for industrial equipment such as factory automation (FA) devices (e.g. AC servo motors for industrial robots) and photovoltaic (PV) inverters, power conditioners, uninterruptible power supplies (UPS) etc (scheduled to be available) in December.

The rapidly expanding xEV market is driving demand for power semiconductors including SiC SBDs, which provide low heat generation along with high-speed switching and high-voltage capabilities in applications such as on-board chargers. Additionally, manufacturers increasingly rely on compact surface-mount devices (SMDs) compatible with automated assembly equipment to boost manufacturing efficiency. Compact SMDs typically feature smaller creepage distances, which makes high-voltage tracking prevention a critical design challenge.

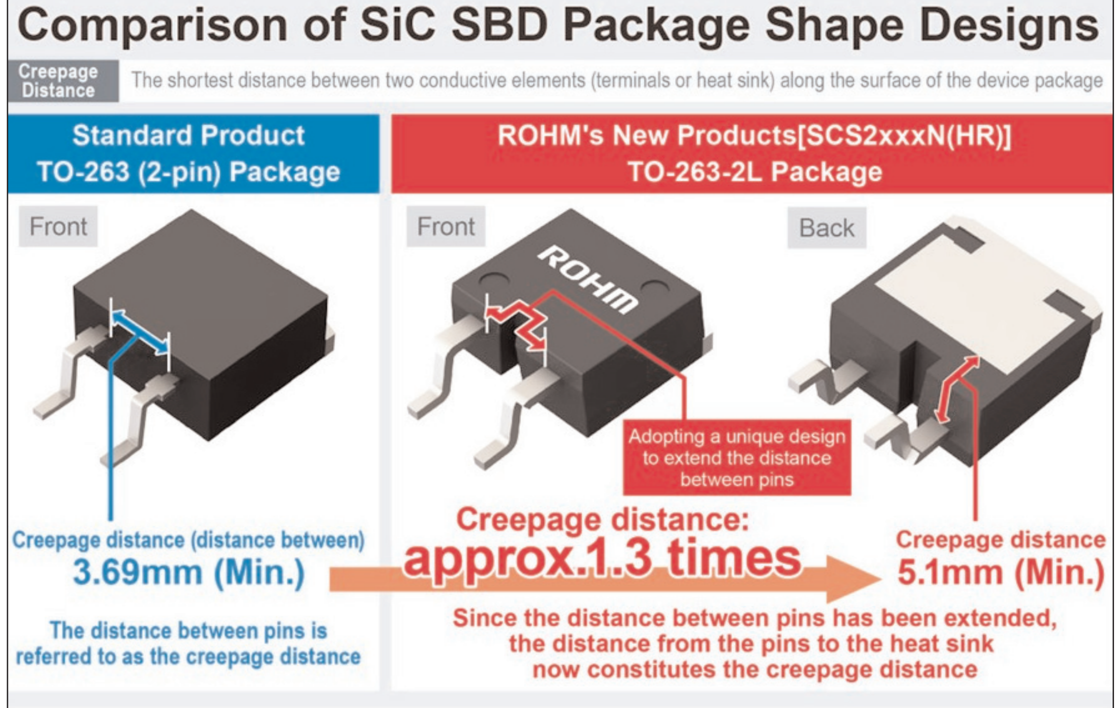
ROHM has been working to develop high-performance SiC SBDs that offer breakdown voltages suitable for high-voltage applications with ease of mounting. Adopting an optimized package shape, it has achieved a minimum creepage distance of 5.1mm, improving insulation performance compared with standard products.

Specifically, the new products utilize an original design that removes the center pin previously located at the bottom of the package, extending the creepage distance to a minimum of 5.1mm, about 1.3 times greater than standard products. This minimizes the possibility of tracking (creepage discharge) between terminals, eliminating the need for insulation treatment through resin potting when surface mounting the device on circuit boards in high-voltage applications. Additionally, the devices can be mounted on the same land pattern as standard and conventional TO-263 package products, allowing easy replacement on existing circuit boards.

Two voltage ratings are offered — 650V and 1200V — supporting 400V systems commonly used in xEVs, as well as higher-voltage systems expected to gain wider adoption in the future. The automotive-grade SCS2xxxNHR are AEC-Q101 qualified, ensuring that they meet the high reliability standards that this application sector demands.

ROHM says that, going forward, it will continue to develop high-voltage SBDs using SiC, contributing to low-energy-consumption and high-efficiency requirements in automotive and industrial equipment by providing optimal power devices that meet market needs.

www.rohm.com/products/sic-power-devices



ROHM and TSMC collaborating on development and volume production of GaN power devices for EVs

Japan's ROHM Co Ltd and Taiwan Semiconductor Manufacturing Co (TSMC) have entered a strategic partnership on development and volume production of gallium nitride power devices for electric vehicles.

The partnership will integrate ROHM's device development technology with TSMC's GaN-on-silicon process technology to meet growing demand for GaN's superior high-voltage and high-frequency properties over silicon for power devices.

GaN power devices are currently used in consumer and industrial applications such as AC adapters and server power supplies. TSMC says that it supports GaN technology for its potential environmental benefits in automotive applications, such as on-board chargers and inverters for electric vehicles (EVs).

The partnership builds on ROHM and TSMC's history of collaboration in GaN power devices. In 2023, ROHM adopted TSMC's 650V GaN high-electron-mobility transistors (HEMT), whose process is increasingly being used in consumer and industrial devices as part of ROHM's EcoGaN series, including the 45W AC adapter (fast charger) C4 Duo produced by Innergie, a brand of Delta Electronics Inc.

"GaN devices, capable of high-frequency operation, are highly anticipated for their contribution to miniaturization and energy savings," notes Katsumi Azuma, board member & senior managing executive officer at ROHM. "Reliable partners are crucial for implementing these innovations in society, and we are pleased to collaborate with TSMC, which possesses world-leading advanced manufacturing technology. In addition to this partnership, by providing user-friendly GaN solutions that include control ICs to maximize GaN performance, we aim to promote the adoption of GaN in the automotive industry," he adds.

"As we move forward with the next generations of our GaN process technology, TSMC and ROHM are extending our partnership to the development and production of GaN power devices for automotive applications," says Chien-Hsin Lee, senior director of Specialty Technology Business Development at TSMC. "By combining TSMC's expertise in semiconductor manufacturing with ROHM's proficiency in power device design, we strive to push the boundaries of GaN technology and its implementation for EVs."

www.tsmc.com

EcoSiC technology adopted by power supply maker COSEL

ROHM says its EcoSiC products — including SiC MOSFETs and SiC Schottky barrier diodes (SBDs) — have been adopted in the HFA/HCA series of 3.5kW output AC–DC power supply units for 3-phase applications made by Japan-based power supply maker COSEL Co Ltd. Incorporating ROHM SiC MOSFETs and SiC SBDs into the forced-air-cooled HFA series and conduction-cooled HCA series achieves up to 94% efficiency. The HCA series has been mass produced since 2023. The HFA series began mass production in 2024.

Many industrial applications that handle high power in the industrial sector, including MRI machines and CO_2 lasers, require 3-phase power supplies that differ from the single-phase power supplies used in households. COSEL's AC–DC power supply units — equipped with ROHM's EcoSiC technology that is said to excel in high-temperature, high-frequency, high-voltage environments — are compatible with 3-phase power supplies from $200V_{AC}$ to $480V_{AC}$, contributing to improved power supply efficiency across a wide range of industrial equipment worldwide.

The HFA/HCA series are 3.5kW power supplies featuring a wide input range ($200–480V_{AC}$) that meets global power supply requirements. This allows them to be used anywhere in the world without the need to modify the power supply for each region, contributing to the standardization of application designs. Both forced-air-cooled (HFA series) and conduction-cooled (HCA series) models — selectable based on operating environment — are available in 48V and 65V output voltage variants that can be used as power sources for a variety of high-power applications such as laser generation and MRI.

"The HFA/HCA series achieve high efficiency despite delivering a high power output of 3.5kW by incorporating ROHM's low-loss SiC power devices," notes Jun Uchida, general manager, New Product Development Dept. 2, at COSEL. "Operating at high input voltages typically poses a challenge in reducing losses in high-voltage power devices, but using SiC power devices translates to significantly lower losses compared to conventional solutions, resulting in power supplies that maintains high efficiency and power density even under demanding high-power conditions," he adds.

"Going forward, we will continue to collaborate with COSEL to contribute to a sustainable society by enhancing the efficiency of industrial equipment that handle large amounts of power," says Akihiro Hikasa, group general manager, Power Devices business unit, in ROHM's SiC Business Section.

https://en.cosel.co.jp
www.rohm.com

Infineon to co-develop power architecture for Stellantis EVs

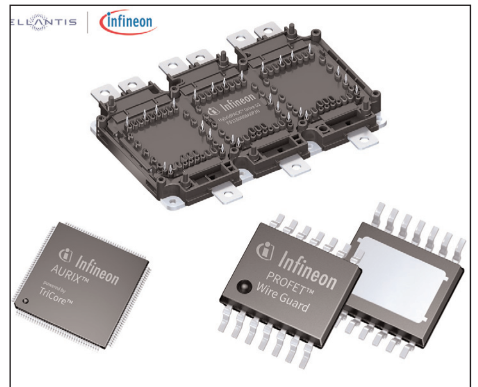
Firms sign supply and capacity reservations for PROFET power switches and CoolSiC semiconductors

Netherlands-headquartered automaker Stellantis N.V. and Infineon Technologies AG of Munich, Germany are to work jointly on the power architecture for Stellantis' electric vehicles.

The companies have hence signed supply and capacity agreements that will serve as the foundation for the planned collaboration to develop the next generation of power architecture, including:

- Infineon's PROFET smart power switches, which will replace traditional fuses, reduce wiring and enable Stellantis to become one of the first automakers to implement intelligent power network management.
- Silicon carbide (SiC) CoolSiC semiconductors, which will support Stellantis in its efforts to standardize its power modules, improving the performance and efficiency of EVs while also reducing costs.
- AURIX microcontrollers, which target the first generation of the STLA Brain zonal architecture.

Stellantis and Infineon are also in the process of extending their cooperation with the implementation of a Joint Power Lab to define the next-generation scalable and intelligent power architecture enabling Stellantis' software-defined vehicle.



"As outlined in our strategic plan, Dare Forward 2030, we are securing the supply of crucial semiconductor solutions required to continue our transition to an electrified future, leveraging innovative E/E architectures for our next-generation platforms," says Maxime Picat, Stellantis chief purchasing & supplier quality officer.

"As the world's leading automotive semiconductor vendor, we bring our product-to-system expertise and dependable electronics to the table," says Peter Schiefer, president of Infineon's Automotive Division. "Our semiconductors drive the decarbonization and digitalization of mobility. They increase the efficiency of cars and enable software-defined architectures that will significantly improve the user experience," he adds.

With what it claims is the world's most cost-competitive SiC fab in Kulim, Malaysia, the upcoming 300mm Smart Power Fab in Dresden, Germany, and the joint venture with Taiwan-based foundry TSMC and partners (ESMC) as well as accompanying supply agreements with foundry partners, Infineon says it is ready to fully meet market demand for automotive semiconductor solutions. According to market research company TechInsights, Infineon is the global number-one supplier of automotive microcontrollers, with a 29% share of the global automotive microcontroller market ('Automotive Semiconductor Vendor Market Shares', April 2024).

www.infineon.com/coolsic
www.stellantis.com

Odyssey announces liquidation distribution

Odyssey Semiconductor Technologies Inc of Ithaca, NY, USA says that its only, and final, liquidating distribution will be of $0.11 per share, to be paid on or about 23 December, to holders of its common stock, as of the record date of 19 August.

Odyssey was a developer of high-voltage vertical power switching components based on proprietary gallium nitride (GaN) processing technology. But on 7 May, it was announced that its assets were to be acquired by Power Integrations Inc of San Jose, CA, USA (which provides high-voltage integrated circuits for energy-efficient power conversion), with all key Odyssey employees joining Power Integrations' technology organization. The acquisition was completed on 1 July.

Pursuant to Odyssey's plan of complete liquidation, dissolution and distribution of assets, approved by the stockholders special meeting on 3 June, the distribution will result in the complete redemption and cancellation of all of the outstanding capital stock.

As of 17 December, Odyssey has a cash balance of about $1.837m. At the board of directors' discretion, after payment of $0.11 per share, or $1,606,096.91 in total for the distribution, the company has reserved cash of about $61,000 for payments for federal and state tax liabilities and related expenses, and $169,000 for legal and other third-party dissolution expenses and both accrued and anticipated obligations.

Following the distribution, the company will file a verified petition with the Delaware Court of Chancery to seek a court order to determine the amount of cash reserves, if any, to be set aside as a security to address any potential claims, if any, that may arise against it.

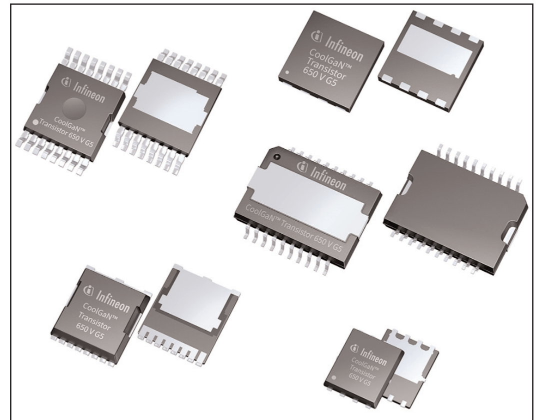
www.odysseysemi.com
www.power.com

Infineon launches CoolGaN Transistors 650V G5 family

Up to 50% lower energy stored in output capacitance, up to 60% improved drain–source charge and up to 60% lower gate charge

Infineon Technologies AG of Munich, Germany has strengthened its gallium nitride (GaN) portfolio by launching a new family of high-voltage discretes, the CoolGaN Transistors 650V G5. Target applications range from consumer and industrial switched-mode power supplies (SMPS) such as USB-C adapters and chargers, lighting, TV, data-center and telecom rectifiers to renewable energy and motor drives in home appliances.

The latest CoolGaN generation is designed as a drop-in replacement for CoolGaN Transistors 600V G1, enabling rapid redesign of existing platforms. The new devices provide improved figures of merit to ensure competitive switching performance in focus applications. Compared with key competitors and previous product families from Infineon, the CoolGaN Transistors 650V G5 offer up to 50% lower energy stored in the output capacitance (E_{oss}), up to 60% improved drain–source charge (Q_{oss}) and up to 60% lower gate charge (Q_g), it is reckoned. Combined, these features result in what are claimed to be excellent efficiencies in both hard- and soft-switching applications. This leads to a significant reduction in power loss compared with traditional silicon technology, ranging from 20–60% depending on the specific use case.



The CoolGaN Transistors 650V G5 product family.

These benefits allow the devices to operate at high frequencies with minimal power loss, resulting in superior power density, the firm says. The CoolGaN Transistors 650V G5 enable SMPS applications to be smaller and lighter or to increase the output power range in a given form factor.

The new high-voltage transistor product family offers a wide range of $R_{DS(on)}$ package combinations. Ten $RD_{S(on)}$ classes are available in various SMD packages, such as ThinPAK 5x6, DFN 8x8 , TOLL and TOLT. All products are manufactured on high-performance 8-inch production lines in Villach (Austria) and Kulim (Malaysia). In the future, CoolGaN will transition to 12-inch production. This will enable Infineon to further expand its CoolGaN capacity and ensure a robust supply chain in the GaN power market, which should rise to $2bn by 2029, says Yole Group's 'Power GaN 2024' report.

A demo featuring the CoolGaN Transistors 650V G5 was showcased at electronica 2024 in Munich (12–15 November).

The CoolGaN Transistor 650V G5 product family can be ordered from Infineon now, and from e-commerce distributors in the coming weeks.

www.infineon.com/gan

ST launches 250W MasterGaN reference design

Robust GaN-based resonant converter with synchronous rectification boosts efficiency to over 94%

STMicroelectronics of Geneva, Switzerland has launched the EVL250WMG1L resonant-converter reference design based on its MasterGaN1L system-in-package (SiP), as ST continues to accelerate the design of gallium nitride (GaN) power supplies (PSUs) that deliver superior efficiency and power density.

ST's MasterGaN SiPs combine GaN power transistors with gate drivers specially optimized to ensure fast and controlled switching. Using these SiPs in place of an equivalent network of discrete components helps to maximize performance and reliability while also accelerating design and saving PCB space, ST says.

The new reference design targets industrial applications where space is limited and efficiency is critical. Combining the MasterGaN1L, which contains two 650V 150mΩ GaN FETs, with ST's L6599A resonant controller, the PSU achieves peak efficiency of over 94% and operates without heat-sinks on the primary side. Also leveraging ST's SRK2001A synchronous-rectification controller, the unit has a compact overall footprint of 80mm x 50mm and power density of 34W/inch^3.

The PSU can deliver up to 10A output current (equivalent to 250W at $24V_{dc}$) while also having standby current consumption below 1μA, aiding energy saving. Protection features built into the L6599A and SRK2001A ensure resilience against overcurrent, short-circuit and over-voltage, while input-voltage monitoring ensures correct startup and provides under-voltage lockout.

The EVL250WMG1L is available now, fully built and ready for evaluation, for $250.

www.st.com/en/evaluation-tools/evl250wmg1

GlobalFoundries' $1.5bn US CHIPS Act funding confirmed by Department of Commerce

After completing due diligence, the US Department of Commerce has confirmed the award (proposed in February) of up to $1.5bn in direct funding through the US CHIPS and Science Act to New York-based GlobalFoundries (the only US pure-play foundry with a global manufacturing footprint including facilities in the USA, Europe and Singapore). The funds will enable GF to expand chip manufacturing and technology development in the USA, strengthening supply chains and supporting customers across end markets spanning automotive, smart mobile devices, IoT, data centers, and aerospace & defense.

"GF's essential chips are at the core of US economic, supply chain and national security," says president & CEO Dr Thomas Caulfield. "We greatly appreciate the support and funding from both the US Government and the states of New York and Vermont, which we will use to ensure our customers have the American-made chips they need."

The award will support three projects:

- Expansion of GF's existing fabrication plant in Malta, NY, by adding critical technologies in production at GF's Singapore and Germany fabs, to enable a secure and reliable supply of domestically manufactured essential chips for the US auto industry.
- Modernization and upgrading of GF's existing fab in Essex Junction, Vermont, to expand production capacity and create a facility capable of high-volume manufacturing of gallium nitride (GaN) semiconductors for use in electric vehicles, data centers, IoT, smartphones and other critical applications.
- Construction of a new fab on GF's campus in Malta, NY, to meet expected demand for US-made essential chips for applications spanning automotive, AI in the data center and at the edge, as well as aerospace & defense.

The two New York-based projects will triple the capacity of GF's Malta campus over the next 10+ years, in alignment with expected market requirements and customer demand. Construction of the new fab will leverage the GF site's existing infrastructure and ecosystem, enabling a fast and efficient path from construction to production.

The projects comprise more than $13bn of investment over the next 10+ years across GF's two US sites, including the $1.5bn CHIPS Act funds, $550m from the New York State Green CHIPS Program, plus support from Vermont, GF ecosystem partners and key strategic customers, and other incentives.

All this should create over 9000 construction jobs and nearly 1000 direct manufacturing jobs.

The New York and Vermont fabs are both Trusted Foundry accredited and manufacture secure chips in partnership with the US government.

As part of its CHIPS Act award, to attract and cultivate a pipeline of semiconductor talent in New York and Vermont, GF will continue to invest in and develop new workforce development efforts including curriculum development, internship and apprenticeship programs, K-12 STEM outreach, plus additional education and training programs.

www.gf.com

GlobalFoundries' gains $9.5m more in US funding for Vermont 200mm GaN-on-Si chip production

The US Department of Defense's Trusted Access Program Office (TAPO) has awarded GlobalFoundries an extra $9.5m to advance the manufacturing of GaN-on-silicon at its fab in Essex Junction, Vermont.

GF will continue to add new tools, equipment and prototyping capabilities to its GaN IP portfolio and reliability testing as it moves closer to full-scale manufacturing of its 200mm GaN chips in Vermont. GF says it aims to create a fast and efficient path for customers to realize innovative designs and products that leverage the unique efficiency and power management benefits of GaN chip technology.

"Realizing full-scale GaN chip manufacturing will be a catalyst for innovation, for both our commercial and government partners, and will add resilience and strengthen the semiconductor supply chain," says Nicholas Sergeant, vice president of IoT and aerospace & defense.

"Strategic investment in critical technologies strengthens our domestic ecosystem and national security, and ensures these assets are readily available and secure for DoD utilization," says Dr Nicholas Martin, director at Defense Microelectronics Activity. "In concert with key partners, this approach fortifies defense systems, empowering resilience and responsiveness."

Including the new award, GF has received over $80m since 2020 from the US government to support research, development and advancements to pave the way to full-scale GaN chip manufacturing.

Vermont is a US-accredited Trusted Foundry and the global hub of GF's GaN program. In July, GF acquired Tagore Technology's Gallium Nitride Power portfolio and created the GF Kolkata Power Center in Kolkata, India. It is closely aligned with and supports GF's facility in Vermont, and is helping to advance GF's research and development in GaN chip manufacturing.

Nexperia & KOSTAL partner on WBG devices for EVs

Initial focus on SiC MOSFETs in QDPAK for EV onboard chargers

Discrete device designer and manufacturer Nexperia of Nijmegen, the Netherlands (which operates wafer fabs in Hamburg, Germany, and Hazel Grove Manchester, UK) has entered into a strategic partnership with automotive supplier KOSTAL of Lüdenscheid, Germany, which will enable it to produce wide-bandgap (WBG) devices that more closely match the exacting requirements of automotive applications. Nexperia will supply, develop and manufacture WBG power electronics devices that will be designed-in and validated by Kostal.

Alongside its established silicon portfolio, Nexperia offers a range of WBG semiconductor technologies including silicon carbide (SiC) diodes and MOSFETs, as well as gallium nitride (GaN) e-mode and d-mode devices.

The collaboration will initially focus on the development of SiC MOSFETs in topside-cooled (TSC) QDPAK packaging for onboard chargers (OBC) in electric vehicles (EV). Nearly one in every two cars worldwide is equipped with KOSTAL's products, including more than 4.5 million onboard chargers.

"Nexperia has been a trusted supplier of silicon components to KOSTAL for many years and is delighted to enter into this strategic partnership that will now extend to wide-bandgap devices," says Katrin Feurle, senior director & head of SiC Discretes & Modules. "KOSTAL will assist in validating our devices in its charging applications, thereby providing us with the type of invaluable 'real-world' data that will allow us to further enhance their performance," she adds.

"KOSTAL is extending its' strategic SiC supply portfolio to support our growth path towards 2030 with a special dedication on e-mobility applications for onroad and offroad applications," says Dr Georg Mohr, KOSTAL Group's executive VP purchasing & supply chain. "Under this strategic partnership, which reinforces our long-standing customer–supplier relationship, KOSTAL will leverage Nexperia's expertise in wide-bandgap technology, particularly their SiC MOSFETs, which we believe are among the best in the market. By sharing our insights from real-world EV charging applications, we aim to contribute to the development of even more optimized and tailored SiC devices that meet the specific demands of our next-generation solutions."

www.nexperia.com
www.kostal-automobil-elektrik.com

VisIC and AVL partner on GaN inverters for EVs

VisIC Technologies Ltd of Ness Ziona, Israel — a fabless supplier of power conversion devices based on gallium nitride (GaN) transistors — and mobility technology company AVL of Graz, Austria (which provides development, simulation and testing in the automotive industry and in other sectors such as rail, marine and energy) have partnered to advance high-efficiency GaN inverter technology for the electric vehicles (EV) market. The collaboration will provide automotive OEMs with power semiconductors that exceed silicon carbide (SiC) performance, while offering lower costs at device and system level.

In a recent test conducted at AVL's facilities in Germany, an inverter based on VisIC's GaN-on-silicon D^3GaN components (and mounted on AVL's e-motor test bench and controlled by AVLs SOP eDrive controls algorithm) achieved a benchmark system efficiency level of 99.67% at 10kHz, climbing to over 99.8% efficiency at 5kHz, outperforming comparable SiC inverters by up to 0.5% and cutting energy losses by more than 60%. The AVL and VisIC partnership hence provides an option for automakers striving to balance high efficiency with affordability in EV design, the firms say.

Also, VisIC says that its GaN-on-Si power devices require significantly less energy and CO_2 during chip production compared with SiC. Since they can be produced in 200mm and 300mm silicon foundries, scaling production is straightforward, the firm adds.

"With AVL, we're making cutting-edge GaN inverter technology accessible for even more electric vehicles, establishing a new benchmark for efficiency and cost-effectiveness in the industry," reckons VisIC's chief technology officer Gregory Bunin. "Our partnership reflects a shared commitment to driving EV innovation that's both impactful and accessible, bringing GaN's unparalleled performance to a broader market," he adds.

"Working with VisICs new GaN power module for high-power systems enables us to offer our customers cutting-edge solutions that are optimally aligned with the requirements of next-generation drive systems," Dr Thomas Frey, head of Segment E-Mobility & E-Drive System at AVL Software and Functions GmbH. "These include, among other things, high power density combined with reduced overall system costs," he adds. "Together, we can significantly advance e-mobility and help reduce the carbon footprint."

Looking ahead, AVL and VisIC plan to expand their GaN-on-Si platform to include 800V GaN power modules, ensuring that their technology remains scalable and adaptable to the needs of the growing battery electric vehicle (BEV) market.

www.visic-tech.com

Penn State gains $3m DARPA grant for GaN-on-silicon project with Northrop Grumman

2D materials to be seed layers for heterogeneous integration of GaN on industry-compatible silicon (001)

Penn State is to receive $3m from the US Defense Advanced Research Projects Agency (DARPA) as part of a larger grant awarded to defense, aerospace and technology company Northrop Grumman. The joint project aims to develop a novel method for integrating gallium nitride (GaN) with silicon substrates, since GaN provides superior performance and faster switching speeds for power-intensive applications while silicon offers scalability and affordability. This hybrid approach can lead to more efficient power electronics with lower production costs, suiting high-demand applications like electric vehicles, power electronics and data centers, where efficiency and durability are critical.

"Silicon is the common platform for microelectronics but it is challenging to combine new semiconductor materials with silicon," says Joan Redwing, distinguished professor of materials science and engineering and director of the Penn State Materials Research Institute's (MRI) Two-Dimensional Crystal Consortium, a US National Science Foundation Materials Innovation Platform and national user facility. "To overcome this, we need new approaches to densely integrate advanced materials with silicon," she adds. "Our work with Northrup Grumman is designed to explore integrating gallium nitride directly onto silicon using two-dimensional materials as interlayers."

To achieve this, with the DARPA grant Penn State will work with Northrup Grumman to develop heterogeneous integration using 2D materials that are one to a few atoms thick, such as molybdenum disulfide and gallium selenide, as seed layers to grow GaN on industry-compatible silicon (001), which is the preferred crystal orientation used in existing semiconductor manufacturing.

A seed layer provides a template or foundation that influences the structure, orientation and quality of the material grown on top.

"The current approach to gallium nitride-on-silicon integration has too many drawbacks, from increased thermal resistance to device fabrication challenges on silicon (001)," says Joshua Robinson, professor of materials science and engineering and Penn State's principal investigator on the DARPA project. "By using 2D materials as seed layers, we aim to eliminate these issues and develop a direct route to integrating gallium nitride-on-silicon with improved performance compared to current technologies. This could directly impact manufacturing costs and enable market entry into energy-efficient devices."

The project will leverage Penn State's infrastructure for growing and characterizing 2D materials and wide-bandgap semiconductors. "This program allows us to demonstrate that 2D materials could be key to enabling advances in 3D semiconductors," Robinson says. "We're combining our expertise in 2D research with the real-world need for improved semiconductor performance, setting the stage for years of innovation in heterogeneous integration."

The equipment and methodologies developed through this grant will be available to other researchers through MRI's user facilities, Robinson says, with the goal of fostering collaboration and innovation among a variety of partners.

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MACOM to lead US CHIPS Act-funded GaN-on-SiC technology development project

Firm to work with NCSU, Adroit Materials and NRL

MACOM Technology Solutions Inc of Lowell, MA, USA (which designs and makes RF, microwave, analog and mixed-signal and optical semiconductor technologies) has been selected to lead a development project to establish gallium nitride (GaN) on silicon carbide (SiC) process technologies for radio frequency (RF) and microwave applications. Funded by the CHIPS and Science Act via the US Department of Defense (DoD), the project will focus on developing semiconductor manufacturing processes for GaN-based materials and monolithic microwave integrated circuits (MMICs) operating efficiently at high voltage and at millimeter-wave (mmW) frequencies.

MACOM is a member of the Commercial Leap-Ahead for Wide Bandgap Semiconductors (CLAWS) Microelectronics Commons Hub and will work with North Carolina State University (NCSU), NCSU spin-off Adroit Materials Inc of Cary, NC, USA and the US Naval Research Laboratory (NRL) on the project. The year 1 value of this award is $3.4m.

This award expands on a series of GaN technology development activities with the DoD, including a 2021 Cooperative Research and Development Agreement (CRADA) with the US Air Force Research Laboratory (AFRL) where MACOM transferred AFRL's 0.14μm GaN-on-SiC MMIC process to its Massachusetts-based US Trusted Foundry.

Our strategy is to increase domestic production of state-of-the-art RF & microwave power technologies to support our military's radar and sensing applications and to enable next-generation telecommunica tions networks

This was followed in 2023 by a $4m AFRL contract to develop GaN technologies for mmW applications and a Defense Advanced Research Projects Agency (DARPA) award valued at up to $10.1m targeting improved heat dissipation for high-power applications. Earlier this year, MACOM was awarded a separate CHIPS-funded GaN technology development contract worth up to $11.4m.

"Our strategy is to increase domestic production of state-of-the-art RF and microwave power technologies to support our military's radar and sensing applications and to enable next-generation telecommunications networks," says president & CEO Stephen G. Daly. "The technologies and products developed under these contracts will help keep the United States and MACOM on the leading edge," he believes.

www.macom.com

MACOM acquires fabless semiconductor firm ENGIN-IC

GaN MMICs & integrated microwave modules expand target markets

MACOM has acquired fabless semiconductor company ENGIN-IC Inc of Plano, TX and San Diego, CA, USA, which designs gallium nitride (GaN) monolithic microwave integrated circuits (MMICs) and integrated microwave module assemblies. It is expected that ENGIN-IC's design capabilities will strengthen MACOM's ability to serve its target markets and gain market share.

Since being founded in 2014, ENGIN-IC has focused on serving the US defense industry. The firm was self-funded and utilized small-business innovative research (SBIR) contracts, Department of Defense (DoD) research projects and custom integrated circuit development projects for defense prime contractors. Its product portfolio includes over 60 standard MMICs and many more custom MMICs, including high-efficiency power amplifiers, integrated transmit/receive chips, phase-shifters, time delay units (TDUs), mixers and modulators, as well as S- to K-band switched filter bank modules and L- to K-band transmit/receive modules.

ENGIN-IC has focused on serving the US defense industry... ENGIN-IC's exceptional wideband and high-efficiency MMIC and module design expertise will enable us to better support our mutual customers

"ENGIN-IC's exceptional wide-band and high-efficiency MMIC and module design expertise will enable us to better support our mutual customers," says MACOM's president & CEO Stephen G. Daly.

"MACOM's talented team and growth strategies align well with ENGIN-IC's strengths, and we look forward to all that we can accomplish together," says ENGIN-IC's co-founder & chief technology officer Stephen Nelson.

The transaction was funded with cash-on-hand and is expected to have an immaterial impact to MACOM's near-term financial performance.

www.engin-ic.com

Navitas presents first 8.5kW AI data-center power supply powered by gallium nitride and silicon carbide

Next-generation solution achieves 98% efficiency with high-power GaNSafe and Gen-3 Fast SiC MOSFETs for AI and hyperscale data centers

Gallium nitride (GaN) power IC and silicon carbide (SiC) technology firm Navitas Semiconductor Corp of Torrance, CA, USA has announced what it claims is the world's first 8.5kW power supply unit (PSU), powered by GaN and SiC technologies to achieve 98% efficiency, for next-generation AI and hyperscale data centers.

The AI-optimized 54V output PSU complies with Open Compute Project (OCP) and Open Rack v3 (ORv3) specifications and utilizes high-power GaNSafe and Gen-3 Fast SiC MOSFETs configured in 3-phase interleaved PFC and LLC topologies to ensure the highest efficiency and performance with the lowest component count. The PSU's shift to a 3-phase topology for both the PFC and LLC (versus 2-phase topologies used by competing PSUs) enables what is claimed to be the industry's lowest ripple current and EMI. Furthermore, the PSU reduces the number of GaN and SiC devices by 25% compared with the nearest competing system, which reduces the overall cost. The PSU has an input voltage range of 180–264V_{ac}, a standby output voltage of 12V, and an operating temperature range of –5ºC to 45ºC. Its hold-up time at 8.5kW is 10ms, with 20ms possible through an extender.

The 3-phase LLC topology is enabled by high-power GaNSafe, which is specifically created for demanding, high-power applications, such as AI data centers and industrial markets. Navitas' 4th-generation integrates control, drive, sensing and critical protection features that enable what is claimed to be unprecedented reliability and robustness. GaNSafe has short-circuit protection (350ns maximum latency), 2kV ESD protection on all pins, elimination of negative gate drive, and programmable slew rate control. All these features are controlled with 4-pins, allowing the package to be treated like a discrete GaN FET, requiring no V_{CC} pin. Suitable for applications spanning 1–22kW, 650V GaNSafe in TOLL and TOLT packages are available with a range of $R_{DS(ON)MAX}$ of 25–98mΩ.

The 3-phase interleaved CCM TP-PFC is powered by Gen-3 Fast SiC MOSFETs with 'trench-assisted planar' technology, which offers what is claimed to be world-leading performance over temperature, delivering cool-running, fast switching and superior robustness to support faster-charging EVs and up to 3x more powerful AI data centers.

"This complete wide-bandgap solution of GaN and SiC enables the continuation of Navitas' AI power roadmap which enables this 8.5kW and plans to drive to 12kW and higher in the near-term," says CEO & co-founder Gene Sheridan. "As many as 95% of the world's data centers cannot support the power demands of servers running NVIDIA's latest Blackwell GPUs, highlighting a readiness gap in the ecosystem. This PSU design directly addresses these challenges for AI and hyperscale data centers."

The PSU was displayed for the first time at Electronica 2024 in Munich, Germany (12–15 November).

Navitas appoints GeneSiC founder Ranbir Singh to board

Former executive VP joined Navitas with acquisition of GeneSiC

Navitas has appointed Dr Ranbir Singh (formerly executive VP at Navitas and founder & CEO of GeneSiC Semiconductor) to its board of directors.

"Ranbir has led the industry with over 20 years of SiC innovation as the founder and CEO of GeneSiC; and 8 years prior to that at Wolfspeed (formerly Cree Inc) and brings deep industry knowledge to the board," comments chairman, president & CEO Gene Sheridan. "We look forward to his contributions as we grow our business with next-generation, clean-energy power for an efficient and sustainable future."

Singh joined Navitas with the acquisition of GeneSiC Semiconductor, which he founded in 2004. He is accredited with several awards, over 200 journal and conference papers, a book and over 40 US patents.

"I am excited to be joining the Navitas board at this pivotal moment as the company leads technical innovation with disruptive, wide-bandgap technology, into fast-growing AI, EV and mobile markets," says Singh.

Singh has a Bachelor of Technology, Electrical Engineering from the Indian Institute of Technology, Delhi, and both Master's and PhD degrees in Electrical Engineering – Power Semiconductors, from North Carolina State University (NCSU) in Raleigh, NC. He was inducted into NCSU's Department of Electrical and Computer Engineering (ECE) Alumni Hall of Fame in 2022.

www.navitassemi.com

Richardson expands Navitas SiC power device distribution

Partnership extended from North America to EMEA

Navitas and Richardson Electronics Ltd of LaFox, IL, USA have announced an expanded distribution partnership for silicon carbide (SiC) power semiconductors for Europe, the Middle East and Africa (EMEA).

Richardson will continue to focus on the GeneSiC product line, expanding from North America into EMEA. This includes Navitas' latest family of Gen-3 Fast MOSFETs, delivering high-speed, cool-running performance that ensures up to 25°C lower case temperatures and up to 3x longer life than alternative SiC products. This enables what is claimed to be unprecedented, industry-leading levels of performance, robustness, and quality.

With a portfolio spanning from 650V to 6500V, including bare die for those requiring further flexibility in engineered solutions, the devices are suitable for higher-power applications including, but not limited to, renewable energy and storage, motor drives, induction heating and welding, battery charging, and high-voltage DC–DC conversion.

"As a global company and technology provider for power management products and applications, Richardson Electronics is very excited to bring Navitas products to EMEA," says Greg Peloquin, executive VP & general manager of the Power & Microwave Technologies and Green Energy Solutions groups. "Expanding our relationship shows our dedication to supporting Navitas products and offering disruptive technology to meet our customers' design needs," he adds.

"Richardson Electronics provides excellent technical and sales support and has a strong reach within our key focus markets. We are looking forward to expanding our customer base in EMEA," comments David Carroll, senior VP of worldwide sales at Navitas.

For over 75 years, Richardson Electronics has been a global provider of engineered solutions, RF & microwave, and power products. The Power & Microwave Technologies group continues this legacy and complements it with new products from technology partners. The group focuses on identifying and designing disruptive technologies, introducing new products on a global basis, developing solutions for customers, and providing worldwide support. As a global firm, it provides solutions through design-in support, systems integration, prototype design and manufacturing, testing, logistics, and after-market technical service and repair, through its existing global infrastructure.

www.rellpower.com

ITC confirms Innoscience's infringement of EPC's patent

Efficient Power Conversion Corp (EPC) of El Segundo, CA, USA says the US International Trade Commission (ITC) has affirmed its initial determination that GaN-on-Si power solutions firm Innoscience of Suzhou, China infringed EPC's foundational patent for GaN technology, which is core to applications including AI, satellites, rapid chargers, humanoid robots and autonomous driving.

The decision imposes a ban on Innoscience (Zhuhai) Technology Co Ltd and its affiliates from importing GaN-related products into the USA without a license from EPC.

EPC says that the decision marks the first successfully litigated US patent dispute involving GaN-based wide-bandgap semiconductors. The decision also paves the way for EPC to expand access to its IP through licensing agreements with potential partners and customers worldwide.

"After pouring nearly two decades and immense resources into developing our uniquely valuable intellectual property portfolio, this is a tremendous victory for EPC and a major win for fair competition globally, which is critical to the success of next-generation technological advances," comments EPC's CEO & co-founder Alex Lidow.

This is the fourth time that EPC's IP rights have been affirmed against Innoscience in the past six months. EPC initially filed the lawsuit against Innoscience in the ITC in May 2023, alleging infringement of its 8,404,508 and 8,350,294 patents. In response, Innoscience challenged the validity of the EPC patents at issue in the USA, as well as EPC's counterpart patents in China. The China National Intellectual Property Administration upheld the validity of EPC's counterpart patents in April and May 2024. The ITC's initial determination by the administrative law judge in July similarly confirmed the validity of the challenged patents, and also found that Innoscience infringed EPC's foundational patent, US Patent No. 8,350,294. The ITC's final determination is subject to a 60-day Presidential review period, expiring on 6 January 2025.

ITC finds no infringement of '508 patent; violation of '294 patent to be resolved by design-arounds

In response, Innoscience notes that the ITC's final determination affirms no infringement of claim 1 (the only asserted claim) of the '508 patent.

However, the final determination affirmed the part of the judge's initial determination that found violation as to claims 2 and 3 of the '294 patent. The ITC's exclusion order is hence limited, prohibiting importation of certain accused Innoscience chips.

Innoscience says it disagrees with and will appeal this ruling, at least because the '294 patent is invalid. The US Patent and Trademark Office (USPTO) instituted an inter partes review (IPR) challenging all claims of the '294 patent under four different grounds and has agreed with Innoscience's invalidity arguments, the firm claims. The '294 IPR decision will be issued in March 2025.

Innoscience notes it is established US law that the limited exclusion order does not prohibit its customers from importing end products that use the accused chips. Moreover, since the final decision clarified the meaning of the claim term "compensated GaN layer," which is at the center of the dispute surrounding the '294 patent, it has provided clear guidance for Innoscience to design around the '294 patent by avoiding use of the "compensated GaN layer." Innoscience already has the design-around in place and will release the new products soon.

Accordingly, Innoscience expects that EPC's litigation will have no impact on its customers. Moreover, it says that it will continue to resolve the dispute with EPC through appeals in court and invalidity challenges at the USPTO.

www.epc-co.com
www.innoscience.com

Innoscience expands 100V automotive-grade portfolio

Innoscience has expanded its portfolio with two 100V automotive-grade GaN devices.

The INN100W135A-Q ($R_{DS(on),max}$ =13.5mΩ) and smaller-package INN100W800A-Q ($R_{DS(on),max}$=80mΩ) are both certified to AEC-Q101 and optimized for LiDAR as well as for high-power-density DC–DC converters, and Class D audio applications in the automotive sector.

The INN100W135A-Q and the ultra-compact INN100W800A-Q, with a WLCSP package measuring 2.13mm x 1.63mm and 0.9mm x 0.9mm respectively, are said to offer significant advantages in terms of size and power efficiency. Both devices are specifically tailored for the requirements of L2+/L3 assisted driving systems, with switching speeds up to 13 times faster and pulse widths reduced to one-fifth of those of silicon solutions. Parameters like Q_g and Q_{oss} are also improved by 1.5–3 times over their silicon counterparts. This results in medium- to long-range recognition capabilities of 200/300m, essential for advanced driver assistance and autonomous driving applications.

"Both devices have been designed to meet the growing demand for efficiency and precision in driving assistance and autonomous driving technologies," says Dr Denis Marcon, general manager, Innoscience Europe. "In LiDAR applications, it is well understood that GaN enables higher resolution and greater detection distances while reducing power loss and temperature rise than is possible with traditional silicon technology."

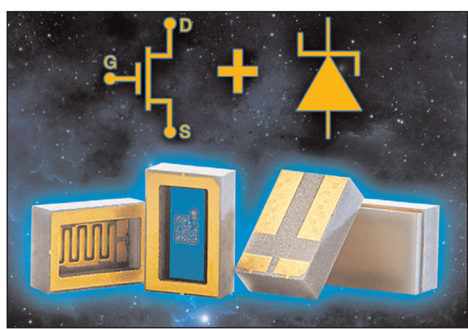
EPC Space launches rad-hard HEMTKY product line

EPC7052BSH integrates 100V, 30A, 10mΩ e-GaN HEMT with Schottky

EPC Space LLC of Haverhill, MA, USA (which provides high-reliability radiation-hardened enhancement-mode gallium nitride-on-silicon transistors and ICs for power management in space and other harsh environments) has launched the HEMTKY product line.

Comprising a high-electron-mobility transistor (HEMT) with an embedded Schottky diode, the presence of an anti-parallel Schottky diode in the HEMTKY structure minimizes third quadrant conduction losses absent GaN HEMT synchronous drive. Advantages include:

- predictable conduction losses, no reverse recovery charge;
- reduced system sensitivity to half-bridge dead-time variance;



- reduced negative voltage stress on gate drivers; and
- no need for an external anti-parallel diode.

First in the new series of products to be launched as part of the HEMTKY product line is the EPC7052BSH, a radiation-hardened e-GaN 100V, 30A, 10mΩ typical HEMT with monolithically integrated GaN Schottky diode in parallel with the source-drain terminals of the GaN power FET. The EPC7052BSH has a total dose rating greater than 1Mrad and SEE (single event effect) immunity for LET (linear energy transfer) of 85MeV/(mg/cm^2).

"EPC Space's HEMTKYs provide designers with ability to reduce their circuit power losses in hard-switching applications where the device is momentarily conducting high current in reverse," says CEO Bel Lazar.

For 500-unit quantities, engineering models are priced at $212 each, while space-level units are priced at $315 each.

www.epc.space/products/rad-hard-gan-hemts

Power Integrations launches 1700V GaN switcher IC

1700V GaN InnoMux-2 IC delivers over 90% efficiency from 1000V$_{DC}$ bus, supplying up to 70W from three accurately regulated outputs

Power Integrations Inc of San Jose, CA, USA (which provides high-voltage integrated circuits for energy-efficient power conversion) has added to its InnoMux-2 family of single-stage, independently regulated multi-output offline power supply ICs by introduced a new device featuring what is claimed to be the first 1700V gallium nitride (GaN) switch, fabricated using the company's proprietary PowiGaN technology. The 1700V rating is said to further advances the state-of-the-art for GaN power devices, previously set by Power Integrations' own 900V and 1250V devices, both launched in 2023.

The 1700V InnoMux-2 IC easily supports 1000V$_{DC}$ nominal input voltage in a flyback configuration and achieves over 90% efficiency in applications requiring one, two or three supply voltages. Each output is regulated within one percent accuracy, eliminating post-regulators and further improving system efficiency by approximately 10%.

The new device replaces expensive silicon carbide (SiC) transistors in power supply applications such as automotive chargers, solar inverters, three-phase meters and a wide variety of industrial power systems.

"Our rapid pace of GaN development has delivered three world-first voltage ratings in a span of less than two years: 900V, 1250V and now 1700V," says Radu Barsan, VP of technology. "Our new InnoMux-2 ICs combine 1700V GaN and three other recent innovations: independent, accurate, multi-output regulation; FluxLink, our secondary-side regulation (SSR) digital isolation communications technology; and zero voltage switching (ZVS) without an active-clamp, which all but eliminates switching losses," he adds.

"1700V rating is substantially higher than any other commercially available GaN HEMT that we are aware of," comments Ezgi Dogmus, activity manager, compound semiconductors at market analyst firm Yole Group. "The power GaN device market is poised to reach $2bn by decade's end, expanding across various application spaces with potentially attractive cost advantages over SiC [according to Yole Intelligence's 'Power GaN report']."

Pricing for InnoMux-2 1700V ICs starts at $4.90 for 10,000-unit quantities. A reference design RDR-1053, which describes a 60W dual-output (5V and 24V) power supply, can be downloaded from the Power Integrations website at no cost.

www.power.com/products/innomux/innomux2-ep

CGD and Qorvo collaborate on evaluation kit

Cambridge GaN Devices Ltd (CGD) and Qorvo Inc of Greensboro, NC, USA have partnered to bring together motor control and power efficiency technologies in the PAC5556A + ICeGaN evaluation kit (EVK). This combines Qorvo's BLDC/PMSM motor controller/driver and CGD's ICeGaN ICs in a board that is said to significantly improves motor control applications.

"We are enabling the development of compact, energy-efficient systems with high power density," says chief marketing officer Andrea Bricconi. "Unlike other GaN implementations, ICeGaN technology easily interfaces with Qorvo's PAC5556A motor control IC for seamless high performance in BLDC and PMSM applications," he adds.

"Wide-bandgap semiconductors like GaN and SiC are being integrated into motor control applications for the power density and efficiency advantages they offer," notes Jeff Strang, general manager of Qorvo's Power Management business unit. "CGD's ICeGaN technology delivers ease of use and reliability — two critical factors for motor control and drive designers. Customers are responding enthusiastically when they experience the power of GaN combined with our highly integrated PAC5556A 600V BLDC motor control solution."

By using CGD's latest P2 ICs, the PAC5556AEVK2 evaluation kit with 240mΩ ICeGaN achieves up to 400W peak performance without a heatsink, while the PAC5556AEVK3 with 55mΩ ICeGaN hits 800W peak with minimal airflow cooling. ICeGaN's efficiency gains result in reduced power loss, increased power availability, and minimized heat dissipation, enabling smaller and more reliable systems, it is claimed. Because ICeGaN integrates essential current sense and Miller clamp elements, gate driver design is simplified and bill-of-materials (BOM) costs are reduced. This makes the solution easy to implement and price-competitive, as well as high performance, CGD claims.

The PAC5556A + CGD GaN EVKs are said to offer higher torque at low speeds and precise control, making them suitable for white goods, ceiling fans, refrigerators, compressors and pumps. Target markets include industrial and home automation, especially where compact, high-efficiency motor control systems are required. PAC5556AEVK2 and PAC5556AEVK3 can be ordered on Qorvo's website. Demos were showcased by CGD's at electronica 2024 in Munich, Germany (12–15 November).

www.qorvo.com
www.camgandevices.com

CGD & IFPEN demo 800V$_{DC}$ inverter that outperforms SiC

CGD and French public research and training organization IFP Energies nouvelles (IFPEN) have developed a demo that confirms the suitability of CGD's ICeGaN650V GaN ICs in a multi-level, 800V$_{DC}$ inverter. The demo delivers high power density of 30kW/l, which is greater than can be achieved by more expensive, state-of-the-art silicon carbide (SiC)-based devices, it is claimed. The inverter also demonstrates the ease of paralleling that ICeGaN technology enables; each inverter node has three 25mΩ/650V ICeGaN ICs — 36 devices in total — in parallel.

"800V$_{DC}$ supports the 800V bus which is being increasingly adopted by the EV industry," notes chief marketing officer Andrea Bricconi. "By addressing automotive and other high-voltage inverter applications with energy-efficient ICeGaN-based solutions, we are delivering on CGD's key commitment — sustainability."

The multi-level GaN inverters can power electric motors to over 100kW peak, 75kW continuous power. The CGD/IFPEN demo features: a high-voltage input of up to 800V$_{DC}$; 3-phase output; a peak current of 125A$_{rms}$ (10s) (180A$_{pk}$); and a continuous current of 85A$_{rms}$ continuous (120A$_{pk}$).

CGD says that the ICeGaN multi-level design proposed by IFPEN reveals several benefits:

- Increased efficiency: the improvement in the efficiency of the traction inverter leads to an increase in battery range and a reduction in charging cycles. It also leads to a reduction in battery cost if the initial range (iso-range) is maintained;
- Higher switching frequencies: GaN transistors can operate at much higher frequencies than silicon transistors. This reduces iron losses in the motor, particularly in the case of machines with low inductances;
- Reduced electromagnetic interferences: the 3-level topology minimizes EMI and enhances the reliability of the system;
- Enhanced thermal management: insulated metallized substrate boards featuring an aluminium core facilitate superior thermal dissipation, ensuring optimal operating temperatures and extending the lifespan of the system and associated GaN devices;
- Modular design: this facilitates scalability and adaptability for varying system requirements.

"Following the implementation of this inverter reference using CGD's enabling ICeGaN ICs coupled with innovative topologies, such as multi-level solutions, IFPEN now strongly believes that GaN is a breakthrough technology in terms of performance and cost for high-voltage traction inverters," comments IFPEN program manager Gaetano De Paola.

www.ifpenergiesnouvelles.com

Wise-integration expands in North America with Ottawa Design Center

Canada-based center to develop next-gen WiseGan digital solutions for power conversion

Fabless company Wise-integration of Hyeres, France — which was spun off from CEA-Leti in 2020 and designs and develops digital-control of gallium nitride (GaN) and GaN integrated circuits for power conversion — has opened its North American Design & Development Center in Ottawa, Ontario, Canada. Led by Christian Cojocaru and staffed by experts in analog and digital technology design, the center will drive development of the firm's design portfolio for the next generations of WiseGan.

"The Canadian team will be instrumental in advancing our cutting-edge digital WiseGan series, which is specifically designed to facilitate seamless integration of GaN technology for our customers, and to be fully compatible with and optimized to facilitate MCU control," says CEO Thierry Bouchet. "By maximizing the high-frequency capabilities of GaN without added power losses, the next generations of the two product lines will enable significant reductions in system size and cost, while boosting overall conversion efficiency," he adds. "These innovations will directly address the challenges faced by designers of server power supplies, motor control and other power-converter systems, who are under increasing pressure to optimize power consumption and energy efficiency."

Since its launch in 2020, Wise-integration has established a portfolio of more than 20 patent families for its two core product lines for power electronics applications. WiseGan includes GaN power integrated circuits designed for high-frequency operation in the MHz range, integrating features that streamline implementation with digital control. WiseWare is a 32-bit, MCU-based AC-DC digital controller optimized for GaN-based power supply architectures. It offers simplified system design, a reduced bill of materials, and improved power density and efficiency.

"Our next-generation products will be a perfect vehicle to accelerate GaN adoption across power conversion markets in industrial, data-center, AI and automotive applications, where digital control is essential for managing complex systems," says Bouchet.

In August, in an earlier step of global expansion, the firm announced the launch of Hong Kong-based subsidiary Wise-integration Ltd to support its growing business in China. That was followed in September by the announcement that the investment fund Applied Ventures–ITIC Innovation Fund (AVITIC) had joined its €15m Series B funding round, which was launched in February.

www.wise-integration.com

Wise-integration signs Astute as EMEA distributor

Collaboration to accelerate adoption of GaN for consumer electronics, EVs, data centers and industrial automation

Wise-integration has agreed a strategic distribution partnership covering Europe, the Middle East and Africa (EMEA) with global electronics distributor and supply chain solutions provider Astute Group of Stevenage, UK.

Wise-integration's WiseGan family of GaN power devices and WiseWare digital control software are said to deliver significant performance advantages over conventional silicon-based solutions, including superior efficiency, reduced footprint, and enhanced switching frequencies.

WiseGan includes GaN power integrated circuits designed for high-frequency operation in the MHz range, integrating features that streamline implementation with digital control. WiseWare is a 32-bit, MCU-based AC–DC digital controller optimized for GaN-based power supply architectures.

"Their embedded systems, manufactured with TSMC's leading-edge technology, can be integrated into virtually any electronic component," comments Astute's franchise division manager Kevin Baker. "Our collaboration empowers Astute's customers with the best GaN solutions available," he adds.

"Following the recent launch of our North American Design & Development Center in Canada and our Wise-integration Ltd subsidiary in Hong Kong, this partnership with Astute Group is a significant step in expanding the global reach of our digital GaN power solutions," says Wise-integration's CEO Thierry Bouchet. "Astute's extensive network and deep industry expertise will be invaluable in accelerating the adoption of GaN technology across key EMEA markets."

The collaboration is designed to drive significant innovation and accelerate the integration of GaN technology across a broad spectrum of sectors, including consumer electronics, electric vehicles, data centers, and industrial automation.

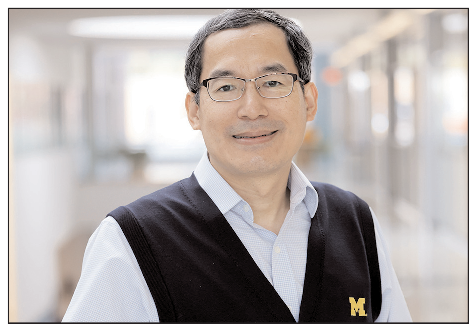
www.astutegroup.com

DARPA awards University of Michigan's Zetian Mi $3m to scale III–V materials on silicon

CMOS-compatible, defect-free growth for heterogeneous integration

The project 'CMOS compatible, defect-free universal growth of III–N and III–V multilayer heterostructures on Si (001)' of Zetian Mi, professor of Electrical Engineering and Computer Science in the University of Michigan's Department of Electrical and Computer Engineering (ECE), has been awarded $3m by the US Defense Advanced Research Projects Agency (DARPA) as part of its Material Synthesis Technologies for Universal and Diverse Integration Opportunities (M-STUDIO) initiative. The goal of M-STUDIO is to "realize a universal heterogeneous integration technology, compatible with leading-edge and future advanced-node semiconductor manufacturing processes, via atomic-precision nanoscale multi-layer material synthesis".

To achieve this goal, Mi and his collaborators Kai Sun (of the University of Michigan's Department of Materials Science and Engineering) and Patrick Fay (of University of Notre Dame) will use a new method to grow ultra-thin layers of III–V compound semiconductor crystals without a foreign metal catalyst, which often introduces impurities. These tens-of-atoms thick layers will allow Mi's team to grow the semiconductor materials on a silicon lattice without defects.



Zetian Mi. (Photo: Brenda Ahearn, Michigan Engineering.)

The final goal of the project will be to partner with Intelligent Epitaxy Technology Inc (IntelliEPI) of Richardson, TX, USA — which manufactures MBE-grown epitaxial wafers — to show the viability of this material at scale for use in industry.

"We must find new materials that have fundamentally better properties than silicon, as far as transistor functionality, but they need to be integrated into the current manufacturing processes," says Mi. "It's not likely for the industry to give up many billions of dollars of infrastructure. As such, the new material should ideally be CMOS compatible," he adds.

"We are looking into the fundamental, long-standing challenge of integrating compound semiconductors with silicon," says Mi. "It's a very difficult problem, but if we are successful, there is the possibility that this material will go into every computer, every cell phone, virtually every electronic device that we use."

www.intelliepi.com
https://ece.engin.umich.edu

India's Solid State Physics Lab develops SiC wafers and GaN HEMTs for up to X-band

GaN-on-SiC-based MMICs with limited production capability established at GAETEC

Solid State Physics Laboratory, a research arm of the Indian Ministry of Defence's Defence Research and Development Organisation (DRDO), has developed indigenous processes for growing and manufacturing 4-inch-diameter silicon carbide (SiC) wafers, as well as fabricating gallium nitride (GaN) high-electron-mobility transistors (HEMTs) up to 150W and monolithic microwave integrated circuits (MMICs) up to 40W for applications operating at up to X-band frequencies.

GaN/SiC technology is a critical enabler of next-generation applications spanning defence, aerospace and clean energy sectors, it notes.

Specifically, the technology offers improved efficiency, reduced size and weight, and enhanced performance, making it essential for future combat systems, radar, electronic warfare systems, and green energy solutions. With rising demands for lighter and more compact power supplies in future combat systems, GaN/SiC technology can provide a vital foundation for communications, intelligence, reconnaissance and unmanned systems for both military and commercial sectors, including electric vehicles and renewable energy, SSPL adds.

Indigenous GaN-on-SiC-based MMICs with limited production capability has been established at the Gallium Arsenide Technology Enabling Centre (GAETEC), Hyderabad. These multi-functional MMICs cater to broad applications in next-generation strategic systems, space, aerospace and 5G/satellite communications. The development of commercially viable SiC- and GaN-based MMIC technology is said to mark a milestone in India's journey towards 'Aatmanirbhar Bharat', fostering self-reliance in semiconductor technology.

www.drdo.gov.in/drdo/

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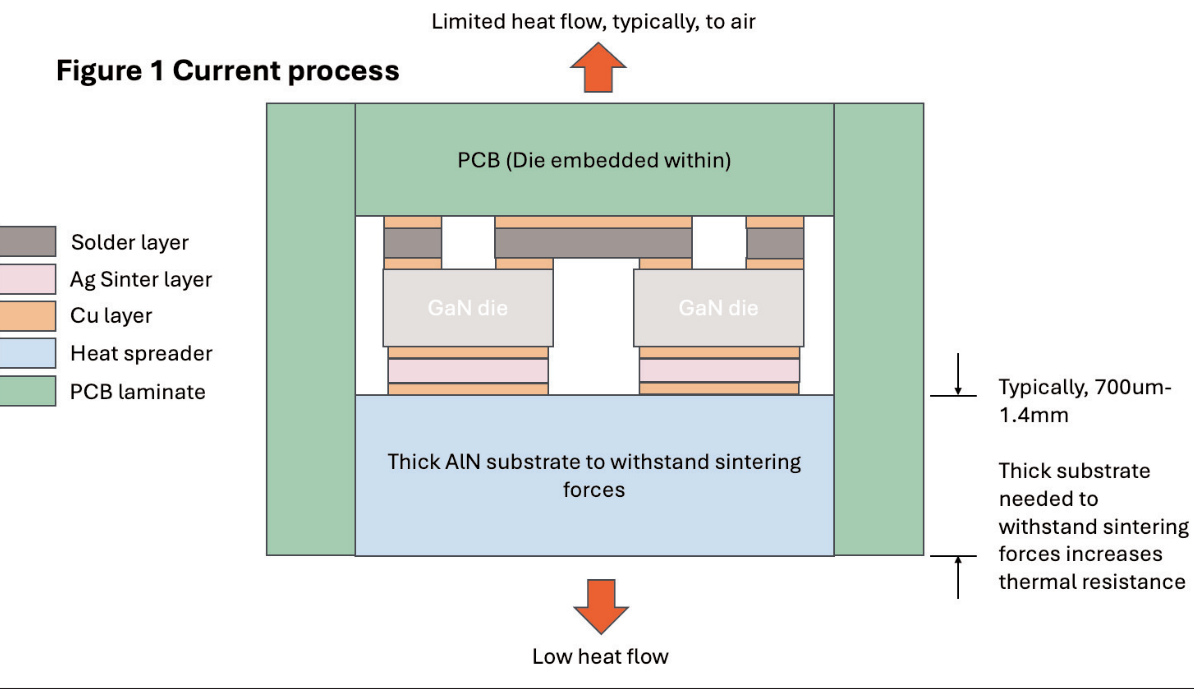
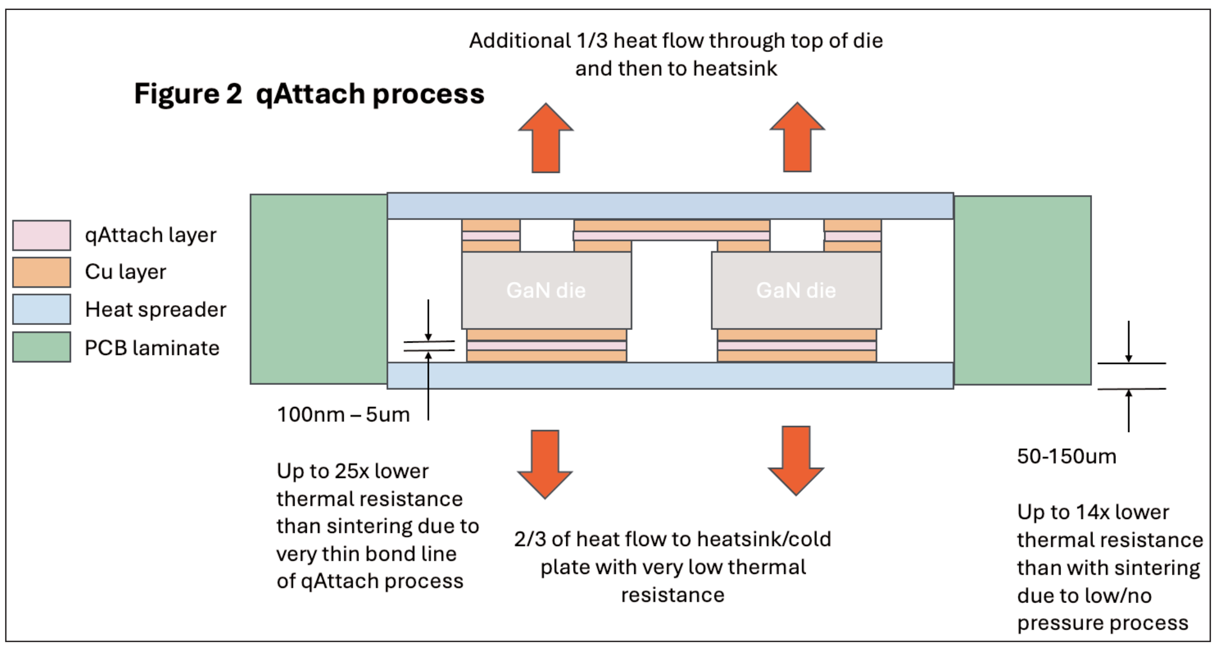
QPT files patent for die attach process that boosts waste heat removal by up to 15x

Improved reliability for power electronics packaging targets automotive and industrial motor applications

As the power handled by transistors increases to meet the needs of new applications, power electronics packaging will increasingly struggle to remove waste heat from the die. Independent power electronics firm Quantum Power Transformation (QPT) Ltd of Cambridge, UK — which was founded in 2019 and develops gallium nitride (GaN)-based electric motor controls — has hence filed a patent for a novel way to attach dies to heat spreaders or substrates which are typically aluminium nitride (AlN). Named qAttach, QPT says that this provides a much better way to conduct heat away from the die and also increases reliability as the assembly process places less stress on the substrates, which is one of the biggest challenges faced by the high-power semiconductor packaging industry.

QPT developed the new process for use with the gallium nitride (GaN) transistors that it uses in its electric motor control designs to enable them to handle the huge amounts of waste heat that results from using them for high-power, high-voltage applications and at high frequency. GaN transistors are now being made that are rated for high voltages but the die size is relatively small for high-voltage transistors, which means there is less surface area to remove heat from. As a result, they are often down rated to enable them to function without overheating. qAttach is said to solve this problem, as now significantly more heat can be efficiently removed from the die so that it will not overheat. This opens up GaN to now being efficiently used for next-generation, high-power, high-voltage applications in automotive,





industrial motors and to finally deliver on the promise of low-cost, high-voltage GaN transistors.

"The problem with the current attachment approach is that the sinter layer, which fixes the die to the substrate, is typically 30–60μm thick and this forms a thermal barrier that impedes the transfer of heat away from the chip," notes chief technology officer Rob Gwynne. "We use reliable, well-established technologies from other fields in a novel way to enable us to create the qAttach attachment layer that is potentially down to a fraction of a micron thick. This major reduction in the thermal barrier thickness means that our solution is up to ten times better at transferring waste heat away from the chip," he adds. "As we refine the process, we are expecting even better thermal transmission rates through this layer."

With the conventional approach, the heat from the die has to pass through the thick sinter layer to the substrate to be dissipated via the heat sink, as in Figure 1, explains Gwynne. The PCB is attached to the top (and around the heat spreader in embedded packages) so there is little heat dissipation that way. QPT's new structure in Figure 2 is a sandwich of heat sink, substrate, qAttach layer, die, qAttach layer, substrate and heat sink with the PCB surrounding the structure at the sides. Because the qAttach layer is ultrathin, heat can be transferred through and away much more quickly, plus this can also now happen from the top of the die to increase the total rate of heat removal by up to 15x.

The qAttach technology is said to have other improvements over the existing sintering process. Firstly, the substrate can be much thinner, as the application of the large force needed by sintering is not required. The thinner substrate significantly reduces thermal resistance to further help heat transfer away to the heat sink.

Secondly, the lower pressure required for this process means that the manufacturing stresses on the dies are lower. This reduces the possibility of device failure, which is of particular interest to automotive companies, where reliability is key.

Thirdly, the ultrathin qAttach layer is not a laminar sheet. It has a proprietary geometry that constrains expansion predominantly in the Z axis (which is perpendicular to the qAttach layer) when heated, so delamination of the attach layer from the die and substrate does not occur, which is a major issue with existing attachment methods. This is because the conventional, continuous sheet of the sintered approach has about seven times the thermal expansion of the die and about three times that of the AlN substrate. These differing rates of expansion create considerable stresses over the length of a large power die, which can result in the structure ripping itself apart when heated. This delamination is the largest cause of failures in power packages, so this new approach further improves the reliability of the assembled device.

"Our new qAttach process is a universal solution to solving the growing problem of the removal of waste heat that would otherwise hold back the development of next-generation power electronics," says Gwynne. "The ability of qAttach to improve heat transfer away from the die by up to 15x can also be used to solve the removal of waste heat from almost any other type of transistors such as silicon carbide (SiC) to enable them to handle higher power loads than they can at present," he adds. "We already have a couple of leading multinationals interested in licensing this process, as they can see the strategic benefits that this innovation would bring to their product lines."

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Diamfab and HiQuTe Diamond partner on synthetic diamond for power electronics

French CNRS spin-offs target vertical Schottky prototypes in Spring

Diamfab of Grenoble, France (which synthesizes diamond wafers and designs diamond-based electronic components as well as developing the corresponding manufacturing processes) and plasma-assisted chemical vapor deposition (CVD) synthetic diamond startup HiQuTe Diamond have announced a strategic technical partnership spanning the key stages in the value chain, from substrate production to the manufacture of electronic components, via the epitaxy of doped layers. HiQuTe Diamond will contribute its expertise in producing high-quality diamond substrates, optimized to maximize the performance of power electronics devices. Diamfab will be responsible for the epitaxial growth of doped layers using advanced crystal growth processes, as well as the manufacture of high-performance components.

Both companies stem from CNRS laboratories: the Institut Néel for Diamfab and the LSPM (Laboratoire des Sciences des Procédés et des Matériaux) for HiQuTe Diamond.

Partners to make diamond semiconductors an industrial reality

The partnership is reckoned to be the first in the world to combine diamond-related expertise in the three key stages — substrate, epitaxy and manufacturing — at such a high level of quality, in both academic and industrial spheres.

The two companies expect that, due to their geographical proximity and industrial agility, they will be able to accelerate iteration cycles to rapidly achieve unprecedented technical and financial performance, with the aim of making diamond semiconductors an industrial reality.

"With performance levels between 10 and 40 times higher than components based on conventional materials, diamond semiconductors are key to widespread adoption of electrification and the decarbonization of entire sectors of the economy," claims Diamfab's CEO Gauthier Chicot. "By working with HiQuTe Diamond, we have the will and the technological, human and geographical resources to create this sector of excellence in France," he adds.

"The plasma-assisted CVD growth process makes it possible to produce boron-doped diamonds that are specifically adapted to the demanding applications of power electronics," notes HiQuTe Diamond's CEO Florent Alzetto. "This sustainable process ensures rigorous control of physical properties, while meeting performance challenges," he adds. "The convergence of our expertise and that of Diamfab offers unprecedented opportunities to meet global industrial challenges in terms of performance and energy efficiency."

Next steps

The two companies plan to begin collaborating by manufacturing a first series of vertical Schottky diodes on HiQuTe Diamond substrates using diamond epitaxy optimized by Diamfab, with the first prototypes expected in Spring 2025.

www.diamfab.com
www.hiqute-diamond.com

Spain gains European approval for €81m subsidy for Diamond Foundry Europe's new fab

The European Commission has approved, under European Union (EU) State aid rules, a direct grant of €81m from Spain to support Diamond Foundry Europe (a subsidiary of Diamond Foundry Inc of San Francisco, CA, USA) in setting up a new factory — involving a total investment of about €675m — for the production of semiconductor-grade rough synthetic diamonds in Trujillo in Extremadura, an area eligible for regional aid under Article 107(3)(a) of the Treaty on the Functioning of the EU (TFEU).

Synthetic diamonds can be used as an alternative to other materials currently used, such as silicon. The project aims to serve the demand of key sectors such as 5G networks or electric vehicles. Using Diamond Foundry's plasma reactor technology, the plant will produce rough synthetic diamond wafers, with a capacity of 4–5 million carats per year.

The subsidy will contribute to the EU's strategic objectives relating to job creation, regional development, and to the green transition of the regional economy. The project should create about 300 direct jobs, as well as further indirect jobs. The new factory is designed to be carbon-neutral, powered through entirely renewable energy generated by a solar photovoltaic plant.

"Today's decision enables Spain to support Diamond Foundry Europe in setting-up its first factory in Europe to produce semiconductor-grade rough synthetic diamonds," comments Teresa Ribera, executive Vice-President for Clean, Just and Competitive Transition. "This will foster the transition to a decarbonized economy and competitiveness," she adds. "The measure will also contribute to the economic development of the region, while limiting possible distortions of competition."

www.DF.com
www.ec.europa.eu

Akash allocated US CHIPS Act funding for diamond cooling technology

Akash Systems of Oakland, CA, USA has signed a non-binding preliminary memorandum of terms with the US Department of Commerce under the CHIPS and Science Act to receive over $68m in direct funding. This includes $18.2m in proposed direct funding and $50m in combined federal and California state tax credits. This proposed funding would provide Akash, a pioneer of diamond cooling semiconductor technologies, significant support for its operational ramp-up in AI, data centers, space and defense markets.

Diamond Cooled servers launched for AI data center and high-performance computing

By reducing a GPU's hot-spot temperature by just 10–20°C, Akash says that it can cause the data-center operator with hundreds of servers to save millions of dollars in cooling costs. Temperature reductions can also cause GPUs to reach their intrinsic speed limit without thermal throttling.

Akash claims that, with Diamond Cooled servers, it is setting new global benchmarks in AI server performance, catering to the growing demands of data centers and high-performance compute applications.

In the rapidly growing industry of artificial intelligence, efficient thermal management is critical to supporting the extreme demands of AI while mitigating its effects on the globe's limited energy supply. Akash Systems' newly launched Diamond Cooled servers address this need, utilizing the extreme thermal properties of synthetic diamond — the most thermally conductive material — to reduce GPU temperatures, and thus the cost of cooling down servers and the data centers that they occupy. This empowers already liquid-cooled servers to operate at even higher clock cycles while also reducing thermal throttling, where the server's operating system reduces workloads on the GPU in order to reduce GPU hot -spot temperatures.

Space communications applications

Beyond terrestrial applications, Akash is targeting satellite communications with its Diamond-Cooled Satellite Radios. Its gallium nitride (GaN)-on-diamond technology is pivotal in producing satellite radios and power amplifiers that offer:

- 5–10x faster data rates: Enhanced communication speeds for satellite operations.
- Increased reliability: Robust performance in the challenging conditions of space.
- 50% small form factor: Reduced size enables lower costs and deployment flexibility.

The firm claims that these advances are instrumental in improving global connectivity and supporting critical space missions. "Integrating Akash Systems' GaN-on-diamond radios into our satellites has been transformative for Pixxel," comments Pixxel's co-founder & CEO Awais Ahmed. "The diamond cooling technology ensures exceptional thermal management, allowing our payloads to operate at peak performance even in the harsh conditions of space," he adds. "This advancement has enabled us to deliver high-resolution hyperspectral imagery with unprecedented efficiency."

Strengthening supply chains

The proposed CHIPS Act funding should help to accelerate the development and deployment of Akash's Diamond Cooling technology across various sectors including AI, data centers, space communications, automotive, clean energy, cellular communications, and defense.

"This proposed funding is an important milestone for Akash Systems and for innovative US technology," says co-founder & CEO Felix Ejeckam. "As a US company developing next-generation semiconductor technology, this validates our vision and strategy, helping us to deliver cutting-edge solutions that address thermal challenges in today's high-performance compute and communication systems."

Akash has previously received Seed and Series A funding from venture capital firms including Founders Fund, Khosla Ventures, and Kearny Jackson.

"Akash Systems has not only developed proprietary materials and technologies that are advancing important industries like AI and space but is also contributing towards the strengthening of critical supply chains in the USA," comments Founders Fund partner Delian Asparouhov.

Sustainability and workforce development

Akash says that it has prioritized responsible resource use in its CHIPS-funded facility, aiming to source 100% of its electricity from renewable sources by 2030. The firm will also implement advanced water recirculation and reuse systems to minimize water discharge and consumption, ensuring a sustainable approach to manufacturing.

Akash has also committed to workforce development for its new facility by partnering with Alameda Building Trades under a project labor agreement, ensuring union support through IUE-CWA, and collaborating with local colleges to recruit, train and hire West Oakland residents, including those from underserved communities.

"As we rebuild the semiconductor industry in the United States, workers and our communities benefit from this historic public investment," says Claude Cummings Jr, president of Communications Workers of America. "Creating good union jobs will mean that production workers can have family-supporting careers in America's semiconductor industry."

www.akashsystems.com

Advantest unveils KGD test cell for power semiconductors

MT series power device tester integrated with new HA1100 die prober maximizes die-level test yields for wide-bandgap devices

Tokyo-based automated semiconductor test & measurement equipment maker Advantest Corp has announced an integrated test cell designed to maximize die-level test yields for wide-bandgap (WBG) devices essential to power semiconductors. The Advantest Known Good Die (KGD) Test Cell combines the firm's CREA MT series power device testers with the new HA1100 die prober.

Screening for failures in WBG devices is challenging, as the probe card, chuck and devices can be damaged due to the high voltage and current at which they operate, notes Advantest. Essentially serving as a one-stop shop for efficient equipment management, the Advantest KGD test cell helps to reduce customers' manufacturing costs, claims the firm, as CREA's proprietary probe card interface (PCI) technology can eliminate damage risk. However, if damage does occur, Advantest can investigate it using the test cell, allowing customers to minimize downtime. The HA1100 die prober for the CREA MT series test systems enables the assembly of dies in power modules using only passed (KGD) die, ensuring that no failed die find their way into the module. This prevents yield loss at module test, reducing the loss of final multi-die assembled power modules.

"Our new KGD test cell is the first solution to combine the CREA MT testers with Advantest's proven handling technology, enabling dynamic test at the die level," says Kazuyuki Yamashita, executive VP, DH Group, Advantest. "The CREA PCI technology regulates power/energy to protect the probe card, the chuck and the devices from damage while testing failing die – a competitive differentiator that lets customers assemble their modules with confidence," he adds.

Currently under development, the HA1100 die prober will be released to the global market in second-quarter 2025.

www.semiconjapan.org

Advantest launches 100MHz–20GHz, 2GHz-bandwidth RF IC test card for V93000 EXA Scale platform

Wave Scale RF20ex provides unified, single-card solution for all standard RF applications plus emerging technologies such as Wi-Fi 8 and 6G devices

Tokyo-based automated semiconductor test & measurement equipment maker Advantest Corp has unveiled the Wave Scale RF20ex instrument for the V93000 EXA Scale platform, enabling customers to test virtually any type of radio frequency (RF) device using a single instrument. Wave Scale RF20ex takes the innovations of the V93000 Wave Scale RF solution but provides double the number of RF ports per instrument. Offering future-proof frequency and bandwidth coverage (with a frequency range of 100MHz to 20GHz and what is claimed to be an industry-leading 2GHz bandwidth capability), it is equipped to address 5G, Wi-Fi 7, ultra-wideband (UWB) and any other current or future standards in RF.

As semiconductors continue to evolve toward higher performance, technology convergence and complexity, a broader and more integrated test solution is needed, says Advantest. The new Wave Scale RF20ex provides a unified, single-card solution for all standard RF applications. For UWB applications, Wave Scale RF20ex on the V93000 platform enables ATE for a new class of devices that are more demanding in their testing requirements in terms of modulation bandwidth and frequency coverage while driving higher levels of multi-site test and lower cost-of-test (CoT).

"Our intent in developing Wave Scale RF20ex is to offer the best-in-class instrument for RF ATE with the best available operational efficiency," says Ralf Stoffels, executive officer & division manager of Advantest's V93000 product unit. "This single card improves performance for many applications while simplifying configurations that can cover the entire RF market — with built-in capability to also handle the forthcoming Wi-Fi 8 and 6G device generations."

Features and benefits offered by the Wave Scale RF20ex card are said to include:

- 64 bi-directional ports per card;
- 100MHz–20GHz coverage on all ports;
- 2GHz of instantaneous bandwidth for stimulus and measurement.

The new Wave Scale RF20ex card is already in use at several customer sites and will be broadly available in December.

www.advantest.com/en/

CVD Equipment's Q3 revenue grows 31% year-on-year

Inventory write-down for 150mm SiC PVT system as wafer producers transition to 200mm SiC PVT system evaluations

For third-quarter 2024, CVD Equipment Corp of Central Islip, NY, USA (a designer and maker of chemical vapor deposition, thermal processing, physical vapor transport, gas and chemical delivery control systems, and other equipment and process solutions for developing and manufacturing materials and coatings) has reported revenue of $8.2m, up 31.4% on $6.2m a year ago. Growth is due mainly to higher CVD Equipment system revenue and an increase in gas delivery system revenue by the SDC segment, plus $0.8m from a modification of a customer contract.

"We are staying the course on our strategic efforts to build critical customer relationships, while carefully managing our costs to achieve our goal of long-term profitability and positive cash flow, while simultaneously focusing on growth and return on investment," says president & CEO Manny Lakios.

"We continue to see an ongoing recovery of our Aerospace & Defense market segment. In early November, we received a $3.5m follow-on order for our CVI/CVD3500 system from an existing aerospace customer."

"The silicon carbide market has remained quite dynamic, with ongoing overcapacity and declining wafer pricing," notes Lakios. "That said, SiC wafer producers are quickly transitioning to 200mm production to stay competitive, and CVD is making progress with the shipment of our first PVT200 system during the third quarter. As we stated previously, this was a strategic order for SiC 200mm crystal boule growth that we received in the first quarter of 2024. The performance of the system is currently being evaluated for production by our now second PVT account. In addition, we are continuing to support both our PVT150 and PVT200 products in the field."

During the quarter, as a result of changes in the overall market for equipment for 150mm SiC wafers, the firm recognized a $1m non-cash charge to reduce PVT150 inventory to net realizable value.

Revenue growth supported an improvement in operating performance and system gross margins. Due to the improvement in contract mix, overall gross margin improved, but this was offset by the inventory charge.

CVD Equipment Corp recognized a $0.625m gain on the sale of equipment by its MesoScribe subsidiary. MesoScribe fulfilled its final orders of $0.7m during the quarter and ceased operations as of end-September.

Net income was $0.2m ($0.03 per share), an improvement on a net loss of $0.75m ($0.11 per share) a year ago.

Cash and cash equivalents at end-September 2024 were $10m, down from $14m at end-December 2023.

"Our order and revenue levels continue to fluctuate, given the nature of the emerging growth end-markets we serve," notes Lakios.

Orders were $4.1m (level with a year ago), principally from the CVD Equipment segment. Orders for the first nine months of 2024 were $21m, up from $19.9m for the first nine months of 2023.

Order backlog at the end of September was $19.8m, down on $24m at end-June but still up on $18.4m at end-December 2023.

"We continue to make investments in both R&D and sales & marketing, focused on our three key strategic markets — aerospace & defense, high-power electronics and EV battery materials/energy storage," notes Lakios.

www.cvdequipment.com

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Australia's MTM to develop US-based critical materials recovery for Indium Corp

Testing on Indium-supplied feedstocks underway at MTM's Texas lab

A memorandum of understanding (MOU) has been signed for MTM Critical Metals Ltd of West Perth, WA, Australia to develop a US-based processing solution using its Flash Joule Heating (FJH) technology to recover high-value metals — including gallium, germanium, indium and tin — from various scrap sources provided by Indium Corp of Clinton, NY, USA (a supplier of refined gallium, germanium, indium and other specialty technology metals).

The initiative aligns with US efforts to establish a secure domestic supply of critical materials. Testing on Indium-supplied feedstocks is already underway at MTM's Texas-based laboratory.

By establishing an onshore processing capability, the partnership addresses strategic vulnerabilities in the US supply chain, reducing reliance on imports from China, which currently dominates global supply and processing of these metals and has previously curtailed supply by restricting exports of refined metals.

"This partnership with MTM aligns with our commitment to enhancing US-based supply chains for critical metals essential to modern technologies," says Indium's global business unit manager Markus Roas. "FJH technology offers a novel and sustainable solution to recover these vital elements from waste materials, ensuring reliable access without relying on external sources. Secondary raw materials and urban mining will become key pillars for the future," he believes.

We are tackling supply chain vulnerabilities with an innovative approach to efficiently recover critical metals domestically, advancing US efforts towards critical metal independence

"We are thrilled to partner with Indium, a global leader in critical technology metals, to secure a US-based supply of metals essential to the defence, semiconductor and high-tech industries," says MTM's CEO Michael Walshe. "This collaboration represents a significant milestone for our company, providing strong external validation of our technology," he adds. "Together, we are tackling supply chain vulnerabilities with an innovative approach to efficiently recover critical metals domestically, advancing US efforts towards critical metal independence."

www.indium.com
www.mtmcriticalmetals.com.au

Rio Tinto progresses development of gallium extraction process in Quebec

Technology development phase to be followed by 3.5 tonne per annum demonstration plant

As part of an R&D program, global mining group Rio Tinto is assessing the potential for extracting and valorizing the gallium that is present in bauxite processed in its alumina refinery in Saguenay–Lac-Saint-Jean (the only one in Canada).

When the preliminary phase of technology development is conclusive, Rio Tinto plans to build a demonstration plant in Saguenay for extraction technology that can produce up to 3.5 tonnes of gallium per year. The Government of Quebec has committed up to CDN$7m for the demonstration phase. Eventually, the extraction potential of a commercial-scale plant could reach 40 tonnes annually, representing 5–10% of existing gallium production worldwide.

"This new R&D project is destined to help strengthen the North American supply chain for critical and strategic minerals," says Jérôme Pécresse, chief executive of Rio Tinto Aluminium. "As many important steps are yet to be achieved, Rio Tinto is strongly involved in this important journey and thanks the Government of Quebec for its important contribution," he adds.

This new R&D project is destined to help strengthen the North American supply chain for critical and strategic minerals

The announcement is "directly in line with our government's vision of a circular economy, wealth creation in a greener economy, and Quebec's influence as a world leader in critical and strategic minerals," says Maïté Blanchette Vézina, Quebec's Minister of Natural Resources and Forestry, and the Minister responsible for the regions Bas-Saint-Laurent and Gaspésie-Îles-de-la-Madeleine.

The announcement is "a key step in developing a strategic North American supply chain," says The Honourable François-Philippe Champagne, Canada's Minister of Innovation, Science and Industry.

www.riotinto.com

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IQE to add 109 jobs and invest $305m expanding US operation in Greensboro

CHIPS Act funding to aid addition of MOCVD epi to existing MBE

Epiwafer and substrate maker IQE plc of Cardiff, Wales, UK has announced an expansion of its manufacturing facility in Greensboro, Guilford County, North Carolina, subject to customer commitments and funding from the US federal CHIPS and Science Act. The company plans to add 109 jobs and invest $305m over the next several years.

IQE has operated for over a decade in Greensboro, where it has 72 staff, using molecular beam epitaxy (MBE) to manufacture epiwafers for the defense and aerospace industries. This potential investment would add complementary metal-organic chemical vapor deposition (MOCVD) epitaxy and provide a new technology for the production of chips serving the electric vehicle (EV) market.

"Greensboro has proven to be a strategic location for IQE and has provided access to exceptional talent," says interim CEO Jutta Meier. "We look forward to continuing our partnership with the city as we progress further with our application for Government funding via the CHIPS Act which, along with funding commitments from the State, will provide us with the capital to invest and expand our local footprint," she adds.

"North Carolina has more than 110 companies exporting $1.2bn of semiconductors and microelectronics around the world," notes North Carolina Commerce Secretary Machelle Baker Sanders. "This expansion validates our reputation for the best talent and research partnerships that continue to attract and retain advanced manufacturers like IQE."

To help facilitate IQE's expansion, a performance-based grant of $275,000 comes from the One North Carolina Fund, which provides financial assistance to local governments to help attract economic investment and create jobs. Companies receive no money upfront and must meet job creation and capital investment targets to qualify for payment. All One NC grants require matching participation from local governments, and any award is contingent upon that condition being met.

Partnering with the North Carolina Department of Commerce and the Economic Development Partnership of North Carolina on this project were the North Carolina General Assembly, the Commerce Department's Division of Workforce Solutions, the North Carolina Community College System, Guilford Technical Community College, GuilfordWorks, the City of Greensboro, Guilford County, the Guilford County Economic Development Alliance, the Greensboro Chamber of Commerce and Duke Energy.

www.iqep.com
www.commerce.nc.gov

III–V Epi's chief technology officer Richard Hogg chairing International Workshop on PCSELs

Kyoto University's professor Susumu Noda giving keynote

Professor Richard Hogg, chief technical officer at III–V Epi Ltd of Glasgow, Scotland, UK — which provides a molecular beam epitaxy (MBE) and metal-organic chemical vapor deposition (MOCVD) service for custom compound semiconductor wafer design, manufacturing, test and characterization — is chairing the International Workshop on PCSELs 2024 (7–8 November) at Aston University's Aston Institute of Photonics Technology (AIPT), where Hogg is Professor of Photonics.

The workshop's keynote speaker is Susumu Noda (Professor of Electronic Science and Engineering at Japan's Kyoto University), who is a pioneer of PCSEL (photonic-crystal surface-emitting laser) research.

CTO Richard Hogg.

"PCSELs are a new and evolving semiconductor laser offering many performance and manufacturing advantages over incumbent laser technologies. The lasers can benefit a wide range of applications, from smart manufacturing, ICT, LiDAR, face recognition, to medical, healthcare, telecoms and datacoms," notes Hogg. "Professor Noda is a world authority in PCSEL research," he adds. "This will be followed by further presentations from other leading researchers from around the world. Attendees will also discuss results and share ideas on device engineering, manufacturing and new applications. As CTO of III–V Epi, I will bring PCSEL manufacturing experience to those discussions."

AIPT is one of over 80 photonic research centers worldwide. It actively collaborates with industrial and commercial partners, including Airbus, IBM, Infinera, Thales, BAE Systems, and Nokia Bell Labs.

www.pcsel.org
www.iii-vepi.com

IQE's flat forecast for 2024 prompts strategic review

Largest shareholder proposes short-term financing amid market dip

In a trading update, epiwafer and substrate maker IQE plc of Cardiff, Wales, UK says it expects revenue for full-year 2024 of about £115m, roughly flat with 2023's £115.3m (rather than September's forecast of year-on-year growth, to the lower end of analysts' forecast of £130–153.7m). "In line with the rest of the industry, we are continuing to see a slower-than-anticipated recovery in key sectors driven by weak consumer demand in end markets," the firm says. IQE expects this to result in an adjusted EBITDA of at least £5m (up from 2023's £4.3m, albeit below analysts' forecast in April of £11.1–16.6m).

"The impact of the slow pace of recovery in the semiconductor industry can be seen across the sector and is reflected in our revenue expectations for full-year 2024," notes IQE's executive chair Mark Cubitt.

Strategic review includes considering options for Taiwan operations

IQE's board remains confident in the firm's long-term prospects because of its leading position in providing compound semiconductors across several market verticals and to a base of global marque customers. The board believes there is significant value in IQE that is not currently reflected in its market capitalization. Consequently, IQE is to conduct a comprehensive strategic review of its asset base to ensure that it has a strong capital position to further invest in its core operations. The board believes there is a significant market opportunity in IQE's core operations and remains focused on reducing its cost structure for profitable growth.

The slow pace of recovery in the semiconductor industry can be seen across the sector and is reflected in our revenue expectations for full-year 2024

In the first instance, IQE will broaden its options in relation to the proposed IPO of its Taiwan operations to include all strategic options, including a full sale. It has retained Lazard to advise on the strategic review, which will be overseen by the board, with input from key stakeholders.

Largest shareholder proposes short-term financing

To help it navigate the ongoing market softness, IQE is negotiating a proposal from its largest shareholder Lombard Odier regarding short-term financing. IQE says that Lombard Odier's willingness to extend up to about £15m via a convertible loan note with a conversion price of 15p per share is a strong demonstration of Lombard Odier's confidence in the embedded value within IQE. The firm intends to consult with its other major shareholders regarding the proposed financing.

IQE also continues to have a constructive dialogue with HSBC, and the directors do not foresee the need to raise further equity should these ongoing discussions progress as expected.

"Looking ahead, the strategic review, including the broader assessment of options for our Taiwan operations, will ensure we have a strong capital base to continue investing in our core business and support IQE's long-term strategy," says Cubitt. "We are confident in IQE's long-term prospects and inherent value."

www.iqep.com

IQE announces departure of CEO Americo Lemos

CFO Jutta Meier becomes interim CEO

Epiwafer and substrate maker IQE plc of Cardiff, Wales, UK says that chief executive officer Americo Lemos has left the company with immediate effect.

Mark Cubitt, who joined the IQE board earlier in October as chair-elect, will become executive chair. He is currently non-executive chair at AIM-listed Beeks Group and Concurrent Technologies. Jutta Meier will take up the position of IQE's interim CEO in addition to her chief financial officer role. Meier joined IQE in January from Intel Corp.

Phil Smith, who has been chair of IQE since 2019, announced earlier in October that he is stepping down from his role but remaining on the IQE board as a non-executive director.

IQE has begun the search for a permanent CEO.

"Whilst IQE continues to navigate the semiconductor market recovery, we are confident that the company's renowned technical expertise is well aligned to long-term growth market vectors," says Smith. "In Mark and Jutta we have two excellent individuals with the necessary sector and leadership skills to capture that growth in partnership with our customers, employees and broader stakeholders," he adds. "Their immediate priorities will include a focus on executing on the near-term pipeline as well as cash generation across the group and on unlocking embedded value by pursuing the IPO of our Taiwan business. They will examine other efforts to optimize our asset base and ensure that resources are centered around IQE's strategic areas of expertise."

AlixLabs gains €345,000 grant from Vinnova

Funds to help advance ALE Pitch Splitting to higher Technology Readiness Level and strengthen customer engagement

AlixLabs AB of Lund, Sweden — which was spun off from Lund University in 2019 and has developed the Atomic Layer Etching (ALE) Pitch Splitting technology (APS) — has been granted SEK4m (about €345,000) in funding from Swedish innovation agency Vinnova. The funding is spread over three years, with SEK658,000 (~€56,000) credited immediately, with the remainder to follow over the coming three years. The funds will help AlixLabs to advance its APS technology to a higher Technology Readiness Level (TRL) and to strengthen customer engagement efforts.

The funding is part of Vinnova's initiative to accelerate deep-tech companies, recognizing the potential of AlixLabs' APS technology to enable cost-efficient Ångström-level scaling of semiconductors.

"The support comes at a crucial stage as we are installing our first 300mm tool in our cleanroom and are increasingly engaging with potential clients around the semiconductor industry," says chief operations officer and R&D manager Amin Karimi. "At the core of our efforts is our APS technology, which we are convinced is the most sustainable and affordable way forward for semiconductor manufacturing at 3nm and 2nm and beyond."

AlixLabs' offering includes its APS technology that already allows for etching of feature sizes comparable to those of today's 3nm-class chips with the company's own equipment. With other proprietary ALE processes, AlixLabs can also contribute to RF and power IC gallium nitride (GaN) and silicon carbide (SiC) workflows, with pattern transfer, precision etching and surface roughness reduction for wafers.

"The semiconductor industry is facing a big challenge with regards to sustainability and rising costs to manufacture leading-edge semiconductors. We propose etching instead of costly EUV [extreme ultraviolet] lithography, and our demonstrations show that we can help produce sub-3nm chips at 35–50% lower costs per wafer pass than by using EUV," says CEO Jonas Sundqvist. "While we target the leading-edge logic and memory producers with APS, our technology also makes it possible for foundries who have given up pursuing sub-20nm production to scale down in a cost-effective way."

The Vinnova grant will be used by AlixLabs to accelerate the commercialization of its APS technology by deepening customer engagement and conducting demonstration projects. These demos will be carried out both at AlixLabs' facilities and on customer platforms, showcasing the practical advantages of APS. This approach is expected to advance the Technology Readiness Level (TRL) of the firm's solutions, paving the way for broader industry adoption and reinforcing AlixLabs' commitment to delivering cost-effective scaling solutions for semiconductor manufacturing.

www.alixlabs.com

AlixLabs debuts 300mm APS wafer processing equipment at SEMICON Japan

AlixLabs participated at SEMICON Japan 2024 (11–13 December), marking the public debut for its 300mm wafer process chamber. Its Made in Sweden APS (ALE Pitch Splitting) tools are aimed at allowing the semiconductor industry to scale down to sub-7nm manufacturing processes in a more sustainable way, and is positioned as an alternative to costly double patterning or EUV (extreme ultraviolet) solutions.

APS is designed to reduce the cost of leading-edge manufacturing, sub-7nm, where feature sizes of less than 20nm are required. An estimated cost saving of up to 40% per mask layer can be achieved with APS rather than relying on EUV lithography, and complex self-aligned multi patterning schemes.

"As our 300mm tool is being put through its paces in our lab, we look forward to demonstrating it for Japanese clients," says chief operating officer & R&D manager Amin Karimi. "Japan is investing heavily in revitalizing its semiconductor industry and once again becoming a leading-edge player in the business. With APS we can help make this happen at lower costs up front as well as during mass production, while we lower the carbon footprint of the production," he adds. "We have a lot of interest from Japanese clients."

APS and the Made in Sweden tools associated with it can already create 20nm half-pitch lines and critical dimensions below 15nm on silicon and 3nm on gallium phosphide. It also has numerous applications for power electronics, including precision etching and surface cleaning, each allowing for improved electrical performance than conventional methods in use today, it is claimed.

AlixLabs' goal is to supply leading semiconductor manufacturers, in both logic and memory segments. At SEMICON Japan, it was represented by Karimi in the EU Pavilion.

www.semiconjapan.org

IntelliEPI awarded Texas Semiconductor Innovation Fund's first grant

$4.12m for new 30,000ft^2 epi facility to nearly triple annual production

Texas Governor Greg Abbott says that the first Texas Semiconductor Innovation Fund (TSIF) grant of $4,120,000 has been extended to Intelligent Epitaxy Technology Inc (IntelliEPI) of Richardson, TX, USA, which manufactures molecular beam epitaxy (MBE)-grown epitaxial wafers for telecoms, photonics, radio frequency and microwave technologies. This will fund the firm's new 30,000ft^2 wafer production facility in Allen, Texas, which is expected to create more than $41m in capital investment and to nearly triple the company's annual wafer production. Abbott signed into law the Texas CHIPS Act (House Bill 5174) in June 2023, establishing the TSIF as well as the Texas Semiconductor Innovation Consortium.

The Texas Semiconductor Innovation Fund is a new incentive program to encourage Texas' leadership in semiconductor research, design and manufacturing. Administered by the Texas CHIPS Office (a newly formed division within the Governor's Economic Development & Tourism Office), the programs are designed to leverage Texas' investments in the semiconductor industry, encourage semiconductor-related companies to expand in the state, further develop the expertise and capacity of Texas institutions of higher education, and maintain the state's position as the nation's leader in semiconductor manufacturing.

"Texas is the no. 1 state for semiconductor manufacturing, leading the nation as the top exporter of semiconductors and other electronic components for the last 13 years," noted Abbott.

The funding will not only expand our production facilities but also solidify the State of Texas' position as a key hub for compound wafer manufacturing, a critical need for America's national and economic security

As the only domestic US manufacturer of epitaxy-based compound semiconductor wafers, IntelliEPI says that it will further modernize its epitaxy reactors in Texas.

"This TSIF award underscores the critical importance of our advanced compound wafer technologies, along with TSIF's strategic goals for semiconductor innovation," notes IntelliEPI's CEO & chairman Dr Yung-Chung Kao. "The funding will not only expand our production facilities but also solidify the State of Texas' position as a key hub for compound wafer manufacturing, a critical need for America's national and economic security," he adds.

"This fund not only supports job creation and economic growth but also fortifies Texas's leadership in semiconductor innovation, ensuring our state's prosperity for generations to come," says Senator Joan Huffman, chair of the Senate Finance Committee.

www.intelliepi.com
www.gov.texas.gov/business/page/texas-chips-office

Riber's year-to-date revenue grows 14% to €18.5m

Order book grows by 14% to €38.3m

For third-quarter 2024, molecular beam epitaxy (MBE) system maker Riber S.A. of Bezons, France has reported revenue of €4.7m, almost halving from €9.3m in Q2/2024 and down from €4m a year previously.

However, for the year to end-September 2024 revenue of €18.5m is up 14% year-on-year from €16.2m, driven by the company's strengthened position in the MBE market for both research and industrial production.

Specifically, MBE Systems revenue rose by 28% from €9.6m to €12.3m (despite machine deliveries falling from five to four).

Services & Accessories revenue has fallen by 6% from €6.6m to €6.2m.

Of total year-to-date revenue, 68% was contributed by Asia, 25% came from Europe and 6% from North America.

Order book grows by 14%

The MBE Systems order book has grown by 16% from €27.6m to €31.9m (comprising 13 systems, including 8 production machines). However, this does not include the order for a production system announced on 21 October.

The Services & Accessories order book has risen by 6% from €6.1m to €6.4m.

The total order book has hence grown by 14% from €33.6m at end-September 2023 to €38.3m to end-September 2024.

Full-year revenue to grow to more than €40m

Based on the fourth-quarter delivery schedule, Riber expects full-year revenue to exceed €40m, along with further improvements in earnings.

Also, against a favorable backdrop of growth in the compound semiconductor market, new orders should continue to be booked before the end of 2024, expects Riber.

www.riber.com

Aixtron Innovation Center opened by North Rhine-Westphalia's Minister for Economic Affairs

First 300mm GaN prototype systems already integrated into pilot lines at several customers

After beginning construction in November 2023, the new €100m Innovation Center of deposition equipment maker Aixtron SE in Herzogenrath, Aachen, Germany has been opened by Mona Neubaur, Minister for Economic Affairs, Industry, Climate Protection and Energy & Deputy Prime Minister of the State of North Rhine-Westphalia.

The official ceremony was attended by representatives from politics, the city of Herzogenrath, and the Aachen Chamber of Industry and Commerce.

Neubaur visited Aixtron as part of an innovation tour in North Rhine-Westphalia. President & chief executive officer Dr Felix Grawert and chief financial officer Dr Christian Danninger showed the minister the new R&D complex, which has 1000m^2 of cleanroom space.

From left to right: Dr Benjamin Fadavian, Dr Felix Grawert, Mona Neubaur, and Dr Christian Danninger. (Photo: Aixtron/Friedrich Stark.)

The Innovation Center building is designed for the transition to 300mm-diameter wafers for gallium nitride (GaN) and other compound semiconductor applications. "The launch of 300mm wafer technology is a milestone for the energy efficiency and competitiveness of our region," stated Neubaur. "Our global competitiveness benefits enormously from robust domestic semiconductor production, because semiconductors are essential for the transformation towards climate neutrality," she added.

Due to GaN's advantageous material properties in power electronics applications, GaN-based devices can increase the efficiency of chargers in consumer electronics, enable efficient power conversion in renewable energy, and provide energy-efficient power supplies for servers and data centers. This also helps with burgeoning artificial intelligence applications, which require large amounts of energy.

This demand is driving Aixtron's development of 300mm deposition technology, as the larger wafer size enables a productivity gain of 2.25 times more wafer area compared with incumbent 200mm wafers. Also, customers can use their 300mm fabs and processing equipment for the first time for compound semiconductor applications, making make GaN device production not only more cost-effective but also offering opportunities for technology performance gains in the future.

"With 300mm wafer technology, we are bringing compound semiconductor for the first time into the mainstream of semiconductor fabrication," says professor Michael Heuken, VP Advanced Technologies at Aixtron. "The Innovation Center is a major element of our strategy, providing space and capabilities for next-generation technologies. The step towards 300mm in compound semiconductor is a landmark milestone, that is set to trigger numerous growth options for the industry in the years to come," he adds.

With 300mm wafer technology, we are bringing compound semiconductor for the first time into the mainstream of semiconductor fabrication

"We already have the first 300mm GaN prototype systems, which have also been integrated into pilot lines at several customers," notes Grawert. "For decades, we have been working on technological solutions even when the market had not yet defined its requirements in concrete terms. This enables us to help our customers with their product developments at an early stage and to offer innovative technologies that are market-ready at precisely the moment when demand first arises."

www.aixtron.com

Aixtron's revenue rebounds in Q3/2024 as red LED resurgence compensates for silicon carbide market dip

Cash flow boosted by inventory reduction

For third-quarter 2024, deposition equipment maker Aixtron SE of Herzogenrath, near Aachen, Germany has reported revenue of €156.3m (up 18.6% on €131.8m last quarter but down 5% on €165m a year ago). This is in the lower half of the guidance range of €150–180m, as the delivery of a major micro-LED-related project was postponed from Q3 to Q4/2024 at the customer's request.

For the first nine months of 2024, revenue was €406.4m, down by just 2% on €415.7m in 2023 despite the weak market environment. However, this was aided by growth in Spare Parts & After-sales Services revenue growing by 18% from $68.1m (16% of total revenue) to $80.3m (20% of total revenue). Revenue from equipment sales fell by 6% from $347.6m (84% of total revenue) to $326.1m (80% of total revenue), segmented as follows:

- Metal-organic chemical vapor deposition (MOCVD)/chemical vapor deposition (CVD) systems for making gallium nitride (GaN)- and silicon carbide (SiC)-based power electronics devices fell from 82% of equipment revenue in the first nine months of 2023 to 58% in the first nine months of 2024, with GaN rising to 32% whereas SiC has fallen to 26% as silicon carbide manufacturing capacity that has been built now exceeds the current demand.
- MOCVD systems for making optoelectronics devices (telecoms/datacoms and 3D sensing lasers for consumer electronics, solar, and wireless/RF communications) comprised 11% of equipment revenue (level with the first nine months of 2023).
- MOCVD systems for making LEDs comprised 26% (rebounding from just 6% in 2023), as companies that have been delivering only to the blue LED market for lighting or backlighting are now also investing in traditional red LED capacity.

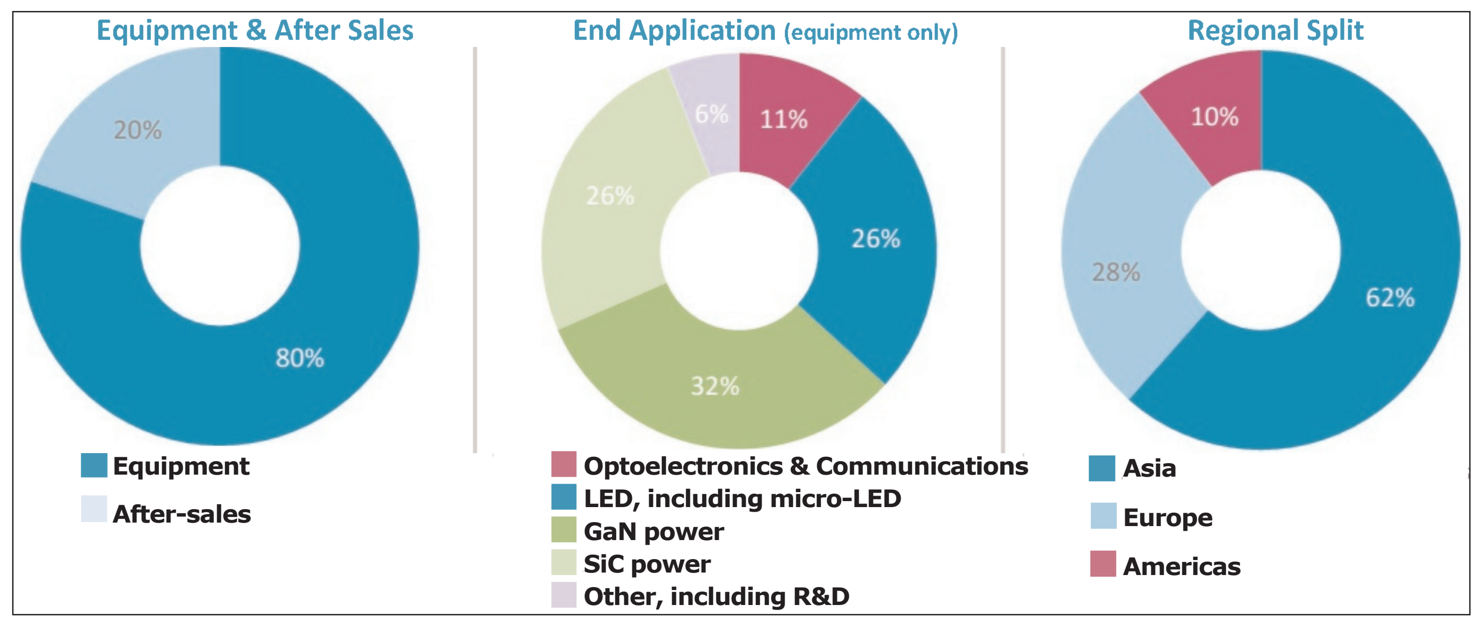
On a regional basis for the first nine months of 2024, 62% of revenue came from Asia (rebounding year-on-year from 44%), 28% from Europe (down from 33%) and just 10% from the Americas (down from 23%).

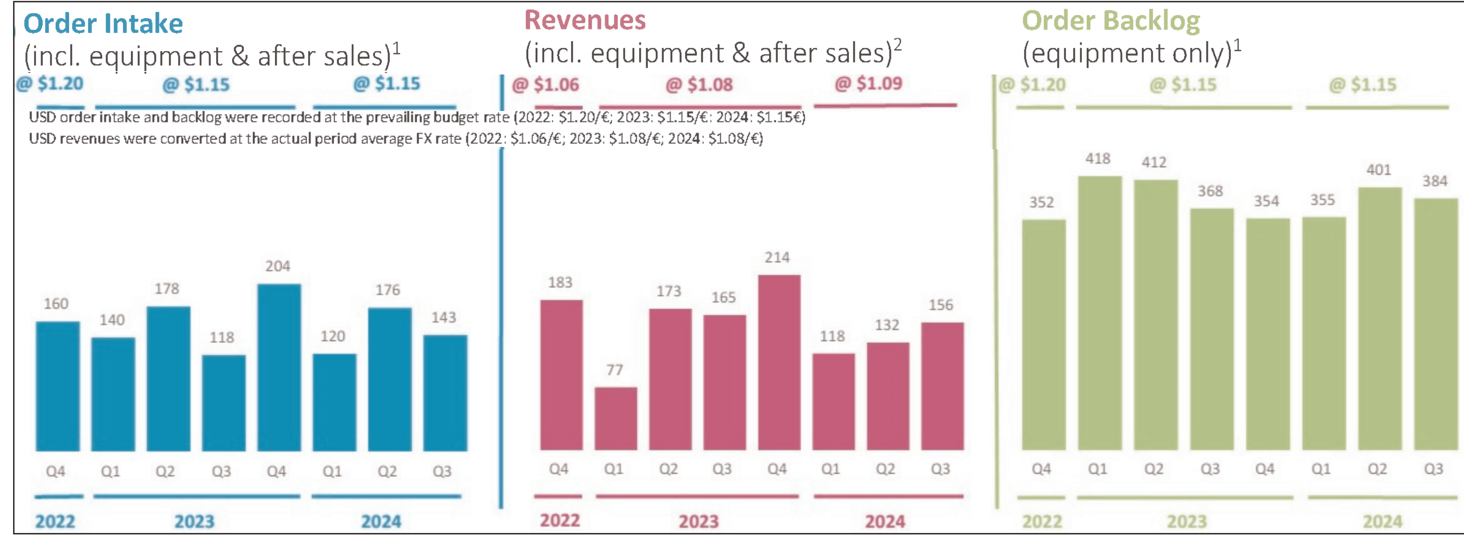
Gross margin rebounds in Q3

For the first nine months, gross margin has fallen from 43% in 2023 to 39% in 2024. This includes Q3/2024 gross margin of 43%, down from 46% in Q3/2023 (due mainly to a less favorable product mix, which included a high proportion of lower-margin traditional LED systems). However, this was a strong rebound from just 37% in both Q1 and Q2/2024.

R&D spending peaks as development of G10 family is finalized

Operating expenses decreased slightly in third-quarter 2024 to €29.6m, down 4% from €30.9m a year ago. However, OpEx for the first nine months still rose by 14% from €87.4m in 2023 to €99.7m in 2024. This was due mostly to R&D spending rising by 15% from €59.8m to €68.7m. R&D costs were at a peak level due to Aixtron finalizing development of the G10 family (the first product of which was launched in September 2022) while, in parallel, starting development of the next-generation (300mm) GaN platform.





Technical progress in silicon carbide

At the International Conference on Silicon Carbide and Related Materials (ICSCRM 2024) in Raleigh, North Carolina in early October, Aixtron presented significant improvements to the 200mm G10-SiC system, achieving what is now claimed to be market-leading across-wafer layer thickness and doping uniformity, as well as the lowest cost per wafer due to the high productivity of the multi-wafer tool.

First 300mm GaN prototype systems used in pilot lines during transition from 200mm

"The potential of GaN-based efficient power electronics is enormous due to energy-intensive artificial intelligence and other applications," says CEO & president Dr Felix Grawert. "Based on the expected high volumes, the first customers are now planning to switch to the next wafer size and are using our first 300mm GaN prototype systems [named Hyperion] in their development and pilot lines. Aixtron is transferring the wealth of experience and core elements of the proven 200mm technology to the next product generation [with volume production shipments expected in 2026-2027]," he adds.

"In addition, we can build on 25-plus years of Showerhead technology in our 300mm single-wafer reactor. With this, we are in a unique position and therefore we have started work on 300mm GaN early and built a dedicated cleanroom, our Innovation Center for our 300mm technology."

First 300mm tool in new Innovation Center

After breaking ground in Q4/2023, Aixtron is investing about €100m in building a new Innovation Center for 300mm technology, comprising an R&D complex with over 1000m^2 of cleanroom space to work with customers on developing and testing next-generation systems. The first Aixtron system was recently moved into the new cleanroom. The official opening of the Innovation Center is scheduled for the end of 2024. "We expect first wafers out in Q4 this year, and first joint customer projects are already scheduled for Q1/25," says Grawert.

Operating profit rebounds in Q3

The operating profit (earnings before interest and taxes, EBIT) for the first nine months has fallen from €93.4m (EBIT margin of 22%) in 2023 to €60.3m (15% margin) in 2024. Q3/2024 EBIT was €37.5m (24% margin), down from €45.3m (27% margin) in Q3/2023, due mainly to the lower gross margin resulting from the less favorable product mix and the higher R&D expenses. However, Q3 EBIT is much improved from first-half 2024's €22.8m (9% margin), due to better volume and product mix.

Net profit for the first nine months has fallen from €83.5m in 2023 to €52.9m in 2024. Q3/2024 net profit was €30.9m, down from €39.6m in Q3/2023, but up from €11.2m in Q2/2024.

Positive cash flow

Operating cash flow significantly improved year-on-year: For Q3/2024, it was €15.4m, more than tripling from €4.9m in Q3/2023 and greater than the €12.8m in first-half 2024. In the first nine months of 2024 it improved by €94m, from –€65.6m in 2023 to €28.2m in 2024. This was positively impacted by inventory being reduced, from the peak of €447.9m last quarter (built up to meet the expected high volume of shipments) to €427m at the end of Q3/2024. This should be followed by even stronger inventory reductions in Q4/2024 and throughout 2025. "The aim is to reduce inventories to a normal level within the next 12 months," says chief financial officer Dr Christian Danninger.

Capital expenditure for the first nine months rose from €16.6m in 2023 to €86.2m in 2024, including €17m in Q3/2024 (up from just €7m a year previously). This was driven primarily by investment in the Innovation Center for 300mm technology as well as the expansion of production capacities in Italy.

In June, Aixtron said that it had spent a single- digit-million euro amount to buy a building on a brownfield site near Turin, Italy, that it can fit out to quickly expand production capacity. First shipments should start contributing to

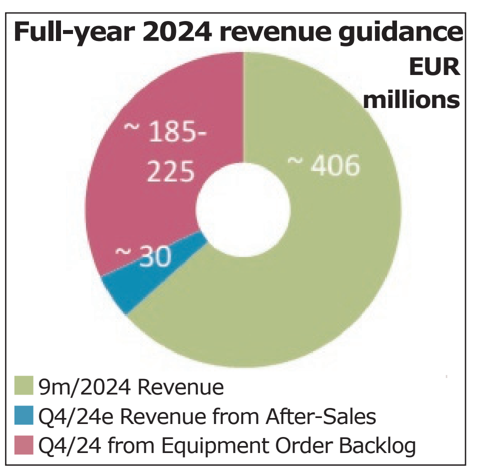
revenue in Q4/2024, then ramp up in Q1 and Q2/2025, thus addressing the expected increase in demand from major customers (and able to cover future order peaks). Capacity could be doubled in future after additional investment in its infrastructure.

Despite these extra investments, free cash flow was –€1.5m in Q3/2024 (a big improvement from –€23.4m in Q2/2024), driving improvement for the first nine months from –€82.3m in 2023 to –€58m in 2024.

During Q3, cash and cash equivalents (including other current financial assets) hence fell only slightly, from €79.4m to €78.1m. This has more than halved from €181.7m at the end of 2023 and €209.9m a year ago, due mainly to the CapEx projects and a dividend payment of €45m in May. However, underlining the firm's continuing financial strength, during Q3/2024 the equity ratio rose from 75% to 79%.

Order intake and backlog rise year-on-year

Order intake in Q3/2024 was €143.5m, down on €175.7m last quarter but up 21% on €118.5m a year ago, as momentum continues in demand for equipment for GaN- and SiC-based power electronics.



Equipment order backlog at the end of September 2024 was €384.5m, down from €400.6m at the end of June but up on €368m a year ago.

Revised full-year 2024 guidance confirmed

In fourth-quarter 2024, inventories should be reduced further by shipment of the large project that was pushed out from Q3 to Q4 at the customer's wishes, boosting revenue dramatically to €215–255m.

This should also improve operating cash flow. Meanwhile, CapEx will come down as Aixtron nears completion of Innovation Center. "These two effects should result in a strong free cash flow," reckons Danninger.

After on 4 July lowering its guidance for full-year 2024 revenue from €630–720m, Aixtron confirms its adjusted guidance of €620–660m. Expected gross margin remains 43–45%. The firm also confirms its revised EBIT margin guidance of 22–25% (reduced on 4 July from 24–26%).

Full-year 2025 revenue to be level or slightly below 2024

Aixtron says that the medium- and long-term drivers for revenue growth remain intact: efficient power electronics for IT and AI applications, SiC technology for e-mobility, and micro-LEDs for next-generation displays. However, in the short term, momentum in the end markets remains slow, so revenue for full-year 2025 is likely to be level or slightly below that of 2024.

Aixtron notes that some orders for 2026 are already being placed, and some orders are being pushed out towards 2026.

www.aixtron.com

PlayNitride qualifies Veeco's Lumina MOCVD system for micro-LED production

Two systems ordered for delivery in 2025

Epitaxial deposition and process equipment maker Veeco Instruments Inc of Plainview, NY, USA says that, following evaluation of its Lumina metal-organic chemical vapor deposition (MOCVD) system, Taiwan-based PlayNitride has qualified it for the production of micro-LEDs, and placed an order for two systems for delivery in 2025.

"We're pleased to partner with Veeco for production and commercialization of our industry-leading micro-LED technology for wearables, TVs, transparent displays and automotive," says PlayNitride's CEO & chairman Dr Charles Li. "The Lumina system is uniquely positioned to exceed market requirements by providing best-in-class performance and productivity advantages, each essential in advancing our technology and cost roadmap," he reckons.

"Veeco's Lumina system is extensively used in high-volume manufacturing utilizing the proven performance of our core TurboDisc technology," notes Veeco's Anil Vijayendran, vice president, MOCVD Product Line Management. "Industry leaders such as PlayNitride require solutions enabling excellent uniformity, brightness, defectivity, and unmatched cost of ownership, all of which our Lumina system delivers."

Core to the Lumina system is Veeco's MOCVD TurboDisc technology, featuring what is claimed to be excellent thickness and compositional uniformity and low defectivity for exceptional yield. The proprietary technology also supports high-throughput enabled by a clean reactor over long campaigns, the firm adds. Providing a seamless wafer size transition, the system is capable of depositing high-quality arsenic phosphide (As/P) epitaxial layers on wafers up to 8-inches in diameter. The Lumina system is said to allow users to customize their systems for maximum value in delivering IR-LEDs, edge-emitting lasers, VCSELs, and solar cells in high-volume production.

www.playnitride.com

www.veeco.com

ASMPT's AMICRA NANO die and flip-chip bonder targets co-packaged optics

Hybrid bonding with accuracy of ±0.2µm and forces from 0.1N to 20N at throughput of 200–400 components per hour

ASMPT Ltd says that its new high-precision AMICRA NANO die and flip-chip bonder has been specially developed for the production of co-packaged optics where optical and electronic components are integrated in a common housing. With what is claimed to be exceptional process stability and a placement accuracy of ±0.2µm @ 3σ, the bonding system is equipped for the communication technology of the future.

For high-performance data centers and networks that require energy-efficient and high-performance data transmission with minimal latency, the electrical signal paths can be shortened by using co-packaged optics to tightly integrate chips and optical interfaces in a very small space, allowing the production of compact, miniaturized components.

"The complexity of semiconductors is constantly increasing and poses enormous challenges, especially with regard to bonding technology," says Dr Johann Weinhändler, managing director of ASMPT AMICRA and responsible for ASMPT's Semiconductor Solutions Division (ASMPT SEMI) in Europe (which supplies advanced packaging and semiconductor assembly solutions). "The chips have more and more inputs and outputs, but they must not get any larger. This means that ever finer structures have to be processed with high precision, and this is exactly why we have developed the AMICRA NANO."

Stable connections with no solder or glue

The NANO die and flip-chip bonder is said to overcome these challenges by employing hybrid bonding technology that does not require any solder paste or glue. Instead, it creates stable mechanical and electrical connections with atomic diffusion.

The AMICRA NANO high-precision die and flip-chip bonder.

Precision the prerequisite for further miniaturization

While hybrid bonding enables a high degree of miniaturization, it requires exceptional placement accuracy — in part, because the components no longer center themselves during the heat treatment. The AMICRA NANO places dies from wafers or waffle packs with an accuracy of ±0.2µm and bonding forces ranging from 0.1N to 20N, achieving a throughput of 200–400 components per hour. With specifications like these, the machine is aimed at the high-mix/low-volume market, for example for chip sets, small lots, prototypes, or feasibility studies for new processes.

The AMICRA NANO achieves its high precision with four high-resolution camera systems that monitor the process from die pickup to final alignment and inspection. Due to the machine's unique design, it is possible to map both the element being placed and the substrate through the bond head at any time. The machine also has an infrared illumination system that penetrates the dies.

Highly flexible technology with ultra-clean process environment

The new machine can also handle direct and indirect hybrid bonding as well as various soldering and gluing processes. The AMICRA NANO offers three different heating options, including laser soldering and UV curing. Since many processes are highly sensitive to contaminants, the machine is equipped with a HEPA filtering and ionization system that ensures a high-purity operating environment.

Fast computers need fast communication

Hybrid bonding will soon be crucial wherever maximum performance is required in the smallest of spaces – for example, in high-performance and quantum computers, AI systems, IoT devices, or autonomous vehicles, says the firm. "In particular, converting electrical into optical signals and vice versa is becoming increasingly important, for which light-emitting and light-sensitive components must be placed with exceptional precision," says Weinhändler. "Having this fast fiber-optic communication technology at your disposal is essential if you want to exploit the potential of future data centers to the fullest."

https://semi.asmpt.com/en/

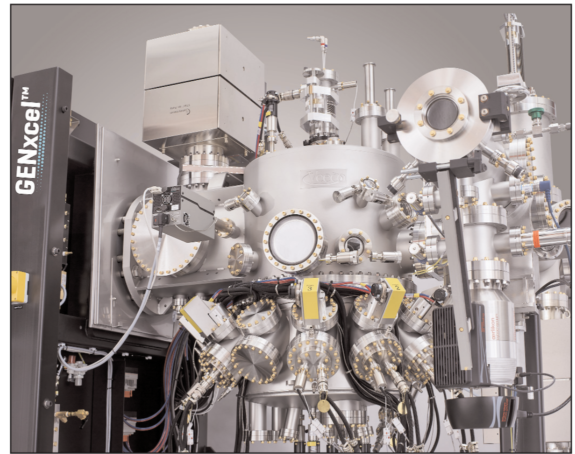
Ohio State orders Veeco GENxcel R&D MBE system

Krishna Infrared Detectors Lab developing gallium antimonide for IR

Epitaxial deposition and process equipment maker Veeco Instruments Inc of Plainview, NY, USA has received an order from the Ohio State University's Krishna Infrared Detectors (KIND) Laboratory for a GENxcel R&D molecular beam epitaxy (MBE) system, to be used for growth of gallium antimonide (GaSb) for infrared (IR) detectors for consumer, automotive, defense and industrial applications.

"This will enable us to grow high-quality antimonide semiconductor material to explore novel device physics and train the next generation of students with advanced semiconductor skills," says professor Sanjay Krishna, who leads the KIND Laboratory.

According to a report from MarketsandMarkets, which states the market, the infrared detector market is growing at a compound annual growth rate (CAGR) of 7% from $535m in 2023 to $731m by 2028, driven by increasing demand for security and surveillance systems, the adoption of IR devices in industrial automation and manufacturing processes, and high penetration of IR devices in non-contact temperature measurement, gas analysis, astronomy, and fire detection applications.



Veeco's GENxcel R&D MBE system.

"We are honored to have been selected by Dr. Krishna and his research team at Ohio State University," commented

"Dr Krishna's deep expertise in this field promises to advance the industry's understanding of these materials, paving the way for new technological developments," comments Matthew Marek, senior director of marketing for Veeco's MBE Group. "Partnering with such a distinguished researcher enhances our commitment to driving impactful material science innovations," he adds. "We look forward to continued collaboration with Dr Krishna and his team."

https://imr.osu.edu

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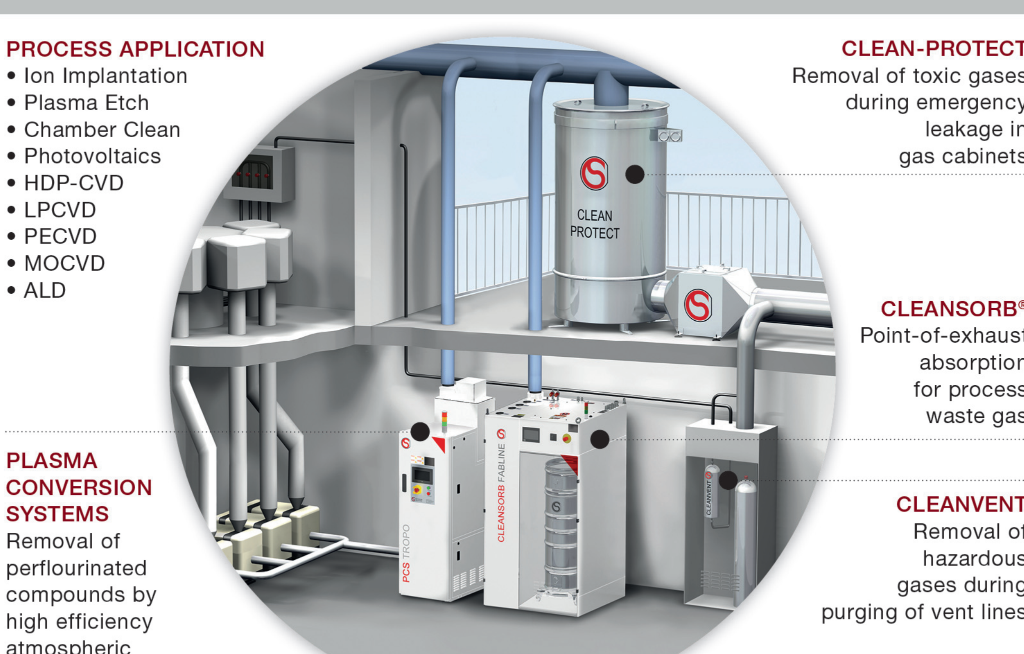

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NS Nanotech releases first solid-state semiconductor to produce human-safe disinfection of UV light

Far-UVC ShortWaveLight 215 Emitter safely disinfects high-risk spaces

In the midst of the COVID-19 pandemic, many people became acutely aware of airborne viral spread. In addition to COVID, the common cold, respiratory syncytial virus (RSV), measles and the flu may all be passed between people through the air they breathe. NS Nanotech Inc of Ann Arbor, MI, USA — a University of Michigan Electrical and Computer Engineering (ECE) spin-off co-founded by professor Zetian Mi in 2017 with the help of Innovation Partnerships — has designed a solution to mitigate this airborne infection.

Since the late 19th century, it has been known that ultraviolet light kills micro-organisms, especially at the short UV-C wavelengths (180–280nm). Traditionally, low-pressure mercury bulbs have been used to generate UV-C light around 254nm, to disinfect air, water and surfaces. However, this wavelength is dangerous to human skin and eyes, so it is restricted to settings and applications where humans are not immediately present. This leaves a gap in places where patients, healthcare workers and the general public may be exposed to airborne infection, especially in small, enclosed spaces.

To fill this gap in protection, NS Nanotech developed a far-UVC ShortWaveLight 215 Emitter, which safely disinfects air and surfaces in spaces where people are working and going about their daily lives. Now available to manufacturing partners and application developers, the device is a nitride semiconductor cathodoluminescent lamp, which is said to be much cheaper and easier to deploy than the existing state-of-the-art devices on the market (222nm-emitting krypton chloride excimer lamps).

Mi's research group has developed III–nitride materials and semiconductors, optoelectronic devices, light-emitting diodes, and UV photonics, for a range of research applications, including water and air purification and disinfection.

The semiconductor-based technology offers an alternative path for air purification and disinfection compared with conventional, inefficient and bulky gas lamps, says Mi. "Moreover, operating in the far UV-C spectrum, it is safer and more effective than traditional UV light," he adds.

"To the best of our knowledge, this is the highest-energy photon any semiconductor device has ever made, in any market, anywhere," reckons NS Nanotech's co-founder & CEO Seth Coe-Sullivan. "The light still does a great job of killing germs but it won't penetrate our dead skin cells or the tear layer at the front of our eye. We think this product is really great for confined spaces, what we call 'personal breathing zones'."

The NS Nanotech team is starting with enclosed, high-value spaces for deployment of the lamps. Many of these applications are in the transportation industry, such as ambulances, school buses, and shuttles for senior citizens. Since the ShortWaveLight 215 Emitter is reckoned to be the first of its kind in the world, NS Nanotech is helping its customers to design the consumer products that will ultimately be deployed in these spaces.

"By marketing business-to-business, we really want a broad set of customers to be able to try this out and deploy it," Coe-Sullivan says.

NS Nanotech hopes to continue the work by developing far-UVC LED lights for the same applications, a process that requires more complex technologies and a longer timeline.

www.nsnanotech.com

NS Nanotech board gains former Corning executive

Experience in product innovation and strategic global growth

NS Nanotech has appointed John Bayne to its board of directors.

A former senior VP & general manager at Corning Inc, Bayne brings more than three decades of experience in product innovation and strategic global growth to NS Nanotech at a time when it is readying multiple innovations for commercial markets.

Bayne led Corning's multi-billion-dollar Mobile Consumer Electronics Division, which included both Corning Gorilla Glass (a product used in billions of smartphones and consumer electronics worldwide) and high-purity fused silica (HPFS), which is used in the manufacture and inspection of semiconductors. Previously, he was VP & general manager of Corning's high-performance displays group, focusing on specialty glass for high-resolution LCDs and new OLED displays. Also, his global business development experience includes three years spent in China, where he was president of Corning's display technologies division.

"His extensive experience launching innovative products, developing high-performance teams, and driving strategic growth in competitive international markets will be invaluable as we continue to expand and commercialize our cutting-edge nanowire LEDs and UVC semiconductor technologies," comments CEO & co-founder Seth Coe-Sullivan.

www.nsnanotech.com

Cree LED licenses LED display technology to Daktronics

Cree LED Inc of Durham, NC, USA (a Penguin Solutions brand) has announced a multi-year, global agreement providing (with limited exceptions) a license for its patented technology to Daktronics of Brookings, SD, USA (which provides large-screen video displays, electronic scoreboards, LED text and graphics displays, and related control systems).

With over 35 years of expertise in LED die and packaging technology, along with a portfolio of intellectual property covering their use in LED displays, Cree LED says that it has consistently invested in innovation, securing numerous patents to protect its advancements.

The agreement enables Daktronics to provide what it claims are industry-leading LED display systems, knowing that its products will not be subject to claims based on the licensed Cree LED patents.

The license agreement ensures that there are no patent disputes between the parties based on the licensed Cree LED patents for the term of the agreement.

www.daktronics.com
www.cree-led.com

Cree LED launches CV28D LEDs with FusionBeam Technology for LED signs and displays

First LED to combine through-hole and surface-mount technologies

Cree LED has launched its new CV28D LEDs with FusionBeam Technology, providing an advance for the LED signage market. The CV28D LED combines the latest through-hole and surface-mount (SMD) RGB LED technology, delivering what is claimed to be superior directionality, image quality and resolution in a durable, easy-to-assemble package.

For information displays, the development is said to provide new levels of clarity and contrast versus existing through-hole LED displays. With this high resolution, CV28D-enabled signs can now display icons, photos, logos and even video, bringing versatility to signs that can currently only display text or simple shapes.

Compared with traditional through-hole LEDs, the CV28D enables displays with 2.5 times the resolution, equivalent to the leap from standard definition 480p to full HD 1080p video. FusionBeam Technology simultaneously blends individual RGB LED dies into a single, uniform color and then sends it only to the intended audience. The new LEDs also feature advanced directionality, focusing light on the intended viewer while reducing light trespass and pollution to four times less than standard RGB SMD LEDs.

The CV28D LEDs with FusionBeam Technology is "the first LED solution to truly bridge the gap between through-hole and SMD technologies in the LED signage market," says president Joe Clark. "By combining the best qualities of both, CV28D enables signage manufacturers to create displays with higher resolution, better directionality and improved durability, all while reducing light pollution," he adds. "FusionBeam Technology LEDs represent the next frontier for LED information signs."

CV28D LEDs offer single LED package per pixel and provide ease of assembly and IP68-rated dustproof and waterproof reliability. With a form factor of only 4.3mm in height, they enable significantly thinner and lighter displays and signs, making them suitable for a wide range of outdoor applications.

SemiLEDs' revenue falls by 13.3% for full fiscal year

For fiscal full-year (to end-August), LED chip and component maker SemiLEDs Corp of Hsinchu, Taiwan says that its revenue fell by 13.3% from $5.979m for 2023 to $5.183m for 2024. However, although fiscal fourth-quarter revenue was down on $1.453m in Q4/2023 to $1.324m in Q4/2024, this is level with third-quarter 2024.

Gross margin fell from 41% last quarter to 12% in fiscal Q4/2024, although this is still up on just 3% a year ago. Full-year gross margin hence still rose from 17% in fiscal 2023 to 20% in fiscal 2024.

Quarterly operating margin worsened from −36% in fiscal Q3/2024 to −62% in fiscal Q4/2024, but this is still better than −73% a year ago. Full-year operating margin was therefore −57% for fiscal 2024, level with fiscal 2023.

Net loss for fiscal Q4/2024 was $560,000 ($0.08 per diluted share), up from $319,000 ($0.04 per diluted share) last quarter but cut from $881,000 ($0.18 per diluted share) a year ago. Full-year net loss has therefore been cut from $2.69m ($0.55 per diluted share) in fiscal 2023 to $2.036m ($0.32 per diluted share) for fiscal 2024.

Cash and cash equivalents have fallen from $2.572m a year ago, but was level at about $1.67m between the end of fiscal Q3/2023 and the end of fiscal Q4/2024.

www.semileds.com

ams OSRAM & Fraunhofer IZM win Deutscher Zukunftspreis

Digital Light LED brings intelligence and precision to car headlights

At a formal ceremony in Berlin, Germany's President Frank-Walter Steinmeier presented the Deutscher Zukunftspreis 2024 (the German Future Award, the Federal President's Award for Innovation in Science and Technology) to a team led by Dr Norwin von Malm and Stefan Grötsch of ams OSRAM GmbH of Premstätten, Austria and Munich, Germany and Dr Hermann Oppermann of the Berlin-based Fraunhofer Institute for Reliability and Microintegration (IZM) for the technological implementation of their idea — an LED matrix that turns car headlights into projectors — which opens up new possibilities for innovative designs due to the high-resolution light distribution and energy efficiency. This is the tenth Deutscher Zukunftspreis for Fraunhofer Institute, and the first for Fraunhofer IZM.

Dr Norwin von Mal (center), Stefan Grötsch (third from right) and Dr Hermann Oppermann (second from left) with Federal President Frank-Walter Steinmeier (second from right), Federal Minister for Education and Research Cem Özdemir (left) and moderator Yve Fehring (right).

As part of their Digital Light project, the research teams completely rethought intelligent LED technology and established a basic technology that enables many new applications, even beyond car headlights. von Malm and Grötsch of ams OSRAM and Oppermann of Fraunhofer IZM have developed a light source that is smaller, lighter, more efficient, more intelligent and more precise in its light output than conventional light sources. The new system will allow car headlights, for example, to illuminate the road ahead precisely and brightly without blinding or endangering oncoming traffic or pedestrians. A conventional low-beam/high-beam combination is not an option here because it must be possible to control the light's spatial distribution and for the light itself to adapt to the respective situation. To achieve this, the new headlight does not use two light sources like conventional headlights. Instead, it relies on 25,600 LEDs in a matrix of 320 points x 80 points, where each individual LED can be controlled with a digital signal. In combination with a special lens, this creates a headlight that works much like a video projector.

Compact design and high efficiency

The new system requires minimal installation space and is highly efficient since only the LEDs that are actually required for the desired light distribution are switched on. Systems with passive light modulation, by contrast, rely on shading, meaning that the light source is always on at full power, and the undesired light is filtered back out. However, this is an inefficient solution, since it involves generating unnecessary light. Furthermore, the generated heat must be dissipated, which requires large and expensive cooling systems. The new system prevents these losses from occurring in the first place.

Increased safety through projected pictograms

ams OSRAM and Fraunhofer says that, to increase safety, their headlight not only provides precise and efficient light for the road ahead; it also acts as a projector and can project pictograms onto the road, e.g. a snowflake if there is a risk of frost or a specific symbol for wrong-way drivers.

Digital Light — intelligent LED technology

Light-based information opens up many new use cases for the team's LED matrix, which can be controlled via a digital system. Examples include optical data communication between computer chips, e.g. in data centers for AI applications, or augmented reality (AR). Here, the light matrix could be used as a virtual monitor for AR glasses, where digital information is displayed in the user's field of vision in addition to the real-world environment. A compact design and energy efficiency are essential here since AR glasses must be lightweight and have a long battery life. These use cases demonstrate the enormous potential of Digital Light when it comes to transforming the ways in which humans and electronic devices interact.

www.deutscher-zukunftspreis.de/de
www.izm.fraunhofer.de/en.html
www.ams-osram.com

ams OSRAM launches Gen 3 OSLON Black Flat S surface-mount LEDs for automotive forward lighting

Upgraded chip boosts brightness by 16% from 395lm to 460lm

ams OSRAM GmbH of Premstätten, Austria and Munich, Germany says that its OSLON Black Flat S family of LEDs has established itself as a light source for forward lighting in both four- and two-wheeled vehicles, since its robust black leadframe QFN package is suited to automated SMT assembly, and is claimed to offer excellent contrast for use in reflector-based lamps.

However, the automotive forward lighting market is highly competitive, and manufacturers are always looking for ways to reduce cost by producing more light with fewer LEDs.

ams OSRAM has hence now introduced a new third generation of the OSLON Black Flat S, offering better performance and mechanical specifications alongside the established benefits of the black leadframe package.

The new Gen 3 products featuring the latest UX:3 chip, raising typical brightness per chip from 395lm at 1A/25°C in Gen 2 to 460lm. This performance is equivalent to that of the OSLON Compact PL Gen 3 products for automotive forward lighting, while the new OSLON Black Flat S family offers superior lumens/€, making it better suited to cost-sensitive forward lighting designs.

As with earlier generations, the OSLON Black Flat S Gen 3 is to be available in a range of one-, two-, three-, four- and five-chip versions.

The products' package has what is claimed to be excellent thermal compatibility with metal-core (aluminium) PCBs, giving mechanical and electrical reliability in forward lighting systems. Due to their package's thermally efficient chip-on-copper structure, the OSLON Black Flat S LEDs help automotive manufacturers to achieve excellent thermal management, the firm says.

Compared to Gen 2, the Gen 3 multi-chip products offer a tighter specification for package height — 0.49mm±0.6mm. This is in the same range as the height of the one-chip device, and allows OEMs to reduce the distance between the emitter and the optics for more efficient optical coupling.

ams OSRAM says that other features that automotive manufacturers have valued in the earlier generations are maintained in the new products: a uniform beam pattern, and consistent color over angle.

Apart from the 16% higher brightness, ams OSRAM has kept the mechanical, electrical and optical specifications of Gen 3 very similar to those of Gen 2. So, users of the earlier products can easily replace them with the new Gen 3 to upgrade headlamps, daytime running lamps (DRLs) and front fog lights.

Samples of the one-, two-, three- and four-chip products are available now, and production release is expected to be in early 2025.

www.ams-osram.com/products/product-families/oslon-black-flat-s

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Blue Laser Fusion and RSE sign MoU for joint R&D

US–Italy collaboration targets first commercial-scale inertial fusion energy power plant

During the inaugural ministerial event of the World Fusion Energy Group at the Ministry of Foreign Affairs and International Cooperation in Rome, a memorandum of understanding (MoU) agreement was signed between Ricerca sul Sistema Energetico (RSE S.p.A., a company indirectly controlled by Italy's Ministry of Economy and Finance through its sole shareholder GSE S.p.A.), and Blue Laser Fusion Inc (BLF) of Santa Barbara, CA, USA (founded in 2022 by CEO professor Shuji Nakamura, winner of the Nobel Prize in Physics in 2014 and member of the RSE Scientific Committee) to initiate joint R&D on what is claimed would be the world's first commercial-scale inertial fusion energy (IFE) power plant.

Activities will be in three phases:
(1) an analytical phase;
(2) a phase to build a prototype of a small-scale commercial inertial fusion energy reactor ('Small-scale Fusion Pilot Reactor'); and
(3) a concluding phase to launch a prototype of a larger-scale commercial IFE reactor ('Full-scale Fusion Pilot Power Plant').

"Our researchers will contribute with the expertise developed in Italy through the Energy System Research activities and through the many international cooperation opportunities, such as those linked to Mission Innovation," says RSE's CEO Franco Cotana. "Working with BLF will allow us to increase our experience and knowledge of a challenging sector with important decarbonization targets," he adds. "Although it cannot yet be considered as an alternative to fission small modular reactors, this innovation marks a decisive step towards fusion, which does not use magnetic confinement but a simpler technology that has already been verified by the US Department of Energy's Livermore experiment in December 2022."

Nakamura pioneered the high-power blue LED that enabled the production of LED lamps. In recent years, Nakamura has focused to the development of high-power lasers, which now make it possible to trigger inertial confinement fusion.

"This agreement with RSE will connect top scientists and engineers in Italy and Europe with the BLF laser, target development team and begin the process for establishing demonstration sites in Italy," says Nakamura.

"We need to make up for lost time in order to promote a change in the pace of Italian and European research, capitalizing on national technical-scientific excellence and industrial know-how at the highest level," says RSE's president Carlo Alberto Giusti (chancellor of Link Campus University Roma), who organized and opened an evening of discussion at the World Fusion Energy Group event on the role of research and technology transfer in the energy transition. The discussion focused on the technical and scientific aspects of the possibilities offered by inertial confinement fusion, to which Italian research and industry can make a decisive contribution, it is reckoned. The event presented an opportunity to identify and develop an Italian roadmap for relaunching R&D activities in the sector.

www.rse-web.it
www.bluelaserfusion.com

NUBURU resolves non-compliance with NYSE rules

Additional controls implemented to avoid future violations of share issuance rules

NUBURU Inc of Centennial, CO, USA — which was founded in 2015 and develops and manufactures high-power industrial blue lasers — says that NYSE Regulation has sent it a warning letter, as provided under Section 1009(a) of the NYSE American LLC Company Guide, describing violations by the firm of Sections 301 and 713 of the Company Guide.

Section 301 prohibits a listed company from issuing, or authorizing its transfer agent or registrar to issue or register, additional securities of a listed class until it has filed an application for the listing of such additional securities and received notification from the NYSE American that the securities have been approved for listing.

Section 713 requires stockholder approval when additional shares to be issued in connection with a transaction involve the sale, issuance or potential issuance of common stock (or securities convertible into common stock) equal to 20% or more of outstanding stock for less than the greater of book or market value of the stock.

As noted in the letter, NUBURU issued about 4.6 million common shares between May and August in connection with the conversion of certain convertible promissory notes that NYSE has determined were in violation of these provisions. NUBURU says that it is consequently implementing additional controls to avoid violations of such NYSE rules in the future.

www.nuburu.net

BluGlass enters into contract with NCSU for visible laser development as part of CLAWS Hub

Year-2 of US DoD's Microelectronics Commons sub-contract to advance capabilities of laser portfolio for quantum computing and intelligence applications

BluGlass Ltd of Silverwater, Australia — which develops and manufactures gallium nitride (GaN) blue laser diodes based on its proprietary low-temperature, low-hydrogen remote-plasma chemical vapor deposition (RPCVD) technology — has entered into a US$1.925m (AUS$2.9m) contract with North Carolina State University (NCSU) for visible laser development activity as part of the Commercial Leap Ahead for Wide Bandgap Semiconductors (CLAWS) Hub.

The CLAWS Hub is one of eight Microelectronic Commons innovation hubs established by the US Department of Defense (DoD) and funded by the CHIPS and Science Act. The US$2bn Microelectronics Commons program is a collaborative capability-building program for the development of next-generation defence and dual-use technologies.
Hub members include Coherent, MACOM, General Electric, Adroit, Kyma, and NCA&T State University.

Under its core-development contract for the second year of the Microelectronics Commons program, BluGlass will advance the capabilities of its laser portfolio for quantum computing and intelligence applications, including maturing its single-frequency visible GaN DFB laser technology for commercial applications. The contract award follows BluGlass' completion of all development milestones of the base year of performance under its AUS$2.9m core-development contract for fiscal year 2024.

BluGlass' GaN DFB laser technology will leverage the firm's proprietary deposition and novel device architectures to enable key performance advantages for next-generation quantum applications, including ultra-precision, higher-efficiency and novel device structures. DFB lasers are commonly utilized in non-visible wavelengths for single-frequency devices that require narrow spectral width and high spectral purity. GaN-based DFB lasers are not currently commercially available in visible wavelengths.

"BluGlass' collaboration with industry leaders to enable groundbreaking advancements in quantum applications is a testament to our growing reputation in delivering innovative solutions and end-to-end production capabilities," reckons CEO Jim Haden. "This important program provides non-dilutive funds to advance our laser technology and toolset, and validates our technical and manufacturing capabilities, growing industry reputation, and GaN laser roadmap," he adds. "Our continued collaboration with hub members is helping to accelerate the development and commercialization of next-generation photonics and optoelectronic devices for materials processing, sensing, communications, AI, future quantum technology applications, and critical defence applications."

BluGlass is a commercial 'off-ramp' in the Microelectronics Commons and was selected as a member of the CLAWS Hub for its commercial manufacturing capabilities, to translate R&D to advanced prototyping and commercial production and help to facilitate technology translation from lab-to-fab.

www.bluglass.com.au

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Phlux wins Institute of Physics Business Start-Up Award for infrared sensors

Aura Noiseless InGaAs IR sensors set "new standards for sensitivity and performance in optical systems"

Sheffield University spin-off Phlux Technology —which designs and manufactures 1550nm avalanche photodiode (APD) infrared sensors — has won an Institute of Physics (IOP) Business Start-Up Award 2024. Presented at the Houses of Parliament in London, the award celebrates young companies leveraging physics for innovation and impact. It recognized Phlux's Aura family of Noiseless indium gallium arsenide (InGaAs) infrared (IR) sensors, which is said to have set new standards for sensitivity and performance in optical systems such as LiDAR, laser range finders, and optical fiber communications test equipment.

Phlux's patented compound semiconductor technology is claimed to result in a 12x sensitivity boost for 1550nm-wavelength InGaAs APDs in IR sensing applications, extending the range of optical systems by up to 50% for a given laser power while significantly reducing costs and size. Designed as drop-in replacements for conventional APDs, Aura sensors provide instant performance improvements.

Left to right: Phlux Technology's co-founders Chee Hing Tan (head of University of Sheffield's Department of Electronic and Electrical Engineering), Jo Shien Ng (Professor of Semiconductor Devices at University of Sheffield), and Ben White (CEO).

Phlux began shipping production quantities of its sensors in early 2024 and has already seen strong demand, particularly in North America.

Two other companies also received an IoP Business Start-Up 2024 award at the event: Metasonixx for its acoustic materials and Silveray for its colour x-ray cameras.

www.phluxtechnology.com

Chips JU to fund new European pilot line for Advanced Photonic Integrated Circuits

PIXEurope to be fifth pilot line of €380m Chips Joint Undertaking

The Public Authorities Board (PAB) of the Chips Joint Undertaking (Chips JU) has selected the consortium with which it will start negotiations to establish the Advanced Photonic Integrated Circuits (PIC) pilot line for Europe (PIXEurope), which will be jointly funded by the European Union, through the Horizon Europe and Digital Europe programs, Chips JU participating states, and private organizations.

PIXEurope will bring together Europe's top research organizations to establish what is reckoned to be the world's first open access photonic integrated circuit ecosystem. It will use state-of-the-art equipment to develop innovative PIC technologies and processes, including design, chip fabrication and hybrid integration, through to packaging, test and reliability technologies.

"This selection is an important step for the semiconductor industry and Europe's capacity in the production of photonic integrated circuits," says Chips JU executive director Jari Kinaret.

Coordinated by the Institute of Photonic Sciences (ICFO) near Barcelona, Spain, the 20-member consortium includes participants from Spain, Ireland, the Netherlands, Finland, Belgium, Portugal, Poland, Austria, Italy, France and the UK. The Chips JU will proceed with the negotiations with the consortium to finalize the hosting agreements, joint procurement agreements, and the related grant agreements.

Previously, in April, the Chips JU announced the selection of four pilot lines to be implemented in Europe. The PIC pilot line now becomes the fifth to enter negotiations, as part of the €380m Chips JU's key effort to strengthen capacity building and innovation in Europe. Aligned with the objectives of the Chips for Europe Initiative, the pilot line is expected to collaborate with the other four Chips JU pilot lines, design platform and competence centers.

www.chips-ju.europa.eu

Aeluma wins NASA contract to advance quantum dot photonic integrated circuits for aerospace and AI

Contract to accelerate development of photonics for next-generation sensors and optical interconnects used in AI infrastructure, HPC and cloud data centers

Aeluma Inc of Goleta, CA, USA — which uses compound semiconductor materials on large-diameter substrates to develop technologies for mobile, automotive, AI, defense & aerospace, communication and quantum computing — has been awarded a contract by the US National Aeronautics and Space Administration (NASA) to develop quantum dot photonic integrated circuits (PICs) on silicon. The technology targets next-generation space and aerospace applications, enabling capabilities such as free-space laser communication, autonomous navigation, and precision sensing.

Aeluma will collaborate with NASA to develop silicon-based photonic circuits that leverage quantum dot technology to enhance optical performance in challenging environments. With NASA's support, this could impact a range of aerospace functions by delivering high-precision, low-power solutions essential for space missions and autonomous systems.

"Our collaboration with NASA will drive major advancements in critical aerospace applications and expand application possibilities in AI-driven systems, such as optical interconnects for data centers and high-performance computing," believes founder & CEO Dr Jonathan Klamkin.

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Beyond aerospace, Aeluma says that its quantum dot PIC technology holds significant promise for AI infrastructure, high-performance computing (HPC) systems, and cloud data centers, where ultra-fast, energy-efficient optical interconnects are critical for performance and sustainability. By integrating quantum dots on silicon photonics, Aeluma aims to provide scalable photonic solutions tailored to meet the rigorous demands of next-generation AI workloads and data-intensive environments.

Aeluma says that the collaboration with NASA underscores its commitment to advancing photonic technology, bringing high-performance quantum dot applications into scalable, silicon-based platforms optimized for widespread adoption in AI and HPC infrastructure.

www.aeluma.com

Aeluma joins Optica as corporate member

CEO appointed Industry Vice Chair of Optica's

Aelum Inc of Goleta, CA, USA — which uses compound semiconductor materials on large-diameter substrates to develop technologies for mobile, automotive, AI, defense & aerospace, communication and quantum computing — has joined Optica, the global society dedicated to advancing optics and photonics worldwide. The corporate membership aligns Aeluma with a network of industry leaders in light science and technology.

Aeluma's CEO & director Dr Jonathan Klamkin has been appointed Industry Vice Chair of the 2025 Advanced Photonics Congress, a role within Optica's Advanced Photonics Strategy Committee. He will assume the Chair position in 2026, driving new initiatives to increase industry engagement at Optica's technical conferences.

In addition, both Klamkin and board member Steven DenBaars Ph.D. were previously named Optica Fellows, underscoring their contributions and expertise in optics and photonics. Awarded to distinguished leaders in light science, the fellowship highlights Klamkin and DenBaars' commitment to advancing photonics technology that meets the growing demands of critical markets.

"Aeluma's membership in Optica, combined with our leadership roles within the organization, highlights our dedication to advancing the semiconductor and photonic industries," says Klamkin. "As we continue to expand our technology's reach across high-growth markets, our collaboration with Optica reinforces our mission to drive scalable, high-performance semiconductor-based photonics solutions for next-generation mobile, automotive, AI, defense & aerospace, communication and quantum computing applications."

www.optica.org

Sivers pauses talks with byNordic on Photonics spin-off

Capital markets for SPAC mergers challenging for small-cap firms

Sivers Semiconductors AB of Kista, Sweden (which supplies RF beam-former ICs for SATCOMs and photonic lasers for AI data centers) says that its board of directors has decided to put on hold its discussions with byNordic Acquisition Corp (BYNO) — a publicly traded special purpose acquisition company (SPAC) — regarding the proposed business combination with its subsidiary Sivers Photonics Ltd of Glasgow, Scotland, UK and release BYNO to seek other merger candidates.

"While we agree with ByNordic's thesis that our photonics business is highly undervalued in Sivers' current market capitalization with its critical positioning in the upcoming AI data centers, the capital markets for successfully executing SPAC mergers remain challenging. Consequently, we have elected to put our pencils down on this opportunity," says Sivers Semiconductors' chairman Bami Bastani. "Meanwhile our board and management team remain committed to continuing to identify and execute opportunities to unlock the value of our remarkable opportunities in both photonics for AI data centers as well as beam-formers for satellite communications markets," he adds.

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Sivers says that the decision was made after a thorough evaluation as well as feedback from its financial advisors, due to the US market conditions surrounding small-cap companies, and SPACs' performance in the current market environment.

www.sivers-semiconductors.com

Sivers and Ayar Labs expanding partnership for high-volume manufacturing of optical I/O solutions for scalable cost-effective AI infrastructure

Partnership to focus on product qualification and manufacturing readiness of Sivers high-precision laser arrays

Sivers Semiconductors AB of Kista, Sweden is in advanced discussions with its strategic customer Ayar Labs of San Jose, CA, USA (which provides silicon photonics-based chip-to-chip optical connectivity solutions) to partner on the next phase of engagement focused on manufacturing at scale to support deployment of Ayar Labs' in-package optical interconnect solutions.

Successful large-scale deployment of high-bandwidth, energy-efficient AI data centers will require a move from copper to optical I/O interconnects, a necessity now widely acknowledged by many in the industry including ecosystem pioneers such as Nvidia, AMD, Intel and several hyperscalers, notes Sivers. The emphasis is shifting from initial development of solutions to the enablement of a robust manufacturing eco-system in the next couple of years to support deployments at scale. Ayar Labs is a key innovator developing optical I/O solutions for AI data centers.

"Ayar Labs, a strategic customer of Sivers Semiconductors, intends to expand its relationship with Sivers Semiconductors through NRE [non-recurring engineering] and pre-purchase of products to prepare for high-volume deployment of optical I/O to address bandwidth bottlenecks in AI infrastructure," says Ayar Labs' CEO Mark Wade.

"Having recently announced closing their $155m Series D round led by Advent Global Opportunities, Light Street Capital and with participation from Nvidia and other top-tier chip companies, Ayar Labs is positioned extremely well strategically, technically and financially to be a very significant customer for Sivers' high-performance laser arrays as shipment volumes are expected to ramp in the next 18–24 months," comments Sivers Semiconductors' CEO Vickram Vathulya. "The continued enthusiasm and funding from top-tier chipmakers, foundries and investment firms into Ayar Labs is a testament to the market conviction in their optical I/O solution as a breakthrough innovation for AI data centers," he adds. "Sivers' high-performance laser arrays are critical enablers for optical I/O solutions in AI data centers. We are enthusiastic about the potential for our strategic partnership with Ayar Labs and look forward to this next stage of our collaboration centered around achieving manufacturing readiness and production scale," Vathulya concludes.

www.ayarlabs.com
www.sivers-semiconductors.com

Ayar Labs raises $155m in Series D funding round led by Advent Global Opportunities and Light Street Capital

Funds to accelerate high-volume manufacturing of in-package optical interconnects for AI infrastructure

Silicon photonics-based chip-to-chip optical connectivity firm Ayar Labs of San Jose, CA, USA has secured $155m in a Series D funding round led by Advent Global Opportunities and Light Street Capital. Other new strategic and financial investors participating in the round include 3M Ventures and Autopilot. They join existing investors such as Applied Ventures LLC, Axial Partners, Boardman Bay Capital Management, GlobalFoundries, IAG Capital Partners, Lockheed Martin Ventures, Playground Global, and VentureTech Alliance. This brings total funding to $370m and raises the company's valuation to above $1bn.

With the new funds, the firm aims to apply its optical I/O technology to breaking down the AI bottleneck of data movement, as it prepares its optical solution for high-volume manufacturing strategically aligned to customer roadmaps.

"The leading GPU providers — AMD and NVIDIA — and semiconductor foundries – GlobalFoundries, Intel Foundry, and TSMC — combined with the backing of Advent, Light Street, and our other investors underscores the potential of our optical I/O technology to redefine the future of AI infrastructure," says CEO & co-founder Mark Wade. "We are incredibly fortunate to have the backing of Light Street's deep expertise in technology-specific investments as well as Advent's robust private and growth equity background in this funding round."

AI infrastructure is projected to see more than $1 trillion in investments over the next decade, highlighting the critical need for solutions that eliminate bottlenecks created by traditional copper interconnects and pluggable optics.

Ayar Labs has developed what is claimed to be the industry's first in-package optical I/O solution to replace electrical I/O that is standards-based, commercial-ready and optimized for AI training and inference. Optical I/O allows users to maximize the compute efficiency and performance of their AI infrastructure, while reducing costs and power consumption, to dramatically improve profitability metrics for AI applications.

"We believe optical I/O is on the cusp of revolutionizing the future of AI infrastructure, and we recognize the significant growth potential of in-package optical interconnects," comments Jordan Katz, partner at Advent Global Opportunities, who is joining Ayar Labs' board of directors.

"With this significant capital infusion, Ayar Labs is well positioned to support its growing customer base and meet the explosive demand for optical I/O solutions," believes Shef Osborn, partner at Light Street Capital. "This funding demonstrates to its customers that Ayar Labs has the resources necessary to support their AI infrastructure needs."

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The funding should allow the firm to scale its optical I/O technology, which is claimed to be the industry's first commercially viable optical interconnect solution backed by a robust manufacturing ecosystem. Named as one of America's Best Startup Employers by Forbes earlier this year, Ayar Labs plans to increase hiring next year.

"Intel Capital has long recognized the importance of pioneering new interconnect technologies to improve compute efficiency and performance," says Srini Ananth, managing director at Intel Capital. "We have been dedicated to supporting Ayar Labs' continued growth and are proud to reaffirm our commitment to its optical I/O solutions that aim to disrupt the AI industry," he adds.

"As an early investor and collaborator, Applied Ventures looks forward to continue working with Ayar Labs to advance energy-efficient computing using photonics-based optical interconnects," says Anand Kamannavar, global head of Applied Ventures and board observer of Ayar Labs. "Ayar Labs plays a key role in helping solve the critical challenge of moving vast amounts of data efficiently across chips and data-center systems," he adds.

"3M is excited to invest in Ayar Labs and our opportunities to collaborate," said Mark Copman, senior VP, 3M New Growth Ventures. "This partnership reinforces 3M's commitment to advancing data-center and next-gen solutions for AI infrastructure using 3M's leading material science expertise."

https://ayarlabs.com

Ayar Labs showcases future of AI infrastructure with Fujitsu, Intel Foundry, Corning and Altera

Optical I/O demo for AI scale-up fabrics at Supercomputing 2024

At Supercomputing 2024 (SC24) in Atlanta, GA, USA (17–22 November), silicon photonics-based chip-to-chip optical connectivity firm Ayar Labs of San Jose, CA, USA demonstrated a broad range of optical I/O implementations for AI scale-up fabrics. The firm's optical I/O solution is said to eliminate the inefficiencies, high power consumption and increasing costs of copper interconnects and pluggable optics, boosting the performance and economics of AI infrastructure. At SC24, Ayar Labs is featuring its technology in various AI infrastructure concepts with Fujitsu Ltd, Intel Foundry, Corning Inc, Altera, and others.

"Copper interconnects and pluggable optics have already failed to support large-scale AI workloads," says CEO & co-founder Mark Wade. "Optical I/O overcomes these bottlenecks by enabling scale-up fabrics that connect more GPUs or accelerators per cluster across greater distances. This increases cluster performance without increasing power per rack, which paves the way for more efficient, cost-effective, and profitable AI infrastructure."

Ayar Labs and Fujitsu are showcasing the future of hardware and system architecture design in response to the growing demands of AI and HPC workloads. A conceptual model of Ayar Labs' optical I/O solution integrated with the Fujitsu A64FX processors in a PRIMEHPC FX700 chassis is on display in Ayar Labs' booth representing up to 16Tbps of bi-directional bandwidth with the integration of two TeraPHY optical I/O chiplets per CPU.

"Collaborating with Ayar Labs allows us to showcase a new era of AI and HPC system design," says Naoki Shinjo, senior VP, head of the Advanced Technology Development Unit at Fujitsu. "Our joint architectural concept at SC24 highlights our commitment to push the boundaries of innovation and deliver unparalleled solutions that meet tomorrow's most demanding computational challenges."

Copper interconnects and pluggable optics have already failed to support large-scale AI workloads. Optical I/O overcomes these bottlenecks by enabling scale-up fabrics that connect more GPUs or accelerators per cluster across greater distances

In addition to the model on display,, Ayar Labs and Fujitsu presented a joint talk 'New Optical-Based Scale-Up Fabrics to Meet the Performance and TCO Requirements of Next-Generation AI/HPC System Architectures'. Ayar Labs' chief technology officer & co-founder Vladimir Stojanovic and Miki Atsushi, a member of Fujitsu's Advanced Technology Development Division, discussed the key challenges in current architectures and the requirements for future systems, while Ayar Labs is explaining how optical I/O-based scale-up fabrics enhance system-level performance and reduce total cost of ownership for these systems.

Other demonstrations and displays at SC24 included:

- *Innovative AI System Architecture Tool:* Developed by Ayar Labs, this new tool can predict the performance and economics of AI inference workloads, including future agentic models. It helps to assess next-gen AI infrastructure by simulating various GPU and network configurations. Visitors to the booth can see the impact Ayar Labs' optical I/O has on scaling large language model (LLM) inference, with profitability gains of up to 20x and a 3–4x interactivity improvement in future GPT models.
- *Advancing AI with Optical FPGAs:* Ayar Labs, Altera and Corning have partnered to pioneer a new optical field-programmable gate array (FPGA) solution. This proof of concept provides 4Tbps of bi-directional I/O data transfer by integrating Ayar Labs' TeraPHY optical I/O chiplets with Corning's advanced glass waveguide modules to Altera's FPGA fabric. This unique solution provides what is claimed to be unprecedented bandwidth and latency for compute-intensive applications such as generative AI, LLMs and AI scale-up fabrics.
- *4Tbps In-Package Optical I/O Solution*: SC24 guests could experience a live demonstration of Ayar Labs' 4Tbps optical I/O solution powered by its SuperNova light source. Visitors could see first-hand ultra-efficient data transfer at extremely low latency without the need for forward error correction (FEC). Ayar Labs optical I/O provides a high level of energy efficiency, power density and performance per watt that is suitable for AI models with trillions of parameters, advanced HPC designs, and more.
- *Detachable Optical Connector Ecosystem*: Ayar Labs highlighted the latest advancements in detachable optical connectors for optical I/O, including the latest Intel Foundry detachable photonic glass interconnect and the Teramount TeraVERSE detachable connector. These connectors enable flexible, efficient and cost-effective deployment and maintenance of Ayar Labs' in-package optical I/O solutions for AI.

https://ayarlabs.com
https://sc24.conference-program.com/

Lumentum releases 2024 Corporate Sustainability Report

Lumentum Holdings Inc of San Jose, CA, USA (which designs and makes optical and photonic products for optical networks and lasers for industrial and consumer markets) has issued its fourth annual Corporate Sustainability Report, for fiscal 2024 (ended 29 June), showcasing its environmental, social and governance achievements.

Highlights include:

Planet – Continued Momentum and Expansion of Climate Change Initiatives

Lumentum says that it made notable advances over the past fiscal year toward achieving net-zero Scope 1 and Scope 2 emissions by 2030. Additionally, it expanded its commitment to reduce Scope 3 emissions by submitting targets to the Science-Based Targets initiative (SBTi). Accomplishments in fiscal 2024 included:

- Reduced Scope 1 and Scope 2 greenhouse-gas emissions by 38% compared with fiscal 2023, despite a new company acquisition.
- Increased procurement of renewable electricity to 79%, up from 61% in fiscal 2023.
- Transitioned three more sites to 100% renewable electricity, bringing the total to 14 sites.
- Began solar power generation at two major sites: Navanakorn, Thailand and San Jose, California, USA.
- Expanded its ISO 14001 certification to three additional manufacturing sites, increasing the total number of certified sites to eight.

People – Focus on Career Development, Inclusion, and Health and Safety

Lumentum says that it is investing in its people by encouraging and supporting professional development, fostering an inclusive culture and ensuring a safe working environment. Fiscal 2024 highlights include:

- Engaged nearly 250 participants in its employee mentorship program.
- Awarded 20 scholarships to under-represented minority student interns in the USA and Canada.
- Supported more than 230 staff globally through leadership certificate programs.
- Expanded ISO 45001 certification to three additional manufacturing sites, increasing the total number of certified sites to eight.

Innovation – Efficiency and Performance Gains Across Products

Lumentum says that it is continually improving products and processes to deliver value to customers while upholding quality, safety and efficiency. Fiscal 2024 saw the implementation of new product innovations and processes, including:

- Integrated product design Kaizen events early in the new product introduction (NPI) cycle, improving product and process designs across multiple sites.
- Reduced power consumption (power per Terahertz) by 45% in the TrueFlex Twin 16X24 wavelength-selective switch (WSS) product, while still achieving double the switching capacity in optical networks.
- Reduced power consumption of 200G PAM4 externally modulated lasers (EMLs) by 77% per Gbps of optical bandwidth compared with the previous generation of 100G EMLs.
- Filed over 280 new patent applications.

"With ambitious targets recently submitted to the Science-Based Targets initiative, we are committed to continuously raising the bar and driving sustainable growth, which is important to our customers, employees, and communities," says president & CEO Alan Lowe.

www.lumentum.com

Lumentum expands board to nine members

Firm gains expertise in corporate finance, manufacturing and business transformation

Lumentum has appointed Paul Lundstrom to its board of directors, expanding the membership to nine members (eight of whom are independent).

"He brings a wealth of knowledge and expertise in corporate finance, manufacturing and business transformation," comments board chair Penelope Herscher. "He will provide valuable insights as Lumentum executes its long-term strategy to grow its business and shareholder value," she adds.

"Lumentum has significant opportunities for growth with its portfolio of foundational photonic technologies that underpin the explosive growth we are seeing in artificial intelligence and cloud infrastructure," believes Paul Lundstrom. "I look forward to working together with the senior leadership team and the rest of the Lumentum's board of directors to capitalize on these compelling opportunities and to help build lasting value for shareholders."

Lundstrom is currently chief financial officer at sustainable climate solutions firm Copeland. Prior to Copeland, he was CFO of Flex Ltd, where he was a key member of the team that led the analysis, carve-out and IPO for Nextracker, and served as a member of the Nextracker board of directors. Prior to Flex, Lundstrom was CFO of Aerojet Rocketdyne. He has also held a number of senior finance leadership roles while at United Technologies.

Celestial AI wins 2024 Global Semiconductor Alliance 'Start-Up to Watch' award

Firm honoured for Photonic Fabric technology platform and customer engagement model

Celestial AI of Santa Clara, CA, USA has been selected by a committee of venture capitalists and industry entrepreneurs to receive this year's Global Semiconductor Alliance (GSA) 'Start-Up to Watch' award for its innovative and transformative Photonic Fabric technology platform and customer engagement model.

The annual award is presented to companies that demonstrate the potential to positively change the semiconductor industry, through the innovative use of semiconductor technology or a new application for semiconductor technology.

"This award underscores the transformative potential of our Photonic Fabric platform and the caliber of our world-class team as we usher in a new era of optical connectivity for accelerated computing," says Celestial AI's co-founder & CEO Dave Lazovsky.

The explosive growth in AI models is driving the need for network solutions that enable seamless, high-bandwidth interconnects with ultra-low latency and energy efficiency to meet the demands of next-generation data-center infrastructure, notes the firm. Celestial AI claims that its Photonic Fabric product and technology offerings are the industry's leading solution for scale-up networking and network-attached high-performance memory, enabling customers to build clusters of hundreds of XPUs with a high-bandwidth, low-latency interconnect fabric and provision terabytes of unified high-speed memory. The Photonic Fabric addresses the most critical scalability and performance chokepoints in AI processing, unleashing new use-cases and advancements in AI system performance for a sustainable future, says Celestial AI.

www.gsaglobal.org/2024awd
www.celestial.ai

Hamamatsu invests in SuperLight Photonics to drive development of wideband lasers

Hamamatsu CVC Europe business development manager David Castrillo joins advisory board

SuperLight Photonics of Enschede, the Netherlands — a spin-off from the University of Twente that is developing a wideband laser light source for measurement and detection applications — has announced the strategic investment of Hamamatsu Ventures to drive long-term synergy in laser innovation.

SuperLight says its patented PAD (Patterned Alternating Dispersion) technology applies non-linear pulse compression in a highly efficient way. Based on a photonic integrated circuit (PIC) platform, the form factor is substantially reduced compared with similar lasers.

Hamamatsu Ventures Corporate Venture Capital (CVC) is a global VC looking to invest in photonics firms that address future anticipated needs through the development of disruptive photonics technologies with the potential to redefine industries. The new partnership aims to accelerate SuperLight's development of next-generation photonic technologies and strengthen its global market presence.

"Their support validates the enormous potential of our technologies and strengthens our ability to scale quickly, innovate and meet the needs of global customers seeking innovative photonic solutions," says SuperLight's CEO Cees Links. "We are excited to leverage their industry knowledge and network to bring our breakthrough products to new markets," he adds.

"As a strategic investor, we provide business expertise in areas where we have deep experience and we seek to create synergies which might lead to collaborative R&D and joint developments," says Hamamatsu Ventures' CEO Katsuhiro Kobayashi. "It is our ambition to build a long-term, supportive partnership with our portfolio companies," he adds. "We recognize SuperLight Photonics' groundbreaking technology as a game-changer with vast potential to transform a wide range of industries; they align perfectly with our investment focus on technologies shaping the future."

As part of the strategic investment, Hamamatsu CVC Europe business development manager David Castrillo (who has over 30 years of experience in the optical industry at Hamamatsu) will join SuperLight Photonics' Advisory Board and serve as a liaison.

With the investment, SuperLight will focus on expanding its team, scaling its production capacity, and driving innovation across its product portfolio. The company plans to expand into new geographic markets and establish stronger partnerships with global distributors, OEMs and key industry players.

www.superlightphotonics.com

POET expands capacity to meet AI infrastructure demand

Company assumes control of China joint venture and centers Optical Engine assembly in Malaysia

POET Technologies Inc of Toronto, Ontario, Canada — designer and developer of the POET Optical Interposer, photonic integrated circuits (PICs) and light sources for the data-center, telecom and artificial intelligence (AI) markets — is to expand its optical engine production capacity in Malaysia.

The firm also announced that it has signed a binding memorandum of understanding (MOU) with Quanzhou Sanan Optical Communication Technology Co Ltd (SAIC) to transfer to POET its 24.8% stake in the China-based joint venture Super Photonics Xiamen (SPX), along with all the production equipment previously leased by SAIC to SPX. With control of SPX, POET now has the flexibility to implement its 'China Plus One' strategy to locate its wafer-scale assembly operations outside China.

Concurrently, the firm has been negotiating with several contract manufacturers in Malaysia to become the focal point for POET's wafer-scale assembly of optical engines and expects to sign an agreement in November and to start operations by the end of the year.

"The addition of wafer-scale equipment to our assembly & test operations will significantly expand our production capacity to cover the projected needs of our customers for 800G optical engines being sold to AI networks through 2026," notes POET's chairman & CEO Dr Suresh Venkatesan. "We can now project an assembly & test capacity exceeding 1 million optical engines per year, all dedicated to the 800G-and-higher-speed transceivers required for AI clusters."

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The 24.8% equity stake represents SAIC's entire ownership position in the JV. With no other shareholders, SPX will become a wholly owned subsidiary of POET and will continue to assemble optical engines for sale in China, adopting the POET company name. The MOU is binding and is also subject to definitive agreements, which are expected to be signed by the end of November.

Expansion of IR activities

POET has entered into an agreement with 1123963 B.C Ltd DBA CAPITALIZ ON IT to conduct market awareness and marketing services, commencing on 15 November 2024 and terminating on 15 February 2025. The nature of the services to be provided by CAPITALIZ include, but are not limited to, advice, content development, media buying and distribution, and marketing services through social media channels. POET will pay CAPITALIZ a total of US$90,000 for its services, split over the term of the contract in accordance with the services rendered.

www.poet-technologies.com

POET appoints Bob Tirva as board director and Audit Committee member

Number of directors increased to six

POET Technologies has expanded its board of directors to six members by appointing Bob Tirva as director and member of the Audit Committee. Along with the five incumbent directors, he will serve until the next annual meeting of shareholders or until his successor is duly elected or appointed.

Tirva has over 30 years of executive experience in technology industries and several years of advisory experience as a director of companies advancing semiconductor technology. Tirva held various management positions at IBM, Broadcom Corp, Dropbox and Intermedia Cloud Communications Inc before becoming president, chief operating officer and chief financial officer of Sonim Technologies Inc until it was acquired by AJP Holding Company in 2022. Tirva is currently on the board of Skyworks Aeronautics and was recently on the boards of Costar Technologies and Resonant Inc.

"His experience at Broadcom and Resonant is directly relevant to POET and his strong financial background will be an asset to our Audit Committee and management team overall," comments POET's chairman & CEO Dr Suresh Venkatesan.

Following Tirva's appointment, the board will consist of six members: Dr Suresh Venkatesan (chair), Jean-Louis Malinge (lead independent director), Theresa Lan Ende, Glen Riley, Chris Tsiofas, and Bob Tirva.

Scintil names Matt Crowley CEO and forms US subsidiary

Founder Sylvie Menezo to continue heading technology developments and customer partnerships

Scintil Photonics of Grenoble, France and Toronto, Canada, a fabless developer of augmented silicon photonic integrated circuits, has appointed Matt Crowley as chief executive officer and established a US subsidiary to support its expanding customer base in data centers, machine learning and artificial intelligence (AI).

Crowley joins Scintil following his recent role as senior director business development at Qualcomm, where he arrived after leading MEMS technology company Vesper Technologies through its acquisition by Qualcomm. As chief technology officer, Scintil founder Sylvie Menezo will continue advancing the company's product portfolio and customer partnerships and also serve as managing director.

This evolution in strategic leadership and US presence come as Scintil's LEAF Light product gains traction in AI computing applications. LEAF Light serves as a remote light source for GPU interconnects in AI data centers. This is claimed to be the first light source of its kind able to provide a single-chip solution with high power output, high efficiency, small form factor and tightly controlled channel spacing required for extremely high-data-rate DWDM (dense wavelength-division multiplexing) communications, also specified by the CW-WDM Multi Source Agreement.

"Having recently led Vesper Technologies to high-volume shipments and through its successful acquisition, I understand the immense potential of breakthrough technologies in rapidly evolving markets," says Crowley. "Our LEAF Light product demonstrates our ability to deliver transformative solutions for AI data centers and advanced computing applications. Our US presence strengthens our ability to serve customers and accelerate market adoption of our technology," he adds.

"As we expand our business globally, it is essential to have a presence in the United States, in which we will benefit from Matt's highly relevant business experience," says Menezo. "I will continue to advance our innovative technology roadmap, develop our talented team and strengthen our rich partnerships. Close collaboration with our industry-leading customers has always been the driving force behind our innovation and fuels our drive to succeed. I am happy to see the huge appeal our flagship product, LEAF Light, is receiving from the industry," she adds. "Our proprietary Scintil Heterogeneous Integrated Photonics (SHIP) circuit technology, fabricated by Tower Semiconductor and leveraging its high-volume standard silicon photonics, can offer much more in the very near- and longer-term future."

Created in 2018, Scintil and its team of 30 now comprises a US subsidiary, in addition to the two sites located in France (headquarters) and Canada. This new US footprint reinforces the company's capabilities to address local needs as well as serve customers, globally.

"Matt's extensive industry experience and proven ability to scale up high-tech companies make him the ideal leader to partner with Sylvie as we enter our next growth phase," believes co-founder & chairman Pascal Langlois. "Our new US presence demonstrates our commitment to supporting our expanding North American customer base."

www.scintil-photonics.com

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SMART Photonics and X-FAB collaborate on multi-Terabit transceivers

Micro-transfer printing used for heterogeneous integration of InP chiplets and silicon photonics

A strategic collaboration has been announced to use micro-transfer printing (MTP) for the heterogeneous integration of the silicon photonics platform of analog/mixed-signal and specialty foundry X-FAB Silicon Foundries SE of Tessenderlo, Belgium with the indium phosphide (InP) chiplets of independent pure-play InP photonic integrated circuit (PIC) foundry SMART Photonics of Eindhoven, The Netherlands, enabling new capabilities for datacom and telecom applications.

InP technology supports modulator bandwidths exceeding 120GHz, making it the optimal solution for next-generation multi-terabit telecom and datacom standards – pushing transceiver speeds far into the terabit realm. In contrast, market-leading silicon photonics technologies hit a performance ceiling at about 70GHz. The collaboration aims to deliver scalable, high-volume solutions that combine the best of both technologies.

By co-optimizing silicon photonics, InP and MTP technologies to fulfill customer requirements, the collaboration should enable new functionalities and improved system performance while reducing integration costs through relaxed photonics packaging requirements. The MTP technology, licensed from X-Celeprint Ltd of Cork, Ireland – a subsidiary of Tessenderlo-based XTRION N.V. that uses facilities at Ireland's Tyndall National Institute and in Research Triangle Park, NC, USA to develop and license patented MTP and related technology – enables a broad degree of freedom for system and product designers by providing flexible integration of various material system chiplets into the product design.

"As the demand for integrated photonics rapidly increases, thanks to the growth of AI and data transfer, our joint solutions will enable much faster data rates while reducing overall power consumption, and therefore the environmental footprint," says SMART Photonics' CEO Johan Feenstra.

"Through heterogeneous integration, we are combining the best of the InP and silicon photonics worlds," says X-FAB's CEO Rudi De Winter. "This will allow our customers to develop innovative solutions addressing the societal challenges of our times such as decarbonization. It is also a great opportunity to build a strong European value chain."

The collaboration builds upon the PhotonixFAB EU (European Union) funding project, which aims to provide a path to scalable high-volume manufacturing for silicon-on-insulator (SOI) and silicon nitride (SiN) silicon photonics, MTP-ready InP chiplets and micro-transfer printing of chiplets.

X-FAB and SMART Photonics recently signed a memorandum of understanding (MoU) to formalize their collaboration. The aim is to support lead customers with industrial prototyping by 2026, with risk production readiness by 2027. Early customer engagements can be supported within the ongoing PhotonixFAB project framework.

www.photonixfab.eu
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Coherent launches high-speed indium phosphide photodiodes for 1.6T transceivers

General availability planned for Q1/2025

Materials, networking and laser technology firm Coherent Corp of Saxonburg, PA, USA has announced the production release of high-speed indium phosphide (InP) photodiodes.

Designed for use in the next generation of 800G and 1.6T transceivers with 200Gb/s PAM4 optical lanes, and available in both singlet and 1x4 array configurations with integrated lenses, they provide efficient optical coupling and compatibility with all major 4-channel and 8-channel transimpedance amplifiers (TIA).

Featuring a wide optical response from 900nm to 1650nm and high responsivity at 1310nm, the RoHS-compliant devices have a 3dB bandwidth greater than 50GHz, a low capacitance of 50fF, and low dark current.

The photodiode arrays are available in two different flip-chip pad configurations for compatibility with high-performance TIAs and are engineered to meet the demanding requirements of long-wave fiber-optic communication systems.

"These photodiodes represent a major advancement in reliability and performance for data-center applications," says Kou-Wei Wang, vice president, InP DML & Photodiodes at Coherent. "Their high bandwidth and excellent optical characteristics allow our customers to develop high-speed optical transceivers with an additional performance margin."

The high-speed photodiodes are currently available in sample quantities, with general availability planned for first-quarter 2025.

www.Coherent.com

OIF releases 800ZR coherent interface implementation agreement and key 400ZR IA updates

Addressing demand for scalable, interoperable, high-capacity solutions

In its ongoing commitment to meet evolving market demands for interoperability and address real-world network requirements, the Optical Internetworking Forum (OIF) has released its 800ZR coherent interface implementation agreement (IA). OIF has also released updates to the foundational 400ZR coherent optical interfaces IA.

Developed through a systematic process driven by OIF's network operator and vendor members, the new 800ZR IA defines the requirements for an 800G coherent line interface and frame format for single-span, amplified 80–120km dense wavelength division multiplexing (DWDM) links, specifically targeting data-center interconnect (DCI) applications.

"This IA represents a critical milestone in expanding the capacity and efficiency of DCI solutions," says Karl Gass, OIF Physical and Link Layer (PLL) Working Group (WG) Optical Vice Chair. "The 800ZR IA builds on the success of OIF's transformational 400ZR work, providing a clear pathway for vendors and network operators to implement scalable, interoperable 800G solutions."

The 800ZR IA enables Ethernet client interfaces, starting at a minimum of 100GE, to scale up to 800G aggregate bandwidth over a single coherent line interface. It specifies the Ethernet client mappings, frame format, forward-error correction (FEC), modulation and optical characteristics needed for interoperable 800ZR implementations. An important feature of this IA is its focus on low-power, cost-effective coherent solutions in small-form-factor pluggable modules, which provide high port densities typically found in client optics.

The IA marks a significant advancement in 800ZR interoperability, demonstrating its potential to deliver scalable solutions for high-capacity optical links over extended distances, says OIF. The organization recently demonstrated the first multi-vendor interoperability of 800ZR coherent interfaces at the European Conference on Optical Communication (ECOC 2024) held in Frankfurt, Germany (23–25 September), showcasing the technology's readiness for deployment in high-capacity DCI applications.

The updates to the 400ZR IA (3.0) focus on addressing identified deficiencies and clarifying several parameter definitions. These updates aim to enhance interoperability and improve the implementation of 400ZR solutions across the industry.

The 400ZR IA has seen rapid adoption since its introduction, with 400ZR modules now widely available from multiple vendors. OIF recently released a story showcasing the industry impact of the 400ZR IA, highlighting how it has transformed the market by enabling interoperable, cost-effective solutions for data-center interconnects.

"400ZR and its derivatives are by far the most successful coherent technology of all time," says Scott Wilkinson of Cignal AI. "Without 400ZR, data-center development would not be where it is today," he adds.

www.oiforum.com/wp-content/uploads/OIF-800ZR-01.0.pdf

Tower releases 300mm silicon photonics process as standard foundry offering

Figures of merit address evolving needs for next-gen datacoms

Specialty analog foundry Tower Semiconductor Ltd of Migdal Haemek, Israel has released its new 300mm silicon photonics (SiPho) process as a standard foundry offering. The process complements Tower's well-established 200mm (PH18) platform that is in high-volume production currently, providing a solution tailored to meet the growing needs of high-speed data communications for next-generation datacom applications.

The unique 300mm offering features what is claimed to be best-in-class silicon waveguides and the most advanced low-loss silicon nitride (SiN) waveguide offerings in the industry. The larger wafer size enhances compatibility with industry-standard OSAT (outsourced semiconductor assembly and test) platforms, facilitating seamless integration with electronic components and improving overall efficiency.

The new silicon photonics offering provides "a seamless path for our existing customers to transition to next-generation technology on 300mm wafers," says Dr Edward Preisler, VP & general manager of the RF business unit. "This process builds on Tower's industry-leading 200mm SiPho platform both in terms of continuous process enhancements and increasing flexibility of supply for our customers," he adds.

www.towersemi.com

Tower starts producing 1.6Tbps transceivers on latest silicon photonics platform

Doubling speed of 800Gbps high-volume transceivers enables faster, high-capacity solutions for AI, cloud computing and data centers

Specialty analog foundry Tower Semiconductor Ltd of Migdal Haemek, Israel has begun volume production of 1.6Tbps silicon photonic products for multiple lead customers based on its latest silicon photonics (SiPho) platform. The firm's latest platform includes innovations that have helped to double data rates relative to its existing 800Gpbs high-volume products. These innovations have been developed in close collaboration with several tier-1 customers that have designed breakthrough 1.6Tbps products on this enhanced platform and have now begun to order production quantities.

The process supports data rates of 200Gbps per lane, of which eight are built in parallel to achieve the total 1.6Tbps transceiver throughput. This is in contrast to the 100Gbps-per-lane data rates of existing high-volume silicon photonic technology as used in existing high-volume 800Gbps products.

"We have recently announced 1.6Tbps optical transceivers based on silicon photonics technology in addition to ramping up our SiPho-based 8x100G transceivers," says Dr Jack Xu, VP of transceiver engineering at Coherent Corp. "Tower can help innovate and bring to market advanced technology and also has the experience to ramp silicon photonic products to high volume, thereby benefiting our mutual customers."

Tower says that its high-volume silicon photonics platform delivers all of the key enabling features required for high-data-rate optical transceivers including high-bandwidth optical modulators and low-loss edge coupling from lasers, and to optical fibers. These features play a vital role in the development of high-speed datacom components and support the industry shift from 100Gbs per lane to 200Gbs per lane and beyond.

www.towersemi.com/technology/

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Rocket Lab signs $23.9m CHIPS Act Incentives Award to boost manufacturing capability and capacity

Launch services and space systems provider Rocket Lab USA Inc of Long Beach, CA, USA has finalized a $23.9m award from the US Department of Commerce to increase its compound semiconductor manufacturing capability and capacity at its facility in Albuquerque, NM. The semiconductors produced by Rocket Lab are used in space-grade solar cells and other opto-electronic products that are key components for national security and commercial applications.

In July, the firm announced the signing of a preliminary terms sheet for funding under the US CHIPS and Science Act. The funding will enhance manufacturing capabilities at the New Mexico facility, enabling Rocket Lab to scale semiconductor production to meet growing demand. In particular, the space-grade solar cells power satellites that require high reliability and optimum performance in extreme environments.

Rocket Lab technician during the manufacturing process of one of its space-grade solar cells at the facility in Albuquerque, New Mexico.

"This award will help to ensure US leadership in compound semiconductor manufacturing capability while reinforcing Rocket Lab's position as a leader in space-grade solar cell production," says Brad Clevenger, VP of Rocket Lab Space Systems. "The investment will enable Rocket Lab to expand production, create highly skilled manufacturing jobs, and generate economic and workforce development activity in New Mexico."

Rocket Lab is one of only two companies in the USA that specialize in the production of highly efficient and radiation-hardened space-grade solar cells. Its solar cell facility has been a technology hub in Albuquerque for the past 25 years, employing more than 370 people that have delivered more than 4MW of power to over 1100 satellites in orbit. Rocket Lab's products enable critical space programs, including early missile warning and interplanetary science missions, the James Webb Space Telescope, NASA's Artemis lunar explorations, the Ingenuity Mars Helicopter, and the Mars Insight Lander in addition to 100s of commercial telecoms satellites.

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Semiconductor laser market growing at 9% CAGR to over $5bn in 2029

The telecom & infrastructure segment is growing at 18% to over $2.5bn, as consumer applications grow just 1% to $1.75bn, says Yole Développement.

According to market analyst firm Yole Group, the semiconductor laser market is growing at a compound annual growth rate (CAGR) of 9% from $3.1bn in 2023 to more than $5bn in 2029, continuing to be driven by several factors.

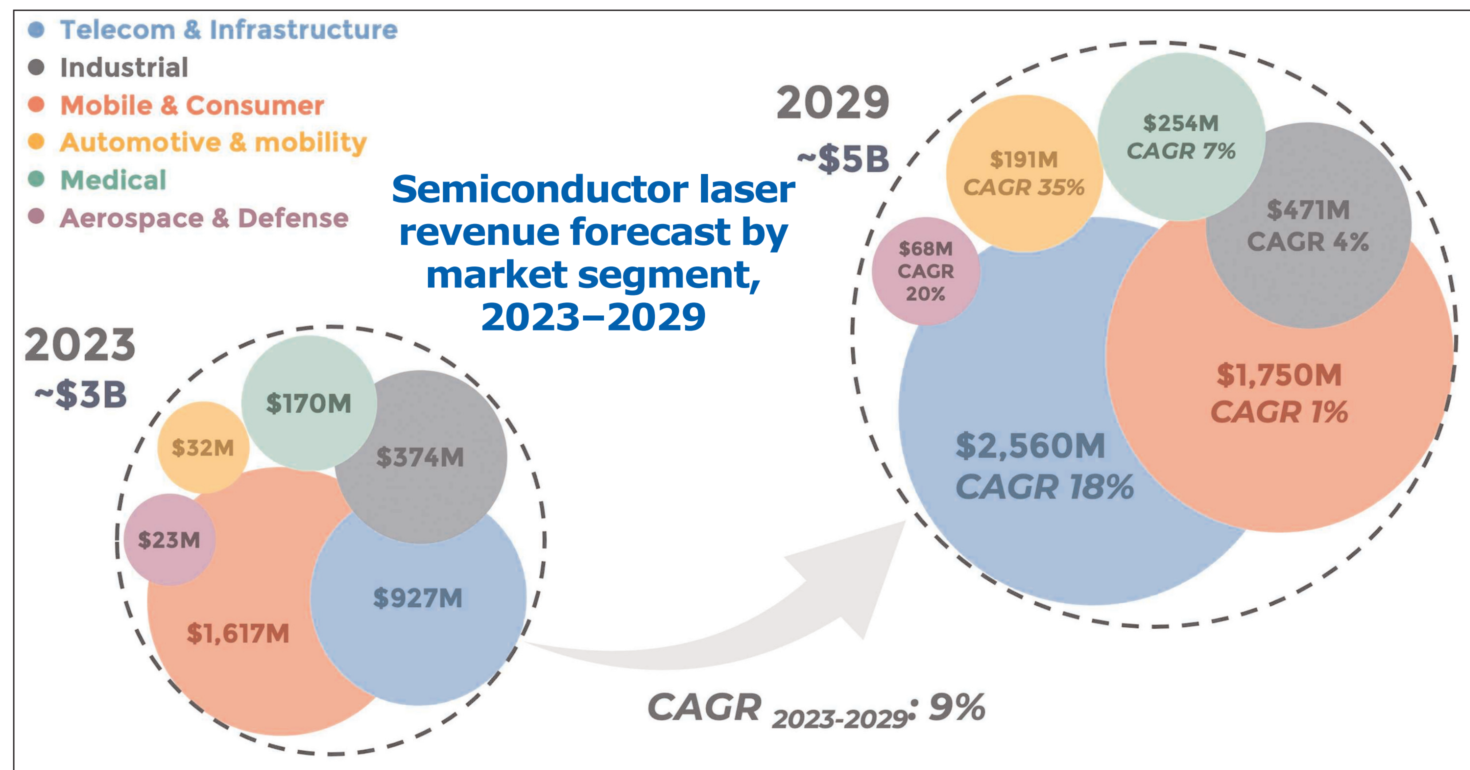
Analysts underline significant and rapid technical advances, growing demand across multiple industries, and a push for higher performance at lower cost. Trends that are shaping the future of the semiconductor laser market include: the expansion of applications using lasers; the shift toward energy efficiency, compact size and precision; and the growth in integration with multiple technology platforms including silicon-on-insulator (SOI), silicon nitride (SiN), indium phosphide (InP) and thin-film lithium niobate (TFLN).

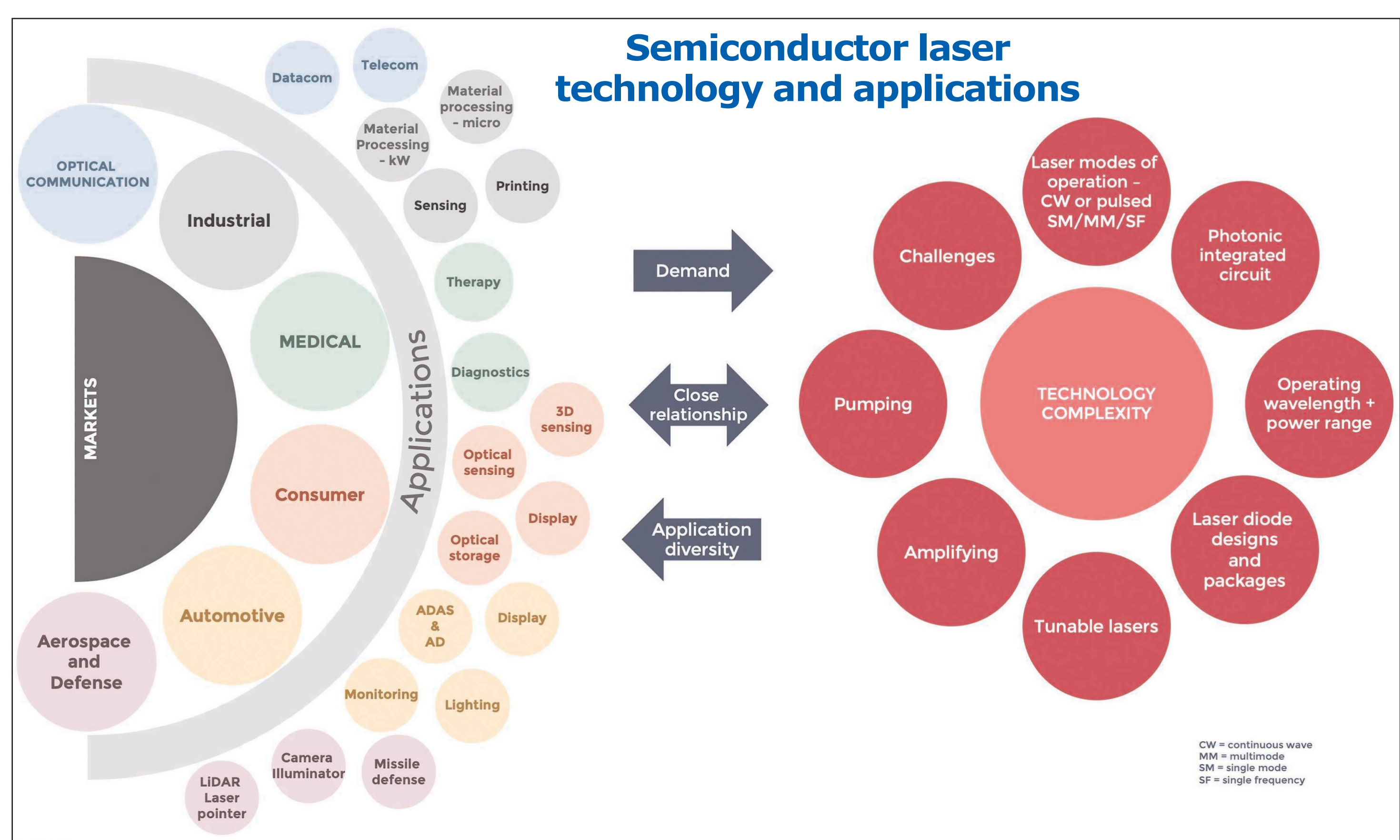
At the same time, geopolitical factors and supply chain challenges are prompting manufacturers to adopt more resilient production strategies. Overall, the semiconductor laser industry is positioned for significant growth, reckons Yole, driven by innovations in both established and emerging markets.

Photonics has taken its place alongside electronics as a critical enabling technology for the 21st century. Photonics-based solutions are entrenched in a broad array of industries, including microelectronics, flat-panel displays, machine tools, automotive, and medical diagnostics, with adoption continuing in ever more diverse applications.

"In this dynamic context, the laser market has grown significantly over the last 40 years… [from] a few millions to a few billion dollars," notes Martin Vallo PhD, senior technology & market analyst, Photonics at Yole Group. "Without doubt, laser technologies represent huge potential. That is why, at Yole Group, we investigate this domain by analyzing the innovative solutions and the applications."

Behind the biggest segment of telecom & infrastructure (growing at a 18% CAGR to over $2.5bn in 2029), consumer applications are forecasted to comprise a significant $1.75bn market in 2029. But the correspon-





ding CAGR of just 1% is less impressive than that for automotive applications, for example.

"In the consumer segment, the moderate market growth is due to the volume drop in optical sensing applications in the 2022–2024 period due to technology replacement," notes Ali Jaffal PhD, senior analyst, Compound Semiconductors, at Yole Group." In contrast, semiconductor lasers in automotive are anticipated to see significant expansion, with a double-digit CAGR during the same period, mainly driven by automotive LiDAR, especially in China." ■

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Hydrogen plasma passivation for blue laser diodes

Researchers claim the first use for a strategy resulting in enhanced power efficiency and thresholds.

Researchers based in China claim the first use of hydrogen (H) plasma treatment as a passivation strategy for blue ridge laser diodes [Lu Wang et al, Optics Express, v32, p34492, 2024]. The treatment enabled an increase in slope efficiency and reduction in threshold current, compared with conventional silicon

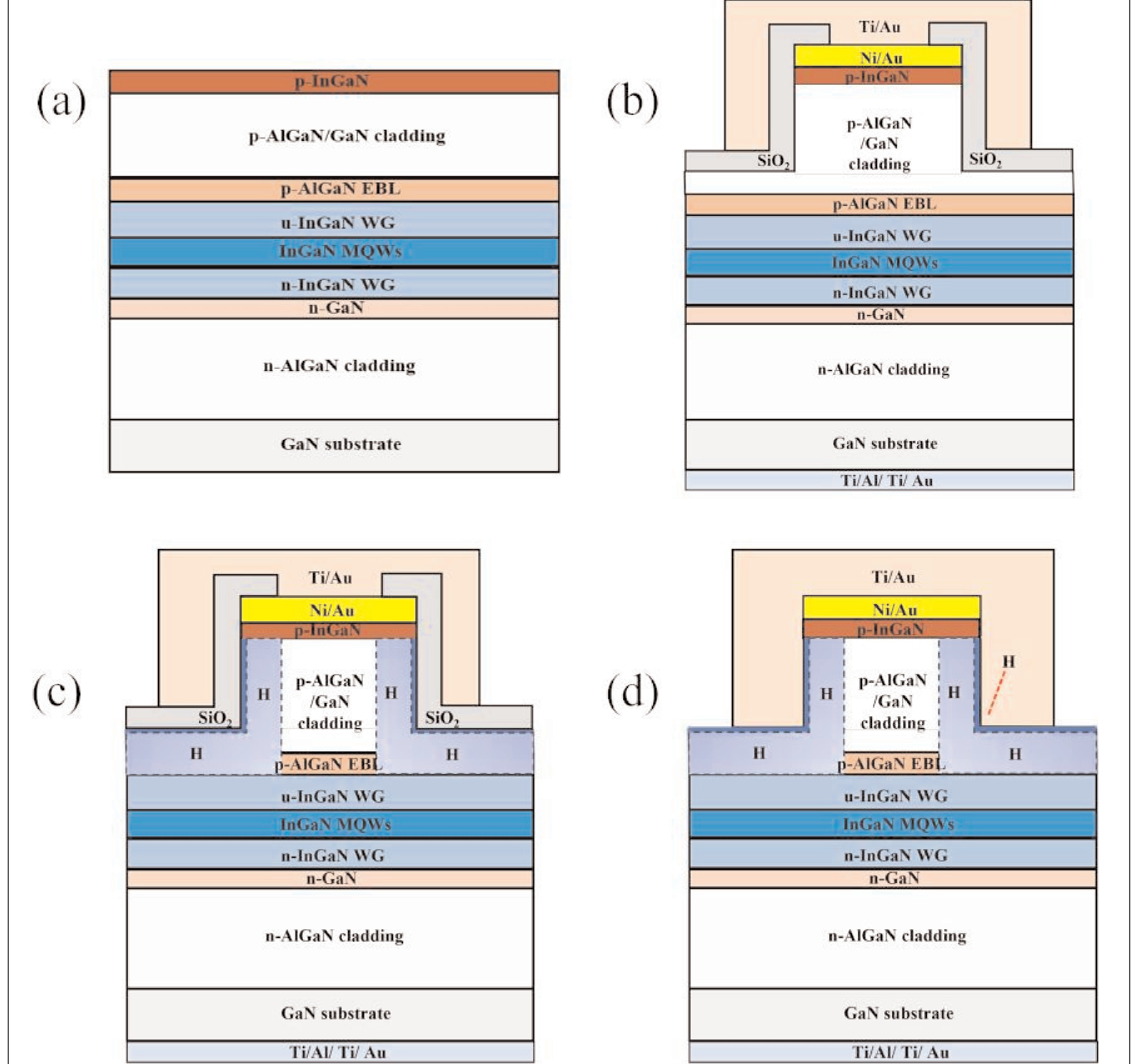

Figure 1. (a) GaN laser diode epitaxial structure. Further schematics of respective S_1–S_3 ridge laser diode passivation strategies: (b) conventional SiO_2; (c) double-layer; and, (d) pure H-plasma laser diode.

dioxide (SiO_2) passivation.

The H plasma treatment interacts with the magnesium (Mg)-doped p-type gallium nitride and aluminium gallium nitride (AlGaN) layers to produce neutral Mg–H complexes. These complexes reduce the conductivity of the p-type layers near the surface — a task usually given to insulating passivation materials such as SiO_2. Indeed, the activation anneal of p-type III–nitrides is designed to drive out H to enhance hole injection into light-emitting structures such as laser diodes.

The team included researchers from Suzhou Institute of Nano-Tech and Nano-Bionics, Changchun University of Science and Technology, University of Science and Technology of China. These researchers hope that the enhanced performance enabled by their H plasma treatment could lead to expanded commercial application of blue laser diodes in multiple fields such as communication, healthcare, military, industrial processing, and beyond.

The researchers comment on the effects of increased surface leakage currents caused by poor passivation: "The increase of the laser diode leakage current not only leads to energy wastage but also causes wavelength drift, reduction in output power, and potentially shortens the laser diode's lifetime."

The disadvantages of SiO_2 include "incomplete encapsulation, poor thermal dissipation, and performance degradation due to high interface state density," according to the authors.

The researchers studied three ridge laser diode passivation strategies: conventional silica/silicon dioxide (SiO_2); mixed H plasma treatment and SiO_2; and just the H plasma treatment (Figure 1). The SiO_2 layers were 200nm thick. The H plasma treatment was carried out in an Oxford Instruments' Plasmalab 100 ICP 180 system.

The RF power was set at 2W with the inductively coupled plasma power at 300W. The gas supply was hydrogen and argon at rates of 30 and 5 standard cubic centimeters per minute (sccm), respectively. The plasma treatment was followed by 350°C rapid thermal annealing for 10 minutes.

The epitaxial structure was grown on c-plane free-standing GaN with the usual AlGaN cladding, and InGaN waveguide (WG) and multiple quantum well (MQW), layers, along with a p-AlGaN electron-blocking layer (EBL) insertion below the p-cladding. The WG and cladding provide optical confinement, and the MQW generates and amplifies the photons via stimulated and spontaneous emission processes.

The ridge waveguide structure was 45μm wide and was created by etching down through the 130nm p-GaN contact layer and 440nm into the p-cladding.

The metal contact layers used nickel/gold (Ni/Au) for the p-electrode, and titanium/gold (Ti/Au) for the pad, applied after the passivation processes. The n-electrode/pad was a stack of Ti/Al/Ti/Au. The metal layers also provided reflectance of light back into the laser cavity.

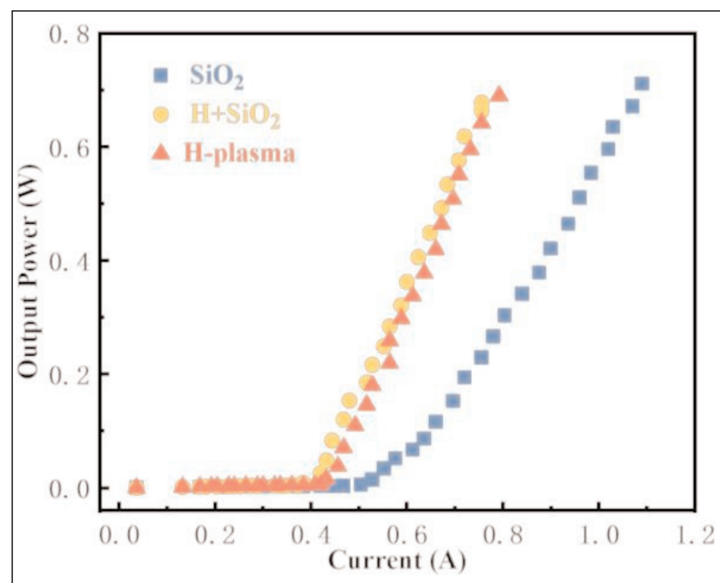

Figure 2. Light output power versus current for three device types.

The final laser diodes were separated into 1200μm-long cavities, and were treated to give 8%/98% reflectance for the front/rear facets, respectively.

In current-voltage measurements both H-plasma treated devices demonstrated a reverse-bias leakage current reduced by three orders of magnitude from ~10^{-5}kA/cm^2 for the conventional diodes to ~10^{-8}kA/cm^2 with H plasma treatment. The leakage with plasma treatment was close to the limit of the ability of the measurement equipment to register.

Under forward bias, the current injection at 6V was slightly lower in the pure plasma-treated diode, compared with the mixed passivation. The team suggests that this could be due to excessive hydrogen diffusion, adding: "In the future, the excess hydrogen entering the laser can be reduced by further optimizing the conditions (such as reducing the concentration of hydrogen gas, reducing the power of the ICP). In this way, only a small amount of hydrogen can form a complex reaction on the ridge, ensuring leakage and slope efficiency, and solving the voltage problem."

The light output power of the diodes (Figure 2) showed a slope efficiency of ~1.95W/A of the plasma-treated devices over 1.40W/A with just SiO_2 passivation. The pure H plasma diode (S_3) had a slightly higher slope efficiency, compared with the mixed passivation device.

The researchers comment: "During the deposition process of SiO_2 in S_2, some minor diffusion of Si and O atoms may occur. However, in S_3, no SiO_2 was introduced, resulting in a lack of Si and O atom diffusion. The above results indicate that, compared to traditional SiO_2 passivation layer, laser diodes treated with H plasma on the ridge exhibit significantly higher

Table 1. Summary of light output power-current behavior under three isolation/passivation conditions.

Sample	Isolation	Threshold current	Slope efficiency	Leakage
S_1	SiO_2	0.55A	1.40W/A	10^{-5}kA/cm^2
S_2	SiO_2 + H plasma	0.40A	1.93W/A	10^{-8}kA/cm^2
S_3	H plasma	0.42A	1.96W/A	10^{-8}kA/cm^2

Table 2. Benchmark of Suzhou et al's results and other reports of blue laser diode performance.

Group	Country	Report	Slope efficiency	Light output power	Threshold
Nippon Chemical Industrial	Japan	2017	1.8W/A	5W	—
Sony Corp	Japan	2018	1.8W/A	5.2W	—
Osram Group	Germany	2014	1.6W/A	4.5W	—
Osram Group	Germany	2019	1.4W/A	—	0.01A
Hiya/Nichia Corp	Japan	2024	2W/A	—	0.28A
Suzhou et al	China	2024	1.96W/A	—	0.42A

slope efficiency, demonstrating superior treatment effectiveness."

By analyzing the theoretical factors that can contribute to the slope efficiency, the researchers believe that the primary effect of the H plasma treatment is to reduce the absorption coefficient of the p-GaN layers, decreasing the internal optical losses of the laser diodes.

The threshold current for the H-plasma-treated devices was around 0.4A, compared with 0.55A for the conventional laser diode (Table c). The mixed device had a slightly lower threshold than the pure hydrogen plasma treatment of S3.

The emitted wavelengths of the devices were withing 1nm of each other: 450nm for S_1 and S_3, 449nm for S_2. The researchers also studied the H plasma layer by secondary-ion mass spectroscopy (SIMS), finding the thickness to be 238nm. This is negligible in comparison to the 45μm ridge width.

The Suzhou et al team also provides some comparison data/benchmarks from previous research reports (Table d). ■

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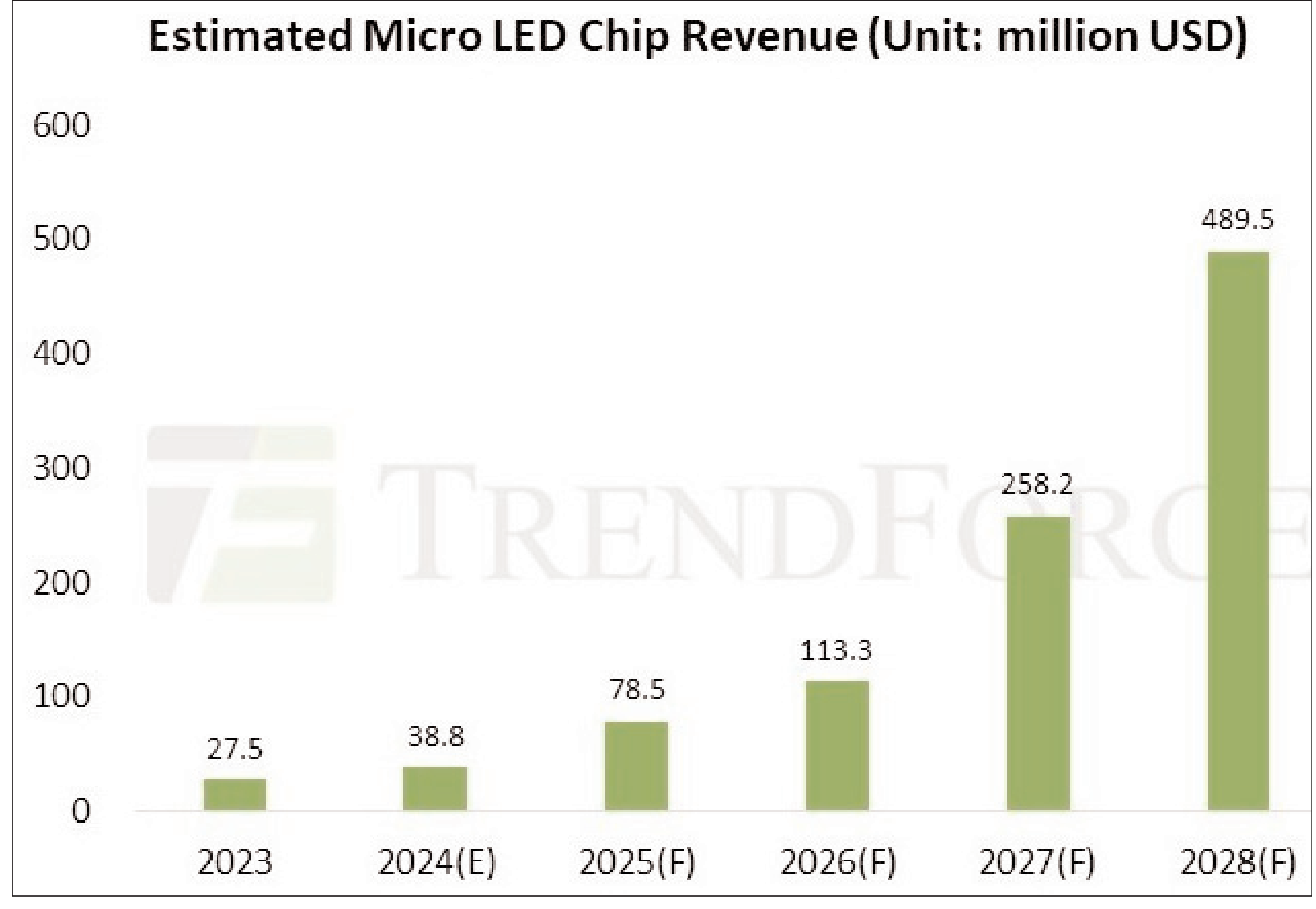
Micro-LED chip market to grow from $38.8m in 2024 to $489.5m by 2028

Artificial reality and automotive applications will drive growth, says TrendForce.

Revenue from micro-LED chips will reach about $38.8m in 2024, with large displays remaining the primary contributor, forecasts market research firm TrendForce. Looking ahead, breakthroughs in technical bottlenecks are on the horizon, while applications in automotive displays and the increasing maturity of full-color augmented-reality (AR) glasses solutions are expected to drive the micro-LED chip market to $489.5m by 2028.

TrendForce highlights several challenges confronting the micro-LED industry in 2024. First, the slow progress in chip miniaturization has hindered cost-reduction efforts. Second, the high price of micro-LED displays has resulted in weak end-user demand, limiting the shipments of large-sized displays already in production. Third, the focus in the wearable device market has shifted to software optimization and hardware–software integration. This has reduced the incentive for brands to innovate hardware and slowed the adoption of new display technologies like micro-LEDs. Lastly, while automotive applications remain a key area of promise for micro-LEDs, they are still in the early stages of adoption and validation, making it difficult to contribute significantly to revenue in the short term.

From a technical perspective, addressing the challenge of seamless large-sized display assembly is crucial. In the short term, improving backplane production



yield through different driving schemes can enhance efficiency and reduce costs. Over the medium to long term, increasing backplane size to minimize the number of required assemblies could eliminate complex manufacturing steps such as side wiring and TGV (through-glass vias).

Additionally, maximizing light extraction efficiency is becoming increasingly important in micro-LED display design and production. Techniques such as micro-structure and reflective structure design can reduce light loss and improve brightness by optimizing reflected light.

TrendForce points out that, as the yield rate of mass transfer technology improves, new challenges are emerging in inspection processes. Although the LED industry already has established testing methods, these solutions require refinement to handle the extreme miniaturization and high volume of micro-LED chips. Addressing these inspection challenges is currently a critical priority for the industry.

The micro-LED's standout characteristics — high brightness, high contrast, and high transparency — continue to attract investment from manufacturers. These features enable micro-LED to integrate into transparent displays for automotive windows or as part of AR-HUD or P-HUD systems, meeting the growing demand for seamless integration of virtual- and real-world information for drivers and passengers. Additionally, combining micro-LEDs with silicon sub-strates offers a robust solution for near-eye displays in AR glasses, positioning micro-LEDs as a benchmark for next-generation metaverse-focused head-mounted devices.

TrendForce emphasizes that the commercialization of micro-LED technology should not depend overly on the mature consumer electronics market. Instead, manufacturers should capitalize on the unique capabilities of micro-LEDs for displays, pairing them with diverse sensor solutions to empower devices with new functionalities and uncover imaginative niche applications. This strategy is expected to accelerate the penetration of micro-LEDs across various markets, further driving growth and innovation. ■

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Deep UV micro-LED display photolithography

Researchers claim a record high 5.7% external quantum efficiency for 270nm-wavelength LEDs.

Researchers based in China report on the fabrication of 270nm-wavelength deep ultraviolet-C (UVC) arrays of micro-LEDs with a view to maskless proximity photolithography [Feng Feng et al, nature photonics, published online 15 October 2024].

The team from Hong Kong University of Science and Technology, Southern University of Science and Technology, Suzhou Institute of Nanotech and Nano-Bionics, comments: "UVC micro-LED arrays are increasingly valued in photolithography and photochemistry as tools for generating arbitrary image patterns and transferring them onto light-sensitive materials like photoresists, eliminating the need for costly photomasks."

UVC LEDs have previously been developed mainly for virus sterilization applications with a view to high efficiency, extended lifespan and low environmental impact, compared with mercury vapor lamps.

The researchers used commercial 2-inch aluminium gallium nitride (AlGaN) epitaxial wafers to fabricate the UVC LED arrays (Figure 1). The team notes that these wafers were bowed by more than 100μm, creating difficulties: "This pronounced bowing effect poses a major obstacle in achieving large-format UVC micro-LED displays, as it causes substantial alignment gaps during fabrication processes such as electrode patterning, hole etching and flip-chip bonding."

This bowing is related to strain effects arising from the significant lattice and thermal expansion mismatching

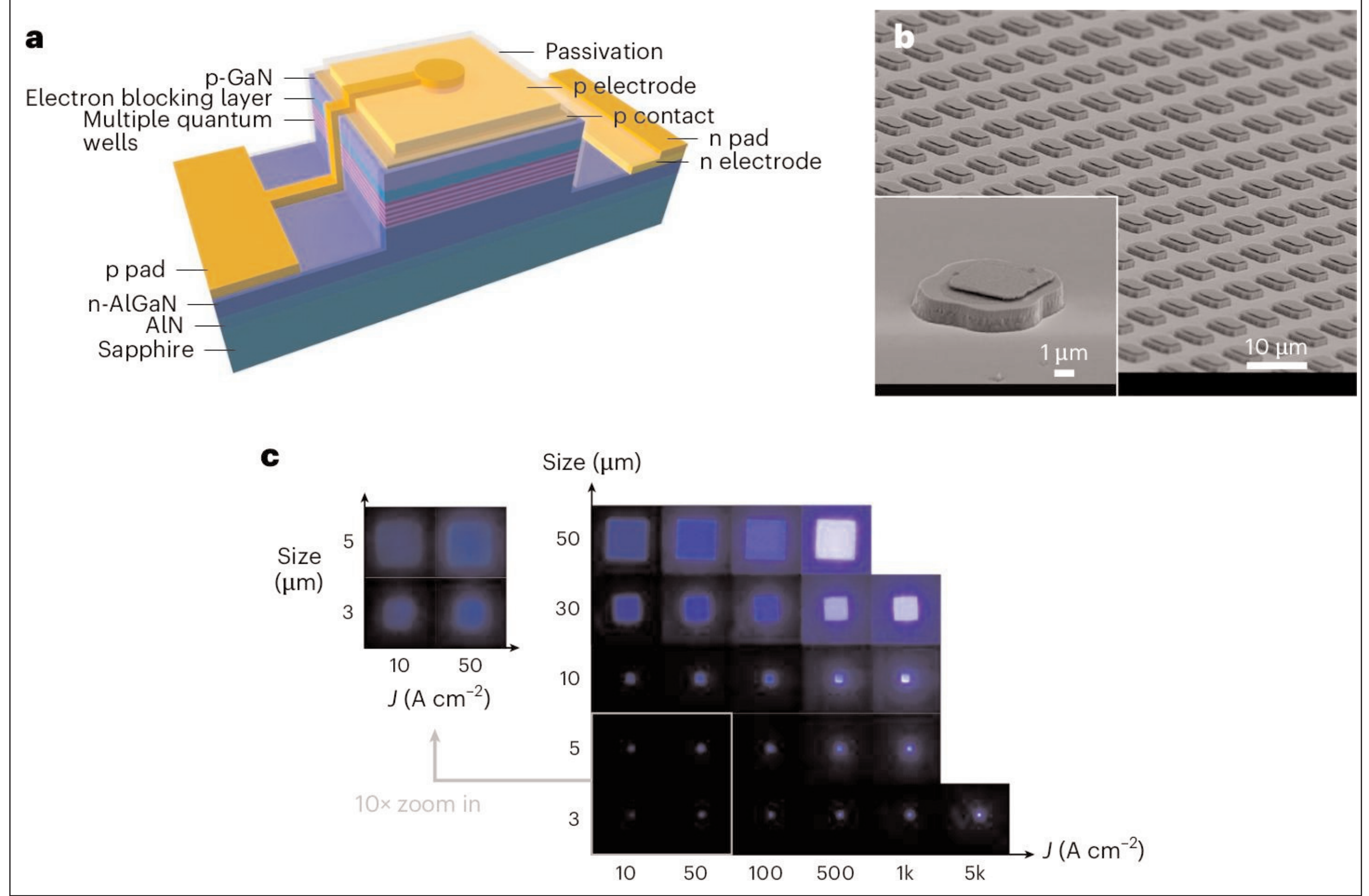

Figure 1. a. Flip-chip UVC micro-LED scheme. b. Scanning electron microscopy morphology of 6μmx6μm UVC micro-LED array, with (inset) stand-alone 5μmx5μm. c. Electroluminescence (EL) micrography of stand-alone devices.

between the AlGaN layers and sapphire substrate.

The researchers reduced the impact of the bowing by using small wafer pieces singulated using laser dicing, allowing acceptable accuracy in the array patterning down to 3μm mesa widths.

The top p-contact consisted of ultrathin nickel/gold, which is practically transparent in the UVC wavelength range.

The resulting device demonstrated very low leakage currents under reverse bias, below the 100fA detection limit of the researchers' measurement equipment. "This can be attributed to the reduced sidewall damage resulting from tetramethylammonium hydroxide (TMAH) treatment and the atomic layer deposition (ALD)-grown sidewall passivation," the team reports.

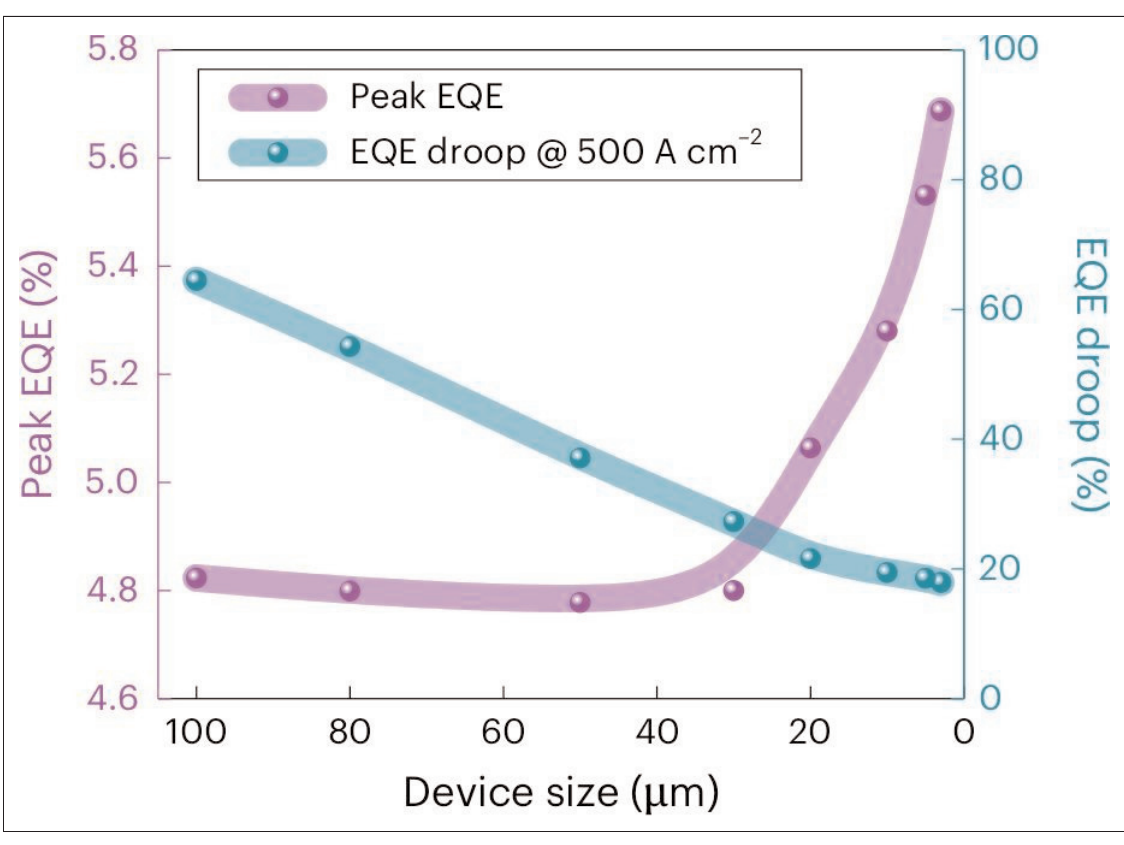

Figure 2. Peak EQE and EQE droop ratio, compared with peak value, for each device size (dots) with trend lines.

Reduced device sizes were found to benefit from higher current density for a given bias, resulting in higher current uniformity across the LED.

The team comments: "The alleviated current-crowding effect and increased surface-to-volume ratios contribute to enhanced heat dissipation in smaller devices, mitigating thermal degradation under high current injection."

The ideality factor of the devices reduced from 3.9 to 2.8 as the forward bias increased from 3.95V to 4.2V. The high ideality was attributed to non-radiative recombination arising from the unoptimized quality of the epitaxial wafers.

The team suggests that its TMAH and passivation treatments were sufficient to make the sidewalls an almost negligible source of non-radiative recombination centers. However, in the smaller devices down to 3μm there was some evidence that "the passivation and TMAH treatments may not be entirely effective in suppressing non-radiative recombinations originating from defects caused by sidewall damage."

The evidence for this was a pushing of peak external quantum efficiency (Figure 2) to higher current density: from 15A/cm^2 to 70A/cm^2 as the device size decreases from 100μm to 3μm, respectively. The EQEs were low compared with what can be achieved with blue or green passivated LEDs (an order of magnitude).

The team reports: "As the device size decreases, the EQE droop diminishes from 67.5% to 17.9%, indicating that smaller devices offer higher stability of light emission at elevated current densities due to their superior heat dissipation."

The researchers attribute the increase in EQE for sizes below 30μm to light extraction efficiency (LEE) enhancement along with higher current-spreading uniformity. The researchers explain: "Smaller devices emit light closer to the sidewalls, resulting in more sidewall refraction and consequently higher LEE."

The peak wavelength of the devices was around 270nm with a full-width at half maximum (FWHM) less than 21nm. The peak wavelength of the 3μm device underwent a 2nm blue-shift at low currents, transitioning to a 1nm red-shift at higher currents above 70A/cm^2.

The team comments: "This shift is due to the competition between bandgap shrinkage caused by self-heating and band-filling effects. However, the total spectral shift across all the current densities is only about 2nm, which can be attributed to the enhanced heat transfer path, leading to a slower rise in junction temperature."

The light output power (LOP) reached 4.5mW at 35mA for the 100μm LEDs, a density of 43.6W/cm^2. For the 3μm LEDs the maximum LOP density was 396W/cm^2. "Smaller devices, with better current-spreading uniformity and thermal stability, can sustain higher current densities, thereby achieving greater

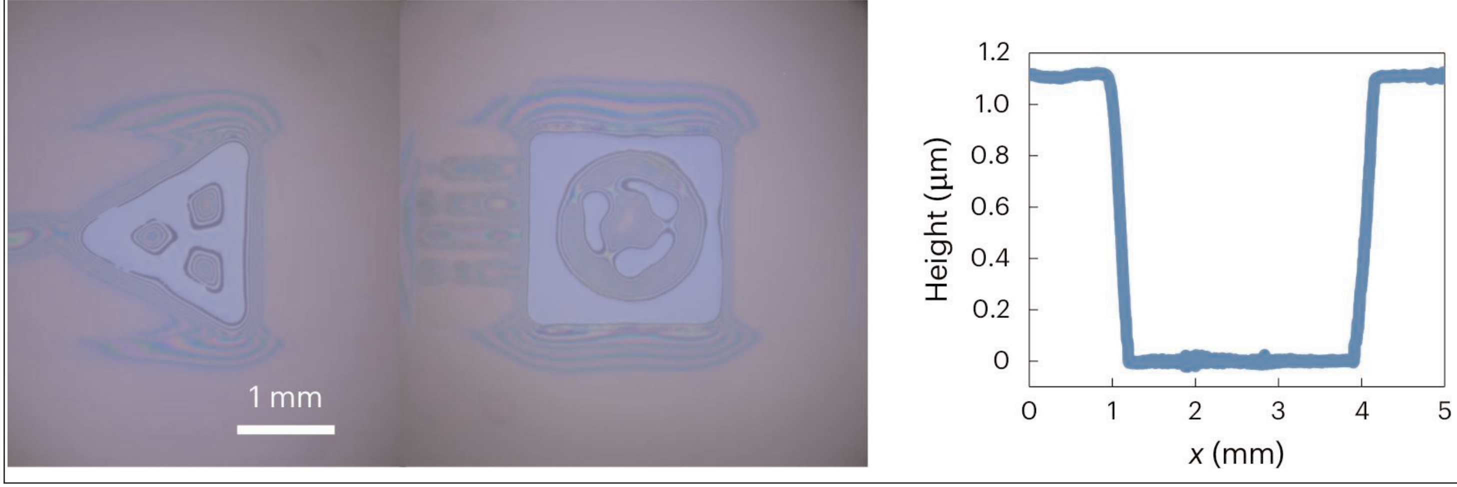

Figure 3. Maskless photolithography images (left) and surface profile (right) revealed on photoresist-coated wafers by UVC micro-LED display photolithography. Exposure was at 80mA for 5s.

optical power densities," the team reports, adding: "This may also be due to the waveguiding effect in AlGaN multi-layers, where larger devices experience increased power loss due to a longer optical path from the emissive multiple quantum wells to the air."

Operating at the maximum power point leads to accelerated aging due to extreme junction temperatures, leading to thermal degradation.

At 100A/cm^2, the LOP density for the 3µm device was 25.9W/cm^2. The researchers see this as showing "excellent potential as a photolithography light source".

The researchers managed to increase the size of UVC LED arrays from the 16x16, previously reported in the scientific literature, to 160x90 pixels (2540/inch), based on 6µm devices at 10µm pitch. The arrays were coated with a highly UVC-reflective Al top surface for enhanced rear-side light extraction through the thinned sapphire substrate.

The array achieved an optical output power of 16.6mW at 20A/cm^2 current density under 12V forward bias. The peak EQE was 4.1% at 8A/cm^2.

The team reports: "The UVC micro-LED display offers an adequate optical power density of up to 1.1W/cm^2 for full-screen lighting, surpassing the 25mW/cm^2 calibration of the 365nm mercury lamp used in the Karl Suss MA-6 mask aligner to meet the photoresist exposure dose requirements."

Photolithography capabilities were tested (Figure 3) using a 320x140 UVC array with 9µm pixels at 12µm pitch. The array was flip-chip bonded with indium bumps onto a CMOS driver chip. The photoresist for the test was the i-line sensitive AZ MiR 703 in a proximity patterning setup. The photolithography technique could be used for visible micro-LED displays, for example.

The researchers comment: "Although the structural resolution is not as high as that achieved with contact exposure, related lens and focusing systems could significantly improve maskless photolithography. As smaller linewidths down to the pixel size of micro-display chips show great potential, such maskless photolithography systems could provide considerable time and cost savings for the semiconductor industry by eliminating the need for laser-writing masks."

The researchers hope to overcome the present limitation to 320x140 pixels by enhancing the epitaxial wafer quality and achieving more accurate alignment, paving the way for much-higher-resolution UVC micro-LED displays up to 8K pixels in each dimension, as needed for HD and UHD resolutions. ■

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Ultra-high-brightness green InGaN LEDs on silicon

Low dislocation epilayers enable high-definition micro-displays.

Researchers based in China report the growth of high-brightness green indium gallium nitride (InGaN) light-emitting diodes (LEDs) on silicon (Si) [Haifeng Wu et al, Light: Science & Applications, v13, p284, 2024]. The epitaxial material was fabricated into normal-size LEDs and arrays of 5μm pixels at 7.5μm pitch in a 1080x780 format. A 30x30 array reached a brightness of $1.2 \times 10^7 cd/m^2$ (nits) at $1000A/cm^2$ current injection, claimed as the highest reported for such micro-LEDs.

The research team from Hunan University, Innovision Technology (Suzhou) Co Ltd, Lattice Power (Jiangxi) Corp, Central South University, Beijing Digital Optical Device IC Design Co Ltd, and Hunan Normal University, sees the green portion of the spectrum as particularly important for "accurate color reproduction and overall image quality".

Micro-LED displays are seen as key next-generation visual interfaces with immediate applications in virtual/augmented-reality contexts.

The researchers grew the green LED InGaN epitaxial material (Figure 1) using metal-organic chemical vapor deposition on Si (111) wafers. The large thermal expansion and lattice mismatches with GaN was bridged with a 200nm aluminium nitride (AlN) nucleation layer and a 1.5μm AlGaN-GaN buffer layer. The buffer contained strain-control and dislocation-annihilation layer stacks.

The team sees the AlN nucleation layer as being critical for avoiding cracking of the materials that occurs when GaN is grown directly on silicon from thermal expansion mismatching between the layer and substrate. The best quality AlN is grown around 1400°C, which is dangerously close to the 1414°C melting point of silicon. Instead, the researchers used Ga as a surfactant to enable AlN growth at a lower temperature.

The researchers comment: "This approach promoted the migration of aluminum (Al) adatoms at a more moderate growth temperature of 1100°C by passivating the growth surface, thereby ensuring the subsequent growth of high-quality epilayers."

The LED structure included a superlattice (SL) and pre- and green-multiple quantum well (MQW) structures, along with an electron-blocking layer (EBL) and n/p contact layers. According to the team, the pre-MQW structure "plays a crucial role in enhancing the quality and uniformity of MQWs with higher indium concentrations, especially for green light emission."

The structure is credited with giving the main green light-emitting MQW a well-defined periodic distribution of indium with sharp InGaN/GaN interfaces.

X-ray analysis gave an estimate of $5.25 \times 10^8/cm^8$ for the

Contact	p^+-GaN	
Contact	p-GaN	
EBL	p-AlGaN/GaN SL	
MQW	8x($In_{0.25}Ga_{0.75}N$/GaN)	8x(2.5nm/12nm)
pre-MQW	4x($In_{0.10}Ga_{0.90}N$/GaN)	
SL	30x(InGaN/GaN)	
Contact	n-GaN	2μm
Buffer	AlGaN-GaN	1.5μm
Nucleation	AlN	200nm
Substrate	GaN	

Figure 1. Epitaxial structure of green LEDs.

Figure 2. a Micro-LED fabrication process. b 3D integrated micro-LED chip matrix structure. c Layout of display. d Photograph of 4-inch wafer integrating multiple 0.39-inch green micro-LED displays. e Cross-section of pixel. f Three-dimensional structure of chips.

total dislocation density. The convex bowing of the 4-inch diameter wafer was just 16.7μm at room temperature. The researchers credit the low bowing to "the meticulously engineered strain-control stacks". A 6-inch wafer subjected to the same process also had a bow of 16.7μm, according to a supplementary report associated with the paper.

The team comments: "The small wafer bow rendered it highly compatible with subsequent standard wafer-scale fabrication processes such as wafer bonding and photolithography."

A photoluminescence map showed a dominant wavelength

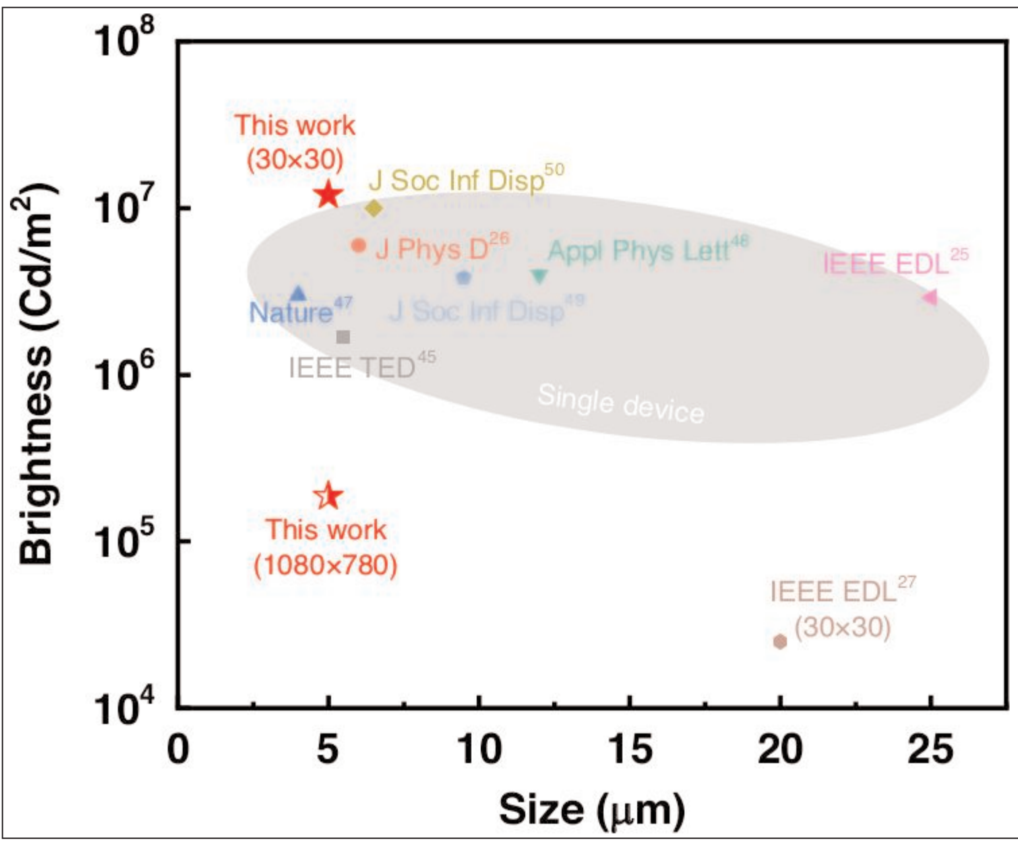

Figure 3. Comparison of micro-LED key parameters with typical reported results.

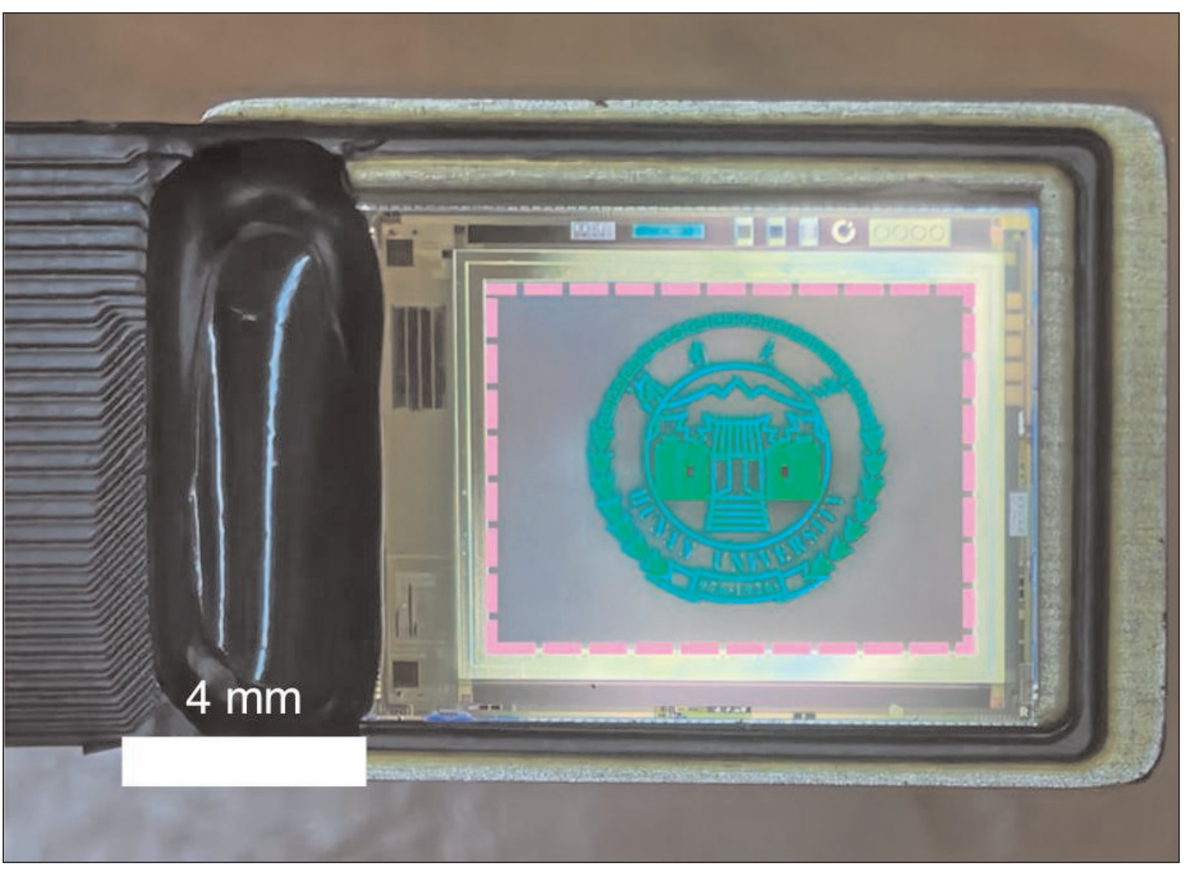

Figure 4. Packaged micro-display.

"This treatment not only removes residual materials from the sidewalls but also roughens the GaN grains on the mesa surface, facilitating photon escape from the chip," the team writes.

Surface passivation consisted of a 50nm atomic layer deposition (ALD) aluminium oxide (Al_2O_3) coating.

The device was completed with window-opening to expose the n-GaN top layer, and deposition and patterning of the cathode and other metals for interconnection to the drive circuitry.

The researchers comment: "These micro-LEDs can be easily manufactured and integrated on a large scale as required."

The up to 1080x780-pixel 0.39-inch displays included pixel array and peripheral circuits. A 30x30-pixel device had a high 10^8 rectifying ratio, 2.1V turn-on voltage, and 2.15 ideality factor. The turn-on voltage is considered to be low relative to the typically reported 2.5–2.8V.

The emission wavelength shifted as the injection current increased: 530nm to 505nm as between 0.3mA and 900mA, respectively. The shift is seen as resulting from piezoelectric and band-filling effects.

The brightness of a 30x30 array reached $1.2x10^7 cd/m^2$ (nits) at $1000A/cm^2$ (Figure 3). The larger 0.39-inch device managed $186017cd/m^2$ at $5A/cm^2$. The peak EQE of the 0.39-inch display reached 7.17% at $2A/cm^2$.

At $1.5A/cm^2$, the brightness standard deviation across the 0.39-inch display was less than $720cd/m^2$ about an average of $32,987cd/m^2$.

The researchers comment: "This exceptional brightness uniformity can be attributed to the uniform GaN-on-silicon epilayers and advanced fabrication technology."

The packaged 0.39-inch displays had an 8-bit grayscale capability, enabling image and movie playback with contrast control (Figure 4). ■

of 531.98nm with a standard deviation of 0.939nm. The researchers add: "Notably, the wavelength variation across the wafer was 6nm and reduced to only 1.7nm at the 0.39-inch scale."

LEDs (660μmx660μm) from the material demonstrated a 45% external quantum efficiency (EQE) at $30A/cm^2$ current injection, similar to the performance of corresponding-sized commercial devices on patterned sapphire.

The researchers also fabricated micro-LED arrays (Figure 2), beginning with adding layers of 110nm sputtered indium tin oxide (ITO) and 700nm of chromium/platinum/gold to the epitaxial wafer. The wafer was then bonded to the CMOS drive chips without the need for alignment.

The researchers comment: "This approach overcomes the alignment accuracy limitations typically associated with thermocompression bonding equipment, enabling the fabrication of higher-resolution micro-LED chips."

The epitaxial growth substrate was then removed.

Mesa formation was a three-step etch process removing the buffer layers, etching down to the metal bonding layers, and finally removing the metal stack with ion-beam etching. The mesa regions were protected by a silicon dioxide hard mask.

Sidewall defect repair and particle removal consisted of potassium hydroxide (KOH) treatment that acted anisotropically on sidewalls and top display surface of the micro-LED structure.

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Author: Mike Cooke

Double V-pits enhance red indium gallium nitride LED internal quantum efficiency

Researchers report an IQE value of 21.5%.

Dongguan University of Technology and Dongguan Institute of Opto-Electronics Peking University in China have reported on improving the internal quantum efficiency (IQE) of indium gallium nitride (InGaN) red light-emitting diodes (LEDs) by using a double V-pit structure [Chuanyu Jia et al, Optics Express, v32, p36489, 2024].

The IQE reached 21.5%, compared with 10.5% for a single V-pit structure at wavelengths of 613nm and 612nm, respectively. [These wavelengths are more precisely orange, 590–625nm, rather than red, 625–750nm.] The improvement in external quantum efficiency (EQE) was less impressive: 6.2%, compared with 5.3%. Recent reports typically have EQEs at about 6%, although Nanchang University has reported a 24% wall-plug efficiency for a 608nm InGaN red LED grown on silicon.

The exploitation of red-emitting III–nitride materials to provide red–green–blue displays is hampered by red InGaN's low IQE relative to blue- and green-emitting alloys at 90% and 60%, respectively.

The researchers believe that their double V-pits layer

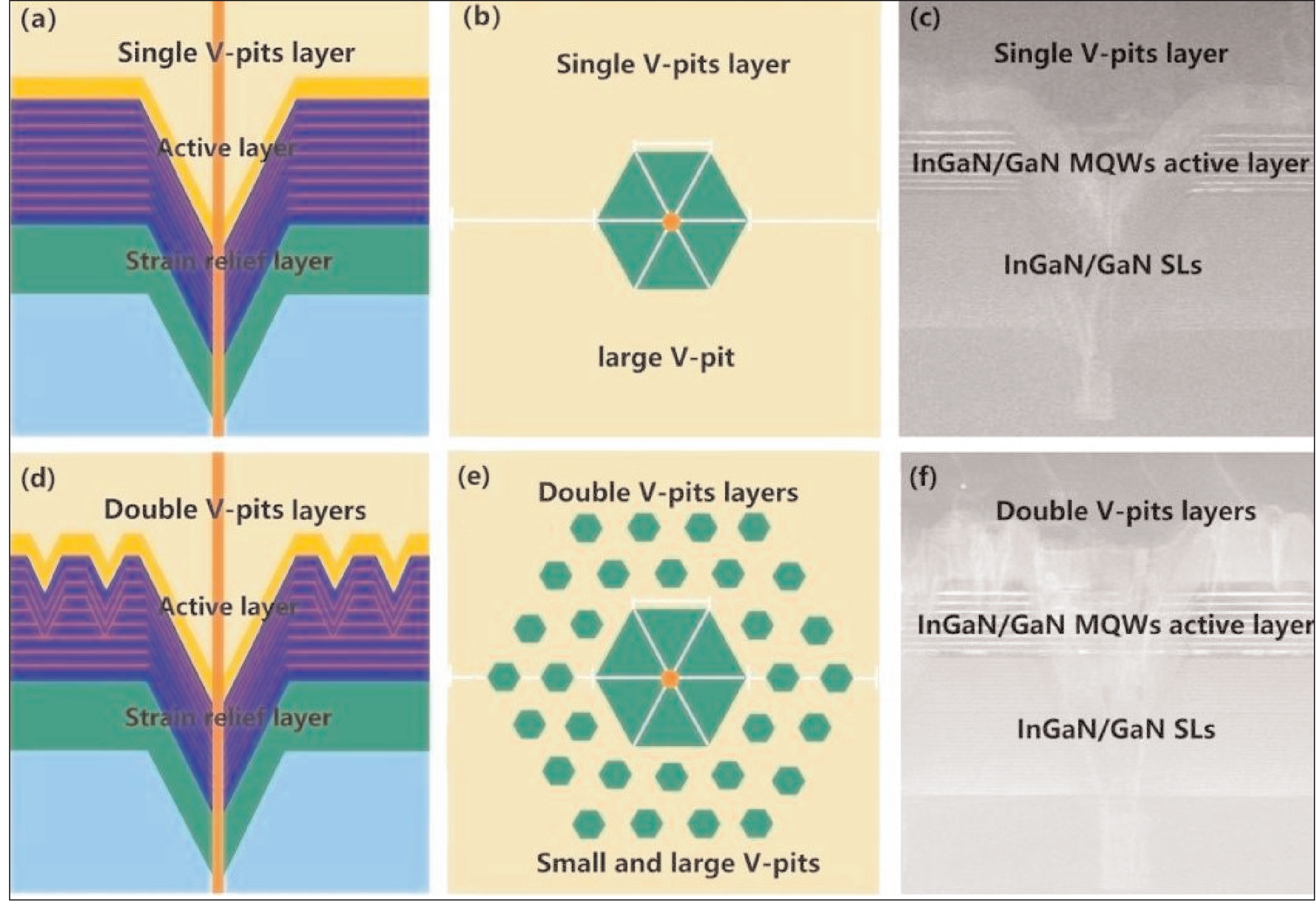

Figure 1. Cross-sectional LED views: (a) sample A with single, and (d) sample B with double, V-pit layers; plan views: (b) sample A, and (e) sample B; transmission electron microscope (TEM) images: (c) sample A, and (f) sample B.

structure relieves the compressive strain of InGaN multiple quantum wells (MQWs), reducing the influence of the piezoelectric polarization field and thus improving the IQE.

The LEDs were grown on patterned sapphire substrate (PSS), using metal-organic chemical vapor deposition (MOCVD). Samples with single and double V-pit structures were grown in the active MQW region (Figure 1).

The large, sparse V-pits were created by a low-temperature (LT) growth of an interlayer between the strain relief and MQW structures. The strain relief consisted of 100nm GaN and a 32-period 5nm/2nm InGaN/GaN superlattice grown at low temperature (820°C). The strain relief reduced the density of threading dislocations. It was at these dislocations that the large V-pits formed.

The dislocation/large V-pit density was about $10^8/cm^2$. One factor that enabled this low dislocation density was the use of a 25nm sputtered aluminium nitride (AlN) layer for nucleation on the PSS before the MOCVD processing.

The MQW structure consisted of 5-periods of $In_{0.2}Ga_{0.8}N$/GaN 'green'-emitting layers, and 3-periods of $In_{0.4}Ga_{0.6}N$/GaN 'red'. The GaN was grown at 830°C and 810°C for the green and red structures, respectively. The corresponding InGaN growth temperatures were 720°C and 700°C. These temperatures are compromises needed to achieve the required crystal quality (high temperature preferred) and indium incorporation (low temperature preferred).

The second small V-pit layer for sample B was achieved by altering the growth conditions of the 5-period green MQW. In particular, the GaN barrier layers were grown at 750°C. The InGaN was grown at 720°C, as for the single V-pit sample A structure.

The lower temperatures resulted in slower growth.

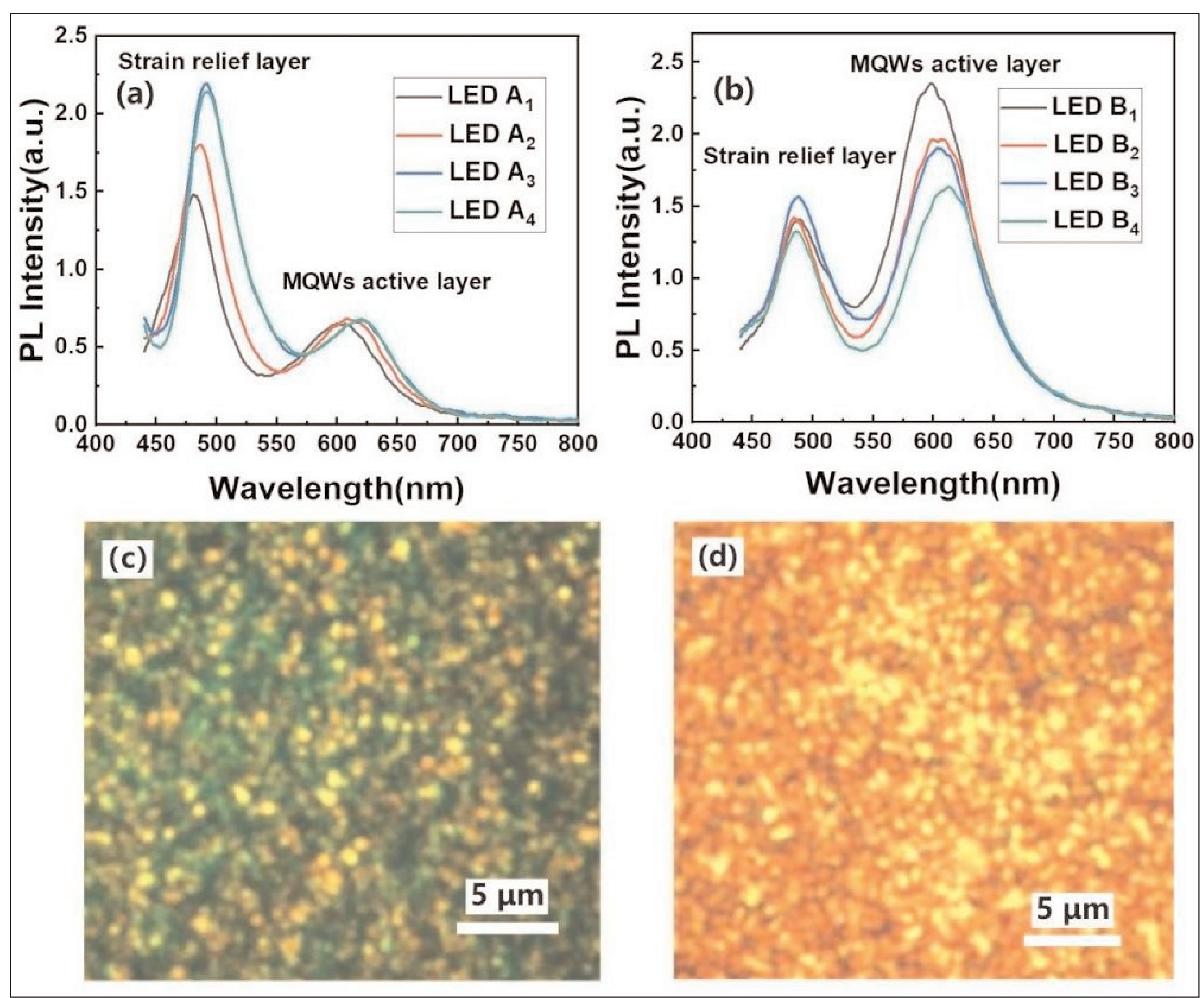

Figure 2. Room-temperature photoluminescence spectra of LED samples: (a) A1–4 and (b) B1–4. Fluorescence images of (c) A2 and (d) B4 taken under identical 405nm laser excitation.

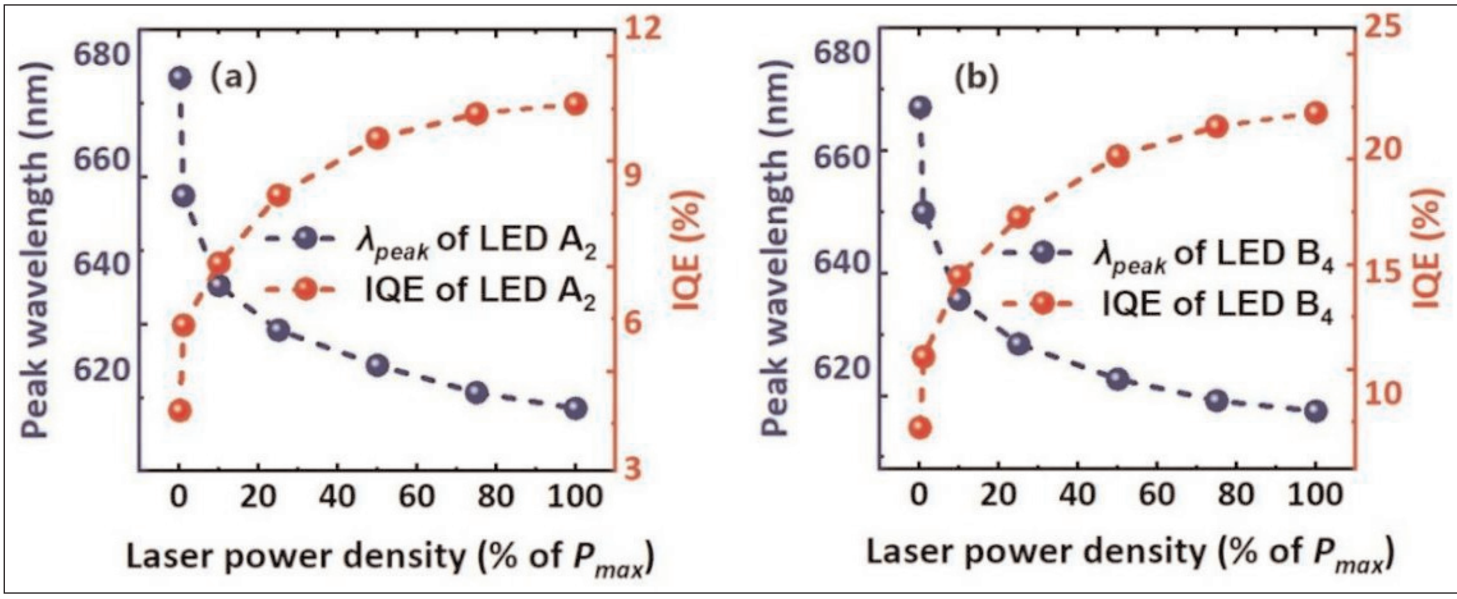

Figure 3. Peak wavelength and IQE of samples (a) A2 and (b) B4.

The researchers report that the total thickness of the low-temperature layers was reduced from 324nm in sample A to 62nm in sample B.

The materials were fabricated into 100μmx200μm LEDs.

The room-temperature PL red emission was a factor of 245% greater in sample B, compared with sample A (Figure 2). Sample A showed a mix of red and green regions under a microscope, with the green tending to dominate. The researchers attribute this to "serious InGaN phase segregation in sample A2, in which the low-indium-component phase emits green light, and the high-indium-component phase emits red light."

There is also some color conversion of green to red light in the red MQW layers.

The team comments: "Compressive strain in the red MQWs of LED sample B can be more effectively released as compared to that of LED sample A by opening small V-shaped pits with high density in the red MQWs region. The small V-pits divides the large continuous area of QW into small isolated pieces, which prevents the transmission of strain, converts the long-range strain on the QW into separated local strain, and makes the strain on the QW smaller. The side-wall surface of the V-shaped pit, as a free interface, also plays a role in the release of strain."

The IQE was estimated by comparing the photoluminescence (PL) responses at room temperature (300K) and 5K (assumed to have 100% IQE). The researchers used a 532nm laser excitation to focus on the red rather than green peak wavelength and IQE of the samples (Figure 3).

The maximum laser excitation power density was 10^5/cm^2. The peak IQEs of samples A2 and B4 were 10.5% at 613nm and 21.5% at 612.1nm, respectively.

The improvement in peak EQE of electroluminescence was less impressive, increasing from 5.3% (sample A) to 6.2% (sample B) at 1A/cm^2. The researchers explain: "The introduction of high-density small V-shaped layer in the active layer will affect the growth of following p-type layer and generate new leakage channels in the active region, which has a negative impact on electroluminescence (EL) of LED sample B."

Both devices show drooping intensity beyond the low 1A/cm^2 current density. The researchers hope that optimizing the p-type layer growth will control leakage and improve EL intensity in future work. ■

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Tunnel-junction-enabled GaN heterojunction bipolar transistors

A new structure allows all the transistor contacts to be made with n-type GaN.

Ohio State University (OSU) in the USA reports on using tunnel junctions (TJs) rather than p-type base contacts for improving the performance of III–nitride heterojunction bipolar transistors (HBTs) [Chandan Joishi et al, IEEE Transactions On Electron Devices (2024), vol.71, issue 10]

The use of p^+/n^+ TJs (Figure 1) enables all the terminal contacts — emitter, collector, and base — of the HBT to be with metals suitable for n-type gallium nitride (GaN). In general, p-type GaN has a much higher resistivity than n-type.

The researchers comment: "This novel approach to HBT design significantly advances the current field of III–nitride HBTs for the next-generation radio frequency (RF) and mm-wave applications by circumventing the need to fabricate p-type contacts on the base as well as eliminating regrowth of the emitter/base epilayers."

The team explains the potential benefit of the TJ structure: "During the forward active mode of operation of the HBT, the forward-biased emitter–base junction injects minority electrons into the base, while the reverse bias at the n^+/p^+ base contact acts like an ohmic contact and injects holes into the base. Thus, the same n^+–p^+ layer behaves as both the emitter/base junction and the base TJ contact layer."

HBT development has tended to lag that of field-effect devices such as high-electron-mobility transistors (HEMTs) "due to several reasons, most of which are related to the resistance associated with the p-type base contact layer," the team reports, adding: "Despite the great success of GaN HEMTs, there are still some factors that make it worthwhile to pursue research that could overcome the challenges associated with GaN HBTs."

Among the factors potentially favoring HBT is the positioning of peak electric fields away from surfaces, where efficiency-sapping recombination rates tend to increase due to surface damage from etch processing. HEMTs also suffer from concentration of the current flow within small volumes, relatively to HBTs. For HBTs, this could result in better thermal management and realization of higher carrier velocities, improving high-frequency performance.

These benefits, and others, have yet to be realized in actual devices that fall far short of predictions. One example the OSU team points to is a reported

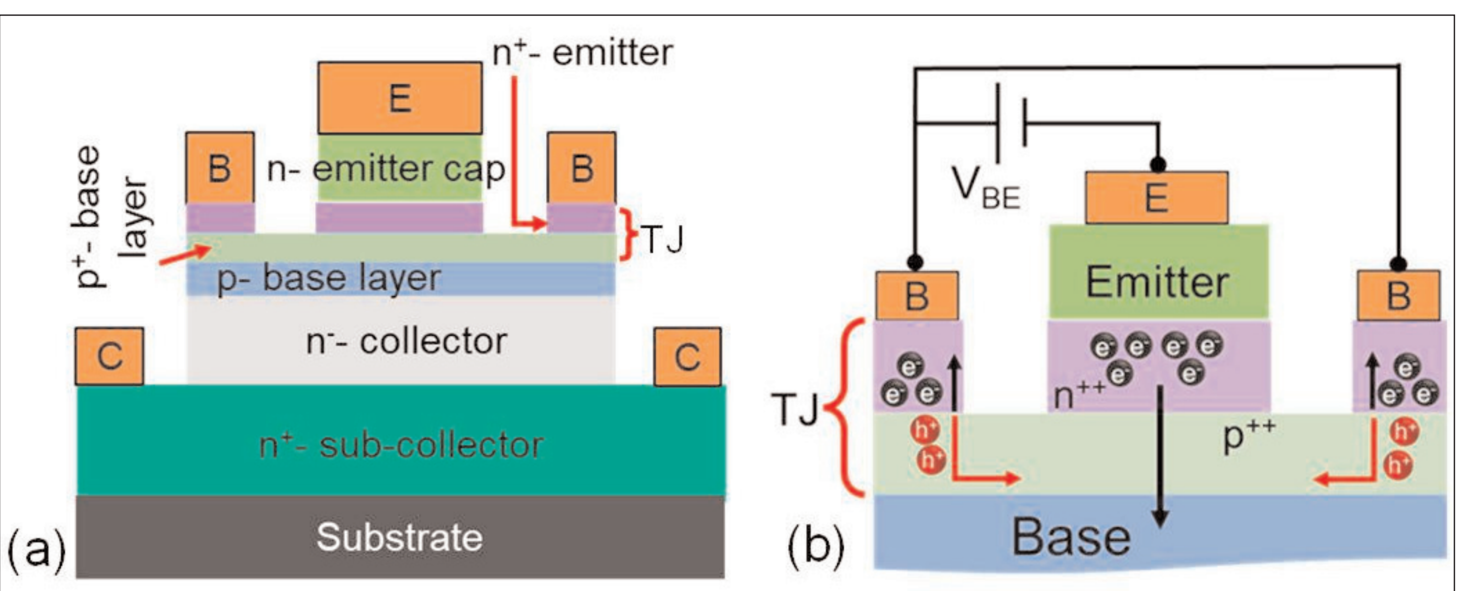

Figure 1. (a) Two-dimensional schematic of proposed III–nitride TJ HBT with n- and p-type epilayers. (b) Zoom-in schematic of emitter–base region displaying carrier flow (electrons, black; holes, red) in active mode (V_{BE} > 0).

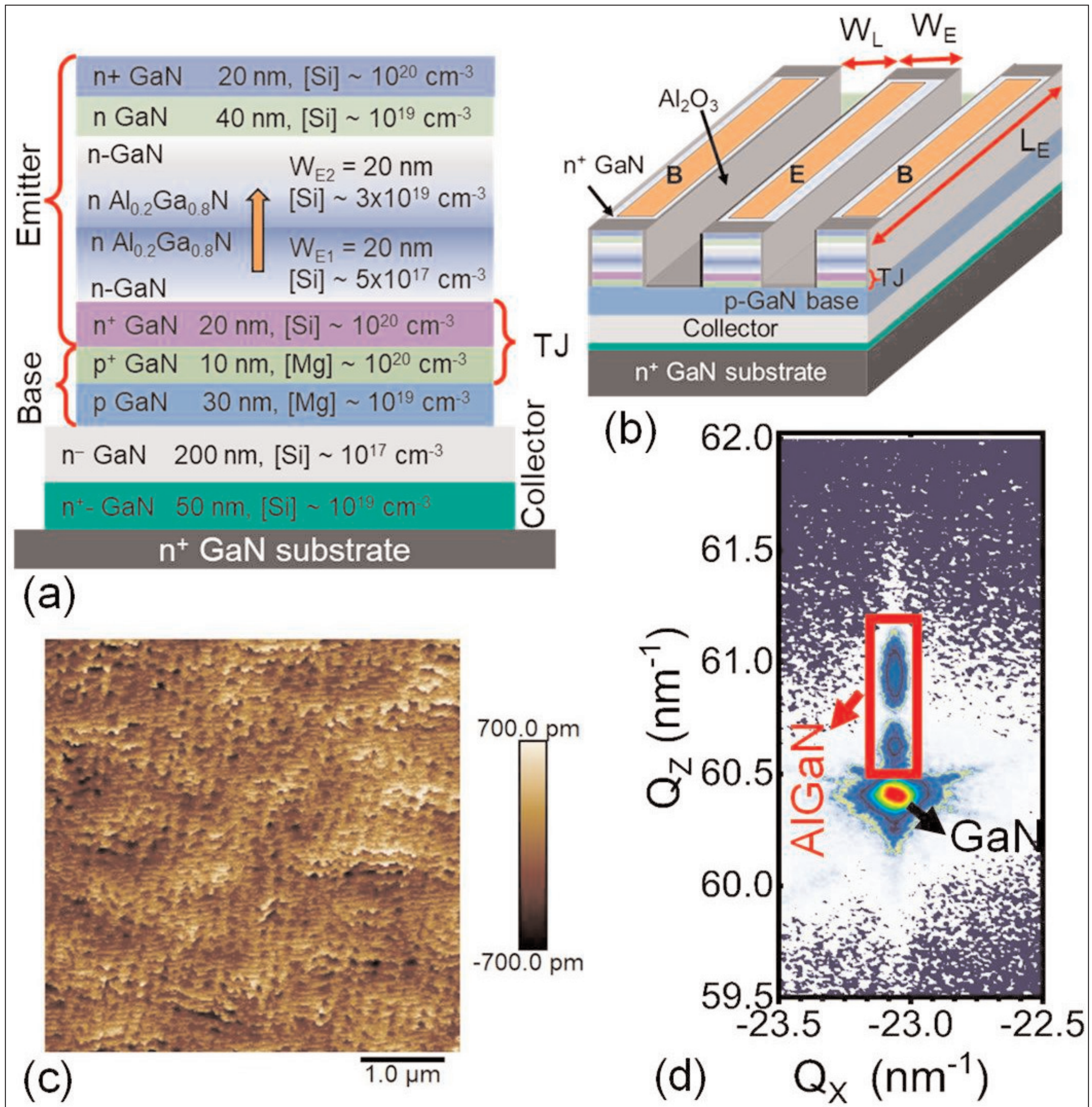

Figure 2. (a) Two-dimensional schematic of as-grown GaN TJ HBT. (b) Three-dimensional schematic of fabricated device. (c) Atomic force microscope (AFM) image of as-grown surface over 5μmx5μm field. (d) X-ray diffraction (XRD) reciprocal space map (RSM) of as-grown epitaxial stack.

500GHz-V Johnson's figure of merit estimate, measuring carrier velocities and breakdown performance, being an order of magnitude lower than the ~5THz-V theory prediction from material properties.

The material used for the HBTs was grown at a rate of ~4nm/min by plasma-assisted molecular beam epitaxy/PA-MBE (Figure 2). The AlGaN regions in the emitter stack were linearly graded up to 20% and back down to 0%. The researchers report: "We used a graded AlGaN/GaN emitter region to improve the emitter injection efficiency."

The as-grown material demonstrated a root-mean-square roughness of 0.2nm in AFM analysis. The RMS measurements showed the desired fully strained growth.

Fabrication began with plasma-enhanced chemical vapor deposition (PECVD) of a 250nm sacrificial silicon dioxide (SiO_2) layer. Photolithography and dry/wet etch opened windows in the SiO_2 hard mask for

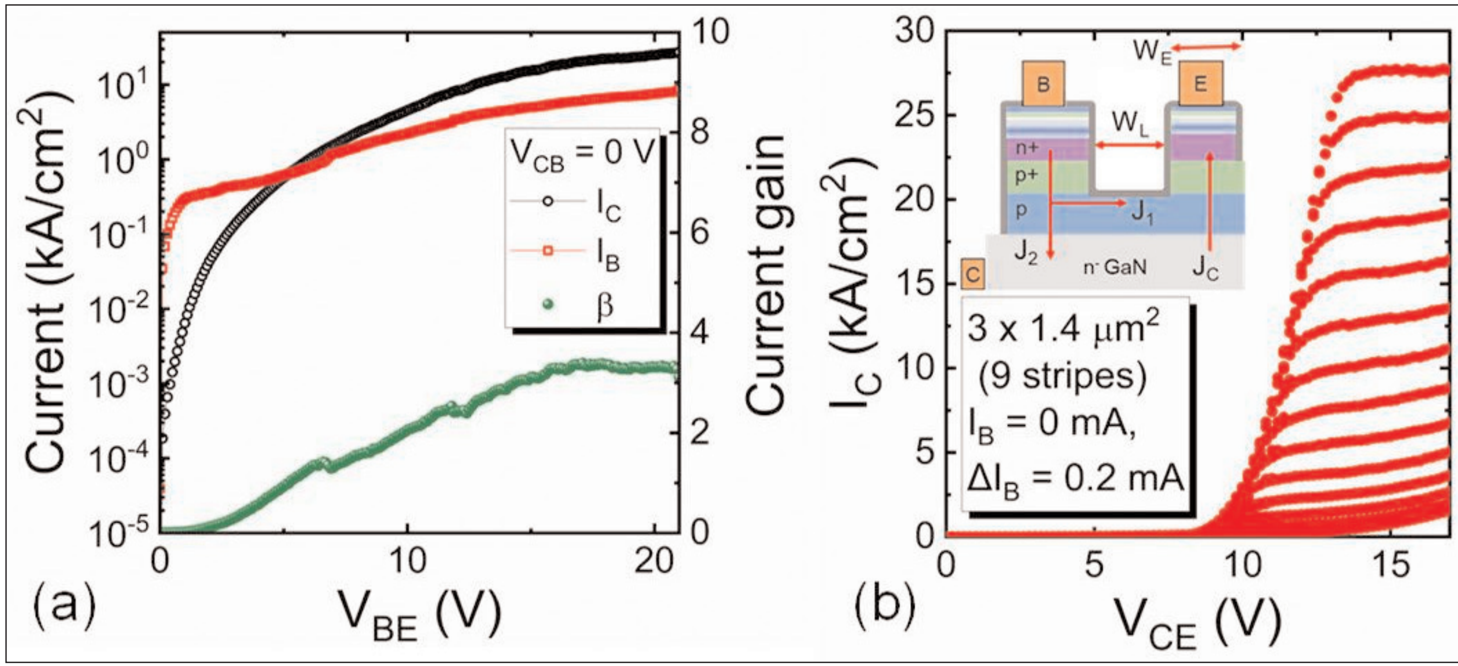

Figure 3. (a) Gummel plot with 0V V_{CB} and (b) common emitter output current–voltage characteristics (I_C–V_{CE}), and inset schematic of current flow path.

further plasma etch of the III–nitride epitaxial layers, defining the collector region.

The SiO_2 mask was then patterned again for III–nitride material reactive-ion etch (RIE)/inductively coupled plasma (ICP) etch to give interdigitated stripes, isolating the base and emitter regions. The team comments: "The emitter–base isolation was achieved through a BCl_3/Cl_2-based low-power (~5W RIE, 40W ICP) etch recipe to minimize etch damage."

The stripes were etched down to the p^+ GaN to avoid potential problems from etch variation, which could potentially reach ~4nm.

The emitter–base contacts were aluminium/nickel/gold. Metal deposition was followed by atomic layer deposition (ALD) of aluminium oxide (Al_2O_3) as both sidewall passivation and isolation layer between the emitter–base bond pads, formed by Ni sputtering into windows etched into the Al_2O_3.

Measurements on a 3µmx1.4µm emitter (L_ExW_E) device with 9 emitter stripes showed a 4.5V base–collector current (I_B/I_C) crossover at 0V V_{CB} (Figure 3). The maximum current gain was less than 4 at current densities greater than 10kA/cm^2.

The crossover was higher than the figure predicted in the design simulations (3V). The researchers blame recombination due to the non-radiative Shockley–Read–Hall (SRH) mechanism, based on the non-observation of light emission during operation. This recombination results in a "shorter minority carrier lifetime in the base and diminishes the base transport factor of the device," the team suggests. The researchers estimate base voltage drop to result from a resistance of order 400kΩ/square.

To improve $V_{CE,offset}$, improvement in current gain, base conductance, and scaling of W_L [stripe separation] is essential. Nevertheless, the output characteristics show a sharp rise in output current density after $V_{CE,offset}$, implying low ON-resistance during device operation

The collector current reached as high as 28kA/cm^2 density at more than 12V V_{CE}.

The researchers comment: "To improve $V_{CE,offset}$, improvement in current gain, base conductance, and scaling of W_L [stripe separation] is essential. Nevertheless, the output characteristics show a sharp rise in output current density after $V_{CE,offset}$, implying low ON-resistance during device operation."

The team suggests four potential enhancements:

1) polarization engineered thin base layers to improve base conductivity;

2) optimized TJ growth conditions using MBE and/or metal-organic chemical vapor deposition (MOCVD) to improve device leakage and mitigate non-ideal recombination by enhancing material quality, increasing minority carrier lifetime and improving the base transport factor;

3) employing alternate approaches, such as ion implantation, to isolate the devices and adjacent emitter–base terminals, mitigating impact of plasma etch damage to emitter–base access region; and

4) sub-micrometer emitter–base multi-fingers to mitigate the impact of current-crowding effects. ■

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Author: Mike Cooke

suppliers' directory

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SPIE Photonics West 2025
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E-mail: customerservice@spie.org
www.spie.org/conferences-and-exhibitions/photonics-west

27–29 January 2025
SPIE AR/VR/MR 2025
San Francisco, CA, USA
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www.spie.org/conferences-and-exhibitions/ar-vr-mr

16–20 February 2025
ISSCC 2025:
IEEE International Solid— State Circuits Conference
San Francisco, CA, USA
E-mail: isscinfo@yesevents.com
www.isscc.org

19–21 February 2025
SEMICON Korea 2025
Korea World Trade Tower, Seoul, South Korea
E-mail: semiconkorea@semi.org
www.semiconkorea.org/en

26–28 February 2025
Asia Photonics Expo (APE 2025)
Level 1, Sands Expo & Convention Centre (Marina Bay Sands), Singapore
E-mail: visitors-ape@informa.com
www.asiaphotonicsexpo.com

5–7 March 2025
Asia Photonics Expo (APE 2025)
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www.asiaphotonicsexpo.com

16–20 March 2025
IEEE Applied Power Electronics Conference (APEC 2025)
Atlanta, GA, USA
E-mail: apec@apec-conf.org
www.apec-conf.org

30 March – 3 April 2025
Optical Fiber Communication Conference and Exhibition (OFC 2025)
Moscone Convention Center, San Francisco, CA, USA
E-mail: custserv@optica.org
www.ofcconference.org

29 April – 1 May 2025
28th Annual Components for Military & Space Electronics Conference & Exhibition (CSME 2025)
Four Points by Sheraton (LAX), Los Angeles, CA, USA
E-mail: info@tjgreenllc.com
www.tjgreenllc.com/cmse

4–8 May 2025
LightFair 2025
Las Vegas Convention Center, Las Vegas, NV, USA
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www.lightfair.com

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4–9 May 2025
2025 Conference on Lasers & Electro-Optics (CLEO)
Long Beach, CA, USA
E-mail: info@cleoconference.org
www.cleoconference.org

6–8 May 2025
PCIM 2025
(Expo & Conference on Power Electronics, Intelligent Motion, Renewable Energy and Energy Management)
Nuremberg, Germany
E-mail: pcim_visitors@mesago.com
www.mesago.de/en/PCIM/main.htm

27–30 May 2025
2025 IEEE 75th Electronic Components and Technology Conference (ECTC)
Gaylord Texan Resort & Convention Center,
Dallas, TX, USA
www.ectc.net

15–17 June 2025
IEEE Radio Frequency Integrated Circuits Symposium (RFIC 2025)
San Francisco, CA, USA
E-mail: support@mtt.org
www.rfic-ieee.org

15–20 June 2025
2025 IEEE/MTT-S International Microwave Symposium (IMS 2025)
San Francisco, CA, USA
E-mail: exhibits@horizonhouse.com
www.ims-ieee.org/about-ims/past-and-future-ims

22–27 June 2025
World of PHOTONICS CONGRESS — International Congress on Photonics in Europe
ICM — International Congress Center,
Messe München, Munich, Germany
E-mail: info@photonics-congress.com
www.photonics-congress.com/en

6–11 July 2025
15th International Conference on Nitride Semiconductors (ICNS-15)
Malmö, Sweden
E-mail: info@icns15.com
https://mkon.nu/icns-15

22–25 July 2025
ALD/ALE 2025: AVS 25th International Conference on Atomic Layer Deposition (ALD 2025) featuring the 12th International Atomic Layer Etching Workshop (ALE 2025)
Jeju Island, South Korea
E-mail: della@avs.org
www.ald2025.avs.org

29–31 July 2025
7th International Congress on Advanced Materials Sciences and Engineering 2025 (AMSE-2025) — "Transforming Technologies for a Sustainable Future"
Krakow, Poland
E-mail: eve@istci.org
https://istci.org/amse2025/Register.asp

10–12 September 2025
China International Optoelectronic Exposition (CIOE 2025)
Shenzhen World Exhibition and Convention Center,
Shenzhen, Guangdong, China
E-mail: cioe@cioe.cn
www.cioe.cn/en

21–26 September 2025
28th European Microwave Week (EuMW 2025)
Jaarbeurs, Utrecht, the Netherlands
E-mail: eumwreg@itnint.com
www.eumweek.com

24–26 September 2025
PCIM Asia – International Exhibition and Conference for Power Electronics, Intelligent Motion, Renewable Energy and Energy Management (PCIM Asia Shanghai 2025)
Shanghai New International Expo Centre, China
E-mail:pcimasia@china.messefrankfurt.com
www.pcimasia-expo.com

28 September – 2 October 2025
ECOC 2025: 51st European Conference on Optical Communication
Bella Center, Copenhagen, Denmark
E-mail:ecoc2025@cap-partner.eu
www.ecoc2025.org

7–9 October 2025
SEMICON West 2025
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