

Gallium nitride & silicon carbide power semiconductor market evolving

Major power semiconductor suppliers are now taking the lead in the GaN and SiC power semiconductor sector following a startup-dominated period, says **Omdia**.

The emerging market for silicon carbide (SiC) and gallium nitride (GaN) power semiconductors is rapidly evolving from a startup-dominated business to one led by large-established power semiconductor manufacturers, notes Omdia in its 'SiC & GaN Power Semiconductors Report — 2020'.

The transition comes as the market reaches a critical size, with revenue forecast to grow to \$854m by the end of 2020 (up from just \$571m in 2018) then surpass \$1bn in 2021, reckons the firm, energized by demand from hybrid & electric vehicles, power supplies, and photovoltaic (PV) inverters.

"The origins of the SiC and the GaN power semiconductor industry were all about enthusiastic little startup companies, many of which have now been swallowed up by large, established silicon power semiconductor manufacturers," says Richard Eden, senior principal analyst for power semiconductors.

During 2016–2019 established player Littelfuse acquired SiC start-up Monolith Semiconductor, and then bought established company IXYS Semiconductor. ON Semiconductor merged with Fairchild, which had previously bought Swedish start-up TranSiC, to enter the SiC market. Later, Microchip Corp acquired Microsemi, giving it a range of SiC products. Also, during this period, several manufacturers entered the SiC market, such as ABB Semiconductors, CRRC Times Semiconductors, PanJit International, Toshiba and WeEn Semiconductor.

Early players among the GaN market startups — such as EPC, GaN Systems, Transphorm and VisiC — are still going, with some forming alliances with established silicon power semiconductor manufacturers, such as the linkages between Transphorm and Fujitsu, and GaN Systems and ROHM Semiconductor. One reason why few of the original startups have been acquired by the silicon power semiconductor manufacturers may be the emergence of the foundry service providers perfecting the production of GaN-on-Si epiwafers and devices, establishing a viable fabless GaN manufacturer market.

There have been fewer mergers and acquisitions (M&A) during the last 12 months. Two M&As have occurred in the SiC power semiconductor industry,

both concerning SiC wafer suppliers: STMicroelectronics' purchase of Norstel Sweden and SK Siltron's purchase of DuPont's SiC Wafer business (formerly Dow Chemicals). Also, Global Power Technologies Group changed its name to SemiQ in late 2019.

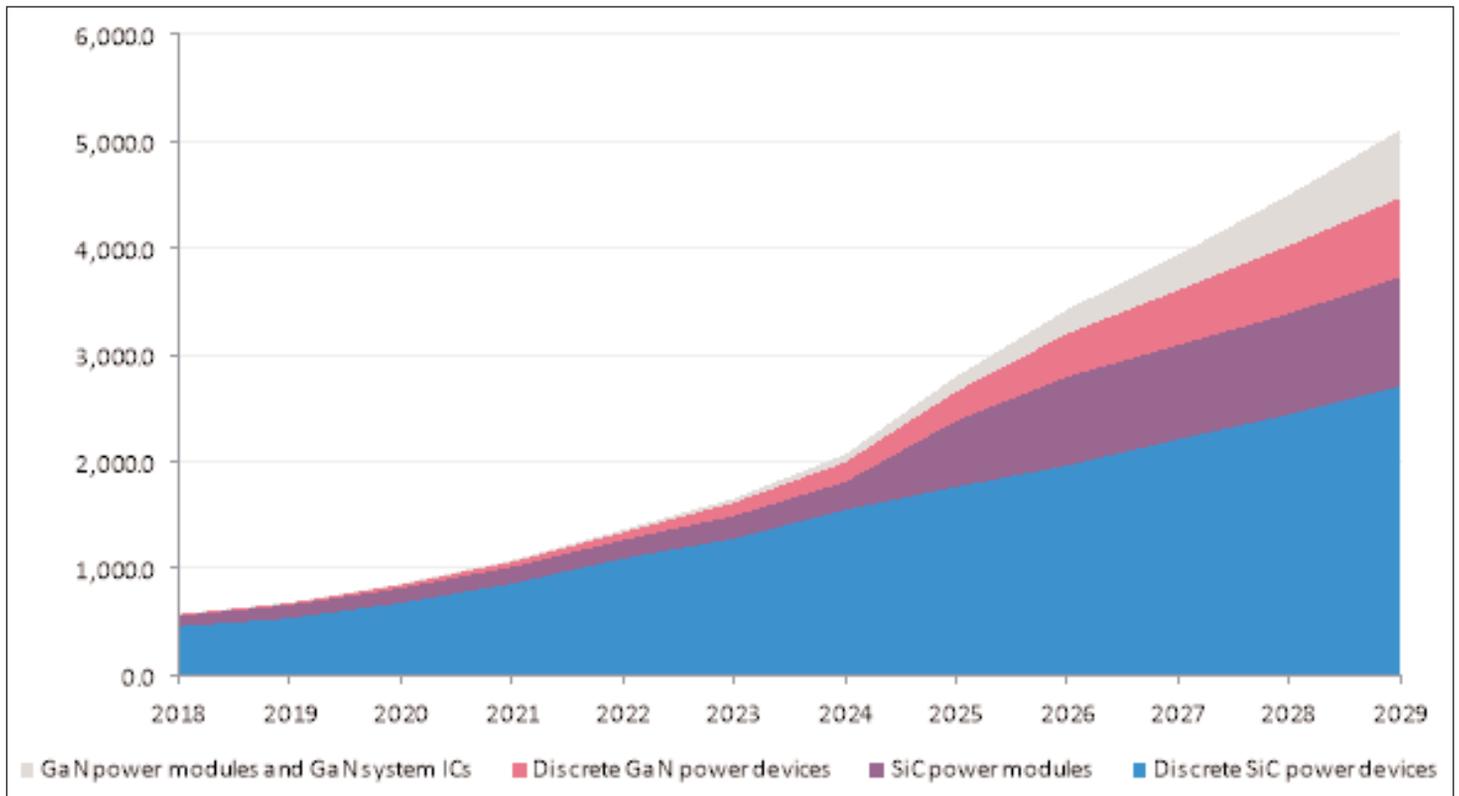
In the GaN power semiconductor industry, STMicroelectronics acquired a majority shareholding in Exagan earlier this year, with the intention of completing a full acquisition at some point in the future. The new entrants into the GaN power semiconductor industry included Power Integrations (which was already in production while in stealth mode), NexGen Power Systems, Odyssey Semiconductor and Tagore Technology.

Infineon Technologies has been joined by Alpha & Omega Semiconductor in offering silicon, SiC and GaN power semiconductors in mass production. ON Semiconductor is very close to joining this exclusive club, as its GaN product development approaches completion. Renesas Electronics, ROHM Semiconductor, STMicroelectronics and Toshiba Electronics are all thought to be joining this exclusive club too.

Substrate wafer market

The SiC substrate wafer supply market is expanding slowly, with many leading players announcing production capacity expansion plans, but wafer prices are not falling fast enough. However, there is not enough competition to the market leader: Cree (Wolfspeed) has announced several long-term supply agreements with device producers such as Infineon Technologies, STMicroelectronics and ON Semiconductor as well as with automotive suppliers like Delphi Technologies, Volkswagen Group and ZF Friedrichshafen AG. As well as its agreement with Cree (Wolfspeed), STMicroelectronics also revealed a long-term supply agreement with SiCrystal (which is owned by ROHM Semiconductor) as well as buying wafer supplier Norstel Sweden outright.

Within the GaN substrate wafer supply market, the biggest surprise of 2019 was that Power Integrations was producing GaN system ICs on GaN-on-sapphire substrates while still in stealth mode. Power Integrations acquired Velox Semiconductor in 2010 and used its GaN-on-sapphire research and know-how to create its 'PowiGaN' technology. Compared with its competitors,



Silicon carbide and gallium nitride power semiconductor market, by technology (in millions of dollars).

the company has taken a different approach by co-packaging GaN switches with silicon driver and protection ICs in its third generation of integrated InnoSwitch devices.

Bulk GaN (or freestanding GaN or GaN-on-GaN) wafers are small and very expensive, but prices are falling as new Chinese suppliers appear, including ETA Research,

Sino Nitride and Nanowin. New developers of trench devices on freestanding GaN wafers, like NexGen Power Systems and Odyssey Semiconductor, have appeared, but it will take many years before devices become prevalent, Omdia concludes. ■

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