

Power GaN: Market & Technology Analysis - Report from Yole Développement

Yole Développement releases its new markets & technological study dedicated to Power GaN industry. GaN is an already well implanted semiconductor technology, widely diffused in the LED optoelectronics industry. For about 10 years, GaN devices have also been developed for RF wireless applications where they can replace Silicon transistors in some selected systems. That incursion in the RF field has open the door to the power switching capability in the lower frequency range and thus to the power electronic applications.

Compared to Silicon, GaN exhibits largely better figures for most of the key specifications: Electric field, energy gap, electron mobility and melting point. Intrinsically, GaN could offer better performance than Silicon in terms of: breakdown voltage, switching frequency and Overall systems efficiency. This report provides a complete analysis of the GaN device and substrate industry in the power electronics field along with key market metrics. It provides company involvement as well as technology state-of-the-art. In addition, an extensive review of the possible substrates for GaN is provided, offering the most complete view of the Power GaN industry available to date.

A \$16.6b 2010 TAM and some key promising applications GaN technology is maturing and now offers transistor, diode and even IC 's compatible with Power Electronic expectations, at least in the 0-600V range. Looking at Total Accessible Market, a \$16.6b market size is envisioned, split in: Power IC s · Power Discretes · Power Modules Now, considering the GaN current state-of-the-art, Yole Développement assume s the most promising applications for Nitride Semiconductors would be (See illustration above/enclosed) IT and consumer , automotive and the following industries: PV inverters, UPS and motor control .

That very cost-driven target make GaN-on-Si the only solution at short term " About 67 % of Power Electronics market is looking at 0-900V voltage range, mostly made of cost-driven consumer and IT applications " , explains **Dr Philippe Roussel** , Project Manager at Yole Développement. To address these segments require a high-volume manufacturing capability as well as a very aggressive market price positioning. Thus, the technical solution involving expensive bulk-GaN substrates are not compatible with market requirements. GaN-on-Si appears as the most cost-effective setup to reach at least the 0-900V applications. It has been calculated that GaN-on-Si HEMT could be 50% cheaper than the same SiC device. However, as of today state-of-the-art, it remains twice and even 3 times more expensive than the similar silicon device.

The choice to integrate GaN instead of Silicon will be made at system level, while calculating the overall module cost. Implementing GaN will allow reducing: · Thermal management costs (fewer fans, smaller heat-sink...) · RF filtering costs (higher switching frequency will need small capacitors and inductances) · Overall housing cost (30% to 50% overall module size shrinking is expected) So Yole Développement assumes GaN-on-Si is the preferred solution to enhance GaN market penetration over the power electronics industry.

GaN power devices: a \$350M market in 2015 GaN power electronics market has just started in 2010 along with the announcements of IR and EPC Corp. about their first products introduction. To now, the maximum commercially available Vb is of 200V that partially covers the IT and consumer segments. In their roadmap, these 2 companies and the other possible new incomers (MicroGaN, Furukawa, GaN Systems, Panasonic, Sanken, Toshiba and so on...) are announcing 600V and even 900V devices in a very short time. Such an increase in the Vb range, will allow GaN to step by step enter into the industrial and automotive segments. Taking into account the minimum qualification period needed for new technology implementation, Yole Développement does forecast that the inflexion point for GaN market ramp-up will occur early 2012, leading to a \$50M+ market size by 2013 and ~\$350M by 2015. In 2015, GaN device business should be equally split between IC 's, discretes and modules. Based on the expected price erosion of the GaN-on-Si 6" epiwafers over the time, the GaN substrate market should exceed \$100M in 2015.

About Power GaN report · **Author & Contributor** Philippe Roussel, Ph.D holds a Ph-D in Integrated Electronics Systems from the National Institute of Applied Sciences (INS A) in LYON . He joined Yole Développement in 1998 and is senior manager of the Compound Semiconductors technology & economical market analysis department. · **Catalogue price: Euros 3,990.00 (single user license) - Publication date: November 2010** For special offers and the price in dollars, please contact David Jourdan (jourdan@yole.fr [1] or +33 472 83 01 90)

· **Companies cited in the report** AmberWave, Ammono Sp, Applied Materials, AZZURRO Semiconductors, BluGlass, Cermet, Cotopaxi Materials LLC , Covalent Materials, Efficient Power Conversion Corp, EpiGaN, Episil, Freescale, Fuji Electric, Fujitsu Electronics, Furukawa Electric, GaN Systems, Goldeneye Inc., Group4 Lab, Hitachi Cable, HK UST, III -V Lab, IMEC , International Rectifier, IQE, Kyma Technologies, LumiLOG , MicroGaN, Micron Technology, Mitsubishi Chemical, NanoGaN, NEC , Nitronex, NTT , Oxford Instruments / TDI , Panasonic, Picogiga - SOITEC , Powdec, Renesas, Rensselaer Polytechnic Institute, Samsung-

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