EMERGING SEMICONDUCTOR SUBSTRATES: MARKET & TECHNOLOGY TRENDS 2019

Emerging Market & Technology Report - May 2019

Emerging semiconductor substrates are expected to grow at a 24% CAGR from 2018 - 2024.

REPORT KEY FEATURES
- State-of-the-art technology development of GaSb, InSb, bulk GaN, Ga2O3, bulk AlN, diamond, GaN, AlN templates, and emerging engineered substrates
- Application potential for each material
- Key players/ecosystem for each material
- Materials market size (in $M) in 2018 and 2024
- Materials price in 2018 and 2024

ELECTRONICS AND PHOTONICS APPLICATIONS ARE CREATING PLENTY OF OPPORTUNITIES FOR EMERGING SEMICONDUCTOR SUBSTRATES

Silicon isn’t the perfect semiconductor, and with it currently being pushed to its limits, alternative platforms and compound semiconductors have emerged. The success stories include GaAs for RF and photonics applications, SiC for power and RF applications, GaN-on-sapphire for LEDs, and SOI for RF and CIS imaging sensors.

Fueled by a desire to push performance limits and reduce cost, new materials are being explored for different semiconductor applications. This report looks at the drivers involved.

Starting with RF applications, there are numerous market drivers, including 5G for infrastructure and handsets, defense applications and civil automotive radar, and more. For example, 5G deploys MIMO, which is used in high-end 4G LTE phones. MIMO is obligatory for handsets, and more filters will be needed. Plus, better performance is required, which implies a big market opportunity for new materials.

Regarding the power electronics market, which is currently driven by the electrification of transportation, renewable energy, motor drive, and numerous power supply applications, enhanced device performance to reduce power consumption is a general trend that has created market opportunities for wide band gap materials like SiC. Indeed, the SiC power device market is taking off, though the substrate remains expensive. Is there a place for other wide band gap and ultra-wide band gap semiconductors, like Ga2O3?

The photonics market, ranging from ultraviolet (UV) to the infrared (IR) spectrum, brings huge opportunities: from water purification and gas sensors, to infrared imagers. Since the wavelength is determined by the bandgap of the material (which is intrinsic to each material), different materials are being developed to push the wavelength towards shorter or longer regions.

Electronics and photonics applications are creating plenty of opportunities for emerging semiconductor substrates. Combined, Yole Développement (Yole) expects the emerging semiconductor substrate market to surpass $400M, growing at a 24% CAGR from 2018 - 2024.

This report covers state-of-the-art crystalline semiconductor substrates, including GaSb, InSb, GaN, Ga2O3, AlN, and diamond. GaN, AlN templates, and engineered substrates like piezo-on-insulator (POI) are also covered.

2018-2024 emerging materials - Market revenue

2018: $122M
2024: $402M*

GaSb InSb Bulk GaN Ga2O3 Bulk AlN Single crystal diamond Heteroepitaxial single crystal diamond Engineered substrates GaN templates AlN template

$67M $6M $5M $5M $5M $20M

Yole Développement, May 2019

*Detailed market size forecast for 2024 available in the report.
Researchers and engineers have plenty of ideas, and now the questions are, “Which emerging semiconductor substrate will be the next game-changer?” and “For which application?”

Starting with GaSb and InSb, laser diodes (LDs) and photodiodes (PDs) based on these materials are already deployed in performance-driven military applications. But this is not all. For example, IQE, a leading antimonide wafer and epiwafer supplier, is actively engaged with tier 1 OEMs on new opportunities to migrate antimonide-based “see in the dark” IR technologies into consumer markets. Yole also sees that an emerging GaSb-based type-2-superlattice (T2SL) technology is being developed by several major detector players including FLIR, Semiconductor Devices, and IRnova. This technology is expected to penetrate into consumer applications, with ramp-up in the coming years.

Bulk GaN wafers have for many years been widely used for laser diode applications. Recently, researchers have explored their usage in power electronics and RF applications. We see a growing effort, led by Japanese players (ranging from materials suppliers to device suppliers like Toyoda Gosei), to make vertical GaN-on-GaN power devices happen. In the meantime, an ultra-wide band gap material (Ga2O3) is garnering increased attention. Wafers up to six inches have been demonstrated, with the promise of potentially lower cost than today’s SiC solutions. Future ramp-up will depend on technology/cost competition from other existing solutions.

Up to now we have considered bulk crystal materials, but they are not the whole story. Templates and engineered substrates are also being developed for either lower cost (i.e. SiC and poly SiC bonding) or better performance, such as piezo-on-insulator for filter applications.

This report conveys Yole understanding of these substrates’ application potential in RF, power electronics, photonics (including laser diodes), LEDs, sensors, and detectors.

### 2018-2024 emerging materials’ target markets

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(Yole Development, May 2019)
REPORT OBJECTIVES

- Overview of different emerging semiconductor substrates other than Si, GaAs, InP and SiC
- Understanding of the driver and the barrier of each materials
- Time to market discussion
- Application potential assessment
- Identification of the key players

COMPANIES CITED IN THE REPORT (non exhaustive list)


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AUTHORS

Since 2013, Hong Lin, PhD has worked at Yole Développement (Yole) as a Senior Technology and Market Analyst, Compound Semiconductors, within the Power & Wireless division. Hong specializes in compound semiconductors and provides technical and economic analysis. Before joining Yole she worked as an R&D Engineer at Newstep Technologies, in charge of developing cold cathodes by PECVD for visible and UV lamp applications based on nanotechnologies. Hong holds a PhD in Physics and Chemistry of Materials.

As a Technology & Market Analyst, Compound Semiconductors, Ezgi Dogmus, PhD is a member of the Power & Wireless division at Yole Développement (Yole). Ezgi’s contributions to the daily development of the division’s activities include a dedicated collection of market & technology reports, as well as custom consulting projects. Prior to joining Yole, Ezgi was deeply involved in the development of GaN-based solutions at IEMN (Lille, France). She has also participated in numerous international conferences and authored or co-authored more than 12 papers. Upon graduating from the University of Augsburg (Germany) and Grenoble Institute of Technology (France), Ezgi received her PhD in Microelectronics at IEMN (France).
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CONTACTS

For more information about :

• Consulting & Financial Services: Jean-Christophe Eloy (eloy@yole.fr)

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