Small-dimension wafer industry: Yole foresees bright prospects for the future

OUTLINE:

• Key figures:
  The small-wafer (1” - 6”) market is showing a 1.8% CAGR between 2019 and 2025 to reach US$5.4 billion by 2025.
  As of 2019, the small-size wafer market in units represent 63% of the total wafer market. In 2025, it is forecasted to represent 53% of the total market.

• The main driver for the small dimension wafers industry can be summarized in two words: « good enough ».

• By wafer size:
  Si is the only wafer material in this study, to lose 6”-and-below market shares with the rise of “More than Moore” devices.
  The 2” market is forecasted to grow (in units) the fastest driven by InP and somehow, GaN-bulk wafers.
  It is followed by a robust 6” market (2.9% 2019-2025 CAGR): the growth of the 6” wafer markets will be mostly driven by GaAs, SiC wafers and sapphire should microLEDs fully emerge.

• Equipment: almost all the major equipment vendors, in terms of 2019 revenue, have sub-8” solutions, either in new equipment form or in refurbished equipment form.

“The small-wafer (1” - 6”) market is anything but “dead”,” asserts Gaël Giusti, PhD., Technology & Market Analyst specializing in Semiconductor Manufacturing and Equipment & Materials at Yole Développement (Yole). “At Yole, we forecast 1.8% CAGR between 2019 and 2025 and estimated revenues of US$5.4 billion in 2025. More than Moore

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1 Extracted from:
6” and Below: Small-Dimension Wafer Market Trends, Yole Développement, 2020
Compound Semiconductor Quarterly Market Monitor, Yole Développement, Q3 2020
2 Including: InP, GaAs, Si, SiC, Sapphire and LT/NL
3 CAGR: Compound Annual Growth Rate
4 Excluding logic and memory applications
5 Si: Silicium
6 InP: Indium Phosphide
7 GaN: Gallium Nitride
8 GaAs: Gallium Arsenide
9 SiC: Silicon Carbide
applications represent the overwhelming part of this market, and as such it is still very dynamic. In fact, non-Si wafer markets exhibit moderate to strong CAGRs over the 2019 - 2025 period: for example, 19.5% for SiC, with revenues estimated at US$712 million in 2025. Only Si exhibits a moderate negative CAGR, with -3.3% over the same period for sub-6” Si wafers, due mostly to power and RF applications increasingly transitioning to 8” and even 12”.

In this context, the market research & strategy consulting company investigates disruptive technologies and related markets in depth, in order to point out the latest technical innovations and underline the business opportunities.

Released today, the 6” and Below: Small-Dimension Wafer Market Trends report gives detailed analysis of the small-dimension wafer market by material, application, and diameter. It also describes the key benefits, added value, and drivers for using small-dimension wafers in the semiconductor industry. Yole’s report deliver a relevant overview of the market trends and forecasts, supply chain, key players and technology trends. The analysts had the opportunity to discuss about the ecosystem, with a focus on China and Russia. At the end, this study is offering a significant snapshot dedicated to the related equipment market and fabs as well as the emerging wafer reclaim industry.

What are the economic and technological challenges of the small-wafers industry? What are the key drivers? Who are the key suppliers to watch, and what innovative technologies are they working on? Yole’s analysts present today their vision of the 6”-and-below wafer diameter industry.

Yole’s analysts investigate the semiconductor industry for a while and are covering all related manufacturing technologies. This year, they add the opportunity to gather their deep expertise and knowledge in a significant technical and market analysis related to the 6”-and-below wafer diameter industry. In this new report, performed by Yole’s semiconductor
manufacturing team, the company proposes a valuable picture of the prosperous industry. According to them, this sub-6” market strength can be linked to:

- A “good enough” device performance/fabrication cost-per-die ratio so that large CAPEX and risky process changes cannot always be fully justified.
  “This “good enough” concept is important and is a strong driver in the use of small-dimension wafers,” explains Vishnu Kumaresan, PhD., Technology & Market analyst, Semiconductor Manufacturing at Yole.

- In parallel, Yole points out strong market drivers for each materials and related applications:
  For example, SiC for power electronics applications is currently facing huge investments. Almost all leading power electronics and compound semiconductor companies are deeply involved in the development of SiC-based solutions.
  “In 2019-2020 period, there has been significant news on SiC device and module business in terms of partnerships and acquisitions”, explains Ezgi Dogmus, PhD. Technology & Market Analyst, Compound Semiconductor & Emerging Materials at Yole. “This clearly validates SiC substrate and device manufacturer’s desire to climb up the value chain to benefit from growing business opportunities at the module level.” Yole’s semiconductor manufacturing team is daily working with Yole’s compound semiconductor analysts to combine their expertise and get a clear understanding of the market evolution and the impact of the adoption of emerging technologies. SiC technologies and related applications are followed by the compound semiconductor team through a dedicated Quarterly Market Monitor.

InP and datacom applications are also a good example to highlight the added value of small dimensions wafers. The case of sapphire is particularly interesting, and the competitive landscape has changed tremendously after a price collapse, with only a handful of players serving a high-volume yet saturated LED market. However, the microLED market could significantly increase demand by 2023, especially in the 6” range.

For Ahmed Ben Slimane, PhD., Technology & Market Analyst, Compound Semiconductors at Yole: “MicroLEDs could also propel the GaAs wafer market, particularly for red pixels – indeed the GaAs growth is significantly boosted by photonics applications, with GaAs VCSEL\(^{10}\) technology strongly dominating this market due to the high volume demand for consumer 3D sensing applications, causing GaAs to grow with a CAGR of no less than 8% between 2019 and 2025. Overall, new applications and needs are driving evolutions in wafer diameters, by material and by application”.

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\(^{10}\) VCSEL: Vertical Cavity Surface Emitting Laser
The GaAs market is studied in the Quarterly Market Monitor mentioned above.

2019-2025 total small dimension market (≤ 6’’)
Breakdown by diameter forecast

As analyzed by Yole’s team in the new 6” and Below: Small-Dimension Wafer Market Trends report, in parallel to mainstream semiconductor equipment there exists a vibrant refurbished equipment & maintenance market. “This is significant and connected to the “fabs never die” trend,” comments Gael Giusti from Yole.

Less known is the existence of a market for depreciated fabs, which also represent tremendous opportunities to produce devices at low cost for any volume. For example, there is still significant demand for 6” Si wafers in standard power IGBT and MOSFET devices. Higher-end devices can then be fabricated in brand-new fabs, for example Robert Bosch and Infineon Technologies in the power electronics industry, in the Si 300 mm range, which is also a way to secure future supplies and assert one’s dominance in the market.

According to Vishnu Kumaresan from Yole: “A similar trend is at play in the SiC wafer manufacturing industry, with some major players moving quickly to 8” wafer diameter and securing their supply chain while leaving behind 6” (and even more so 4”) wafer processing capacities. With the increased use of non-Si substrates, more and more players are offering specific processing equipment for a given material and/or are proposing equipment which can adapt to different materials and diameters, including 4” and 6”. This equipment can be astutely used in fully depreciated sub-6” Si wafer fabs, creating opportunities for players small and large to offer a highly competitive device fabrication cost”.

Therefore, wafer fabs never die…

All year long, Yole Développement publishes numerous semiconductor manufacturing reports. In addition, experts realize various key presentations, interviews and organize key conferences.

11 IGBT: Insulated-Gate Bipolar Transistor
12 MOSFET: Metal-Oxide Semiconductor Field-Effect Transistor
Make sure to be aware of the latest news coming from the semiconductor industry and get an overview of our activities on i-Micronews. Stay tuned!

Press contacts

**Sandrine Leroy**, Director, Public Relations, leroy@yole.fr

**Marion Barrier**, Assistant, Public Relations, marion.barrier@yole.fr

Le Quartz, 75 Cours Emile Zola – 69100 Villeurbanne – Lyon – France – +33472830189

www.yole.fr - www.i-micronews.com – LinkedIn – Twitter
About our analysts

Gaël Giusti, PhD., is a Technology & Market Analyst specializing in Semiconductor Manufacturing and Equipment & Materials at Yole Développement (Yole). As part of the Semiconductor & Software division at Yole, Gaël’s expertise is focused on thin film growth and related applications, equipment, materials and manufacturing processes. He is involved daily in the production of technology & market reports and custom consulting projects. Prior to Yole, Gaël served as a R&D engineer at Sil’Tronix Silicon Technologies for 5 years where he was in charge of upscaling a CVD process to develop epitaxial AlN thin film on sapphire for RF applications. He also worked on transparent conducting thin films for optoelectronics applications as a post-doctoral researcher at LMGP (Grenoble, France). Gaël holds a master’s degree from ENSICAEN (Caen, France) as well as a PhD in Materials Science from the University of Birmingham (UK).

Vishnu Kumaresan, PhD., is a Technology & Market analyst in the Semiconductor Manufacturing Team of Yole Développement, France. He focuses on the semiconductor manufacturing domain, covering both equipment and material segments. His scope includes mainstream microelectronic applications as well as More-than-Moore applications. Having lived and worked in 4 countries, he has more than 11 years of experience in the electronics industry, covering semiconductor, display, and software technologies. Prior to joining Yole, he worked as an epitaxy engineer in an advanced startup in the micro LED display industry and has previously gained corporate experience at IMEC, CNRS, Saint Gobain and Infosys. Vishnu obtained his PhD in Material Physics & Chemistry from Pierre and Marie Curie University, France, and master’s in Microelectronics from National University of Singapore and Technical University of Munich, Germany.”

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

Ahmed Ben Slimane, PhD. is a Technology & Market Analyst, Compound Semiconductors at Yole Développement (Yole). As part of the Power & Wireless team, Ahmed is engaged in the development of dedicated collection of market & technology reports and dedicated monitor. Previously, he worked as an epitaxy (MBE/MOCVD) & fabrication process engineer for GaAsbased photovoltaic applications at TOTAL and IPVF (Paris-Saclay, France). Ahmed also completed his PhD in Material Engineering from KAUST (Saudi Arabia). Ahmed obtained his Master degree in Electronics Engineering from INPG (Grenoble, France).

About the reports

6” and Below: Small-Dimension Wafer Market Trends
Wafer fabs never die: small-dimension wafer is still a growing market – Performed by Yole Développement

Companies cited:

Compound Semiconductor Quarterly Market Monitor, Q3, 2020
Otherwise driven by EV/HEV and consumer fast charger applications, power SiC and GaN markets are expected to feel the short-term impacts of the Covid-19 outbreak.- Performed by Yole Développement
Related reports:
- Epitaxy Growth Equipment for More Than Moore Devices Technology and Market Trends 2020
- Nano-Imprint Technology Trends for Semiconductor Applications 2019
- Power SiC 2019: Materials, Devices, and Applications

About Yole Développement
Founded in 1998, Yole Développement (Yole) has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide… More

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