

How are high-volume 3D Sensing applications shaping the Compound Semiconductor Industry?

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Abstract

Today's remarkable high-volume demand in 3D sensing had a significant impact on the compound semiconductor industry. This report provides an overview of market triggers for VCSEL and the development of GaAs wafer and epiwafer industry, along with market forecast of different impacted segments.

INTRODUCTION

Until 2017, the VCSEL market was driven by Data communications (datacom) applications that emerged in 1996. Datacoms was the first industrial application to start integrating Vertical Cavity Surface Emitting Lasers (VCSELs). Their sweet spot has been in short-distance data communication due to their low power consumption and competitive price compared to Edge Emitting Lasers (EELs). Driven by the development of datacenters, the VCSEL market and production boomed in the 2000s with the internet's popularity, and then grew steadily. Some new applications for VCSEL emerged, like laser printers and optical mice, but were not strong growth drivers.

Since 2017, the datacom application that was driving the market has been replaced by 3D sensing application, especially since the implementation of the Face ID module in

iPhones. Following the release of the iPhone X, several smartphone manufacturers followed the same path and implemented 3D sensing module in the front side of smartphone for face recognition.

3D rear sensing in mobile has diversified its application use cases. First used for photography, to enhance bokeh and zoom capabilities, it will expand into Augmented Reality (AR) and gaming. Beyond smart phones, time of flight (ToF) modules have a broad application market in front of them, including intelligent driving, robots, smart homes, smart TVs, smart security and virtual reality (VR)/AR. Currently, the application of ToF technology in these fields is still in its infancy.

Yole Développement (Yole) expects the global 3D imaging and sensing market to expand from \$5B in 2019 to \$15B in 2025, at a 20% Compound Annual Growth Rate (CAGR) as indicated in fig.1. The significance of the 3D sensing market means the transition from imaging to sensing is happening before our eyes. Artificial Intelligence (AI)-powered devices and robotics are gaining a better understanding of their surroundings and developing a new level of interaction with humans. Advanced Driver Assistance Systems (ADAS) are a highly anticipated application of 3D imaging and sensing technology. The most important

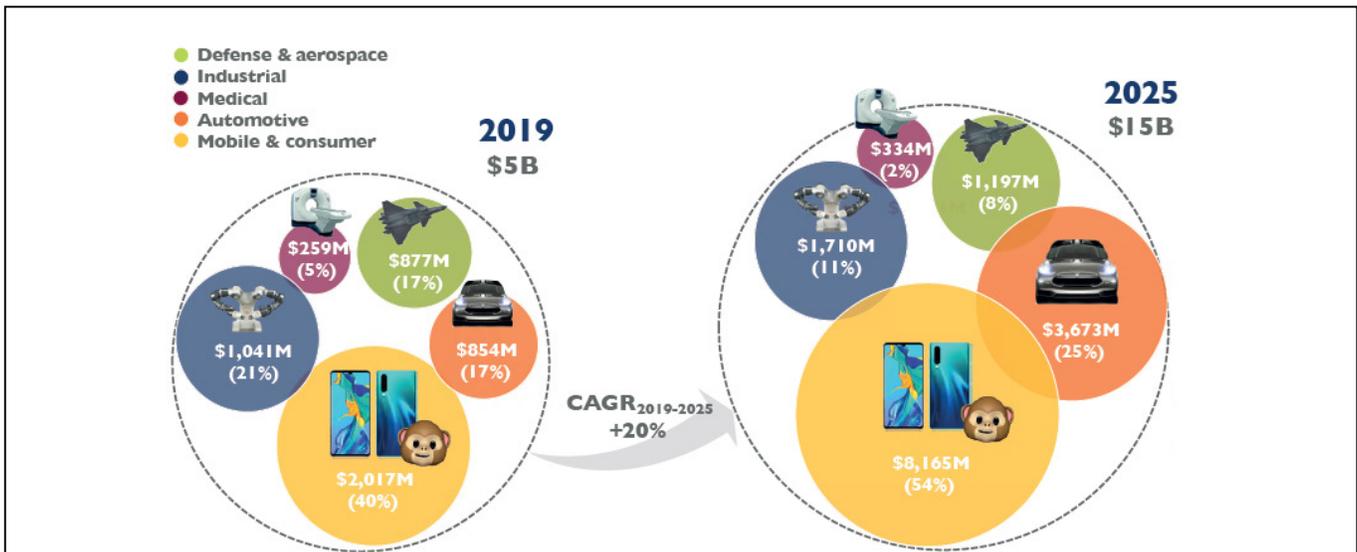


Fig. 1. 3D sensing and imaging – 2019-2025 market forecast (in \$M)

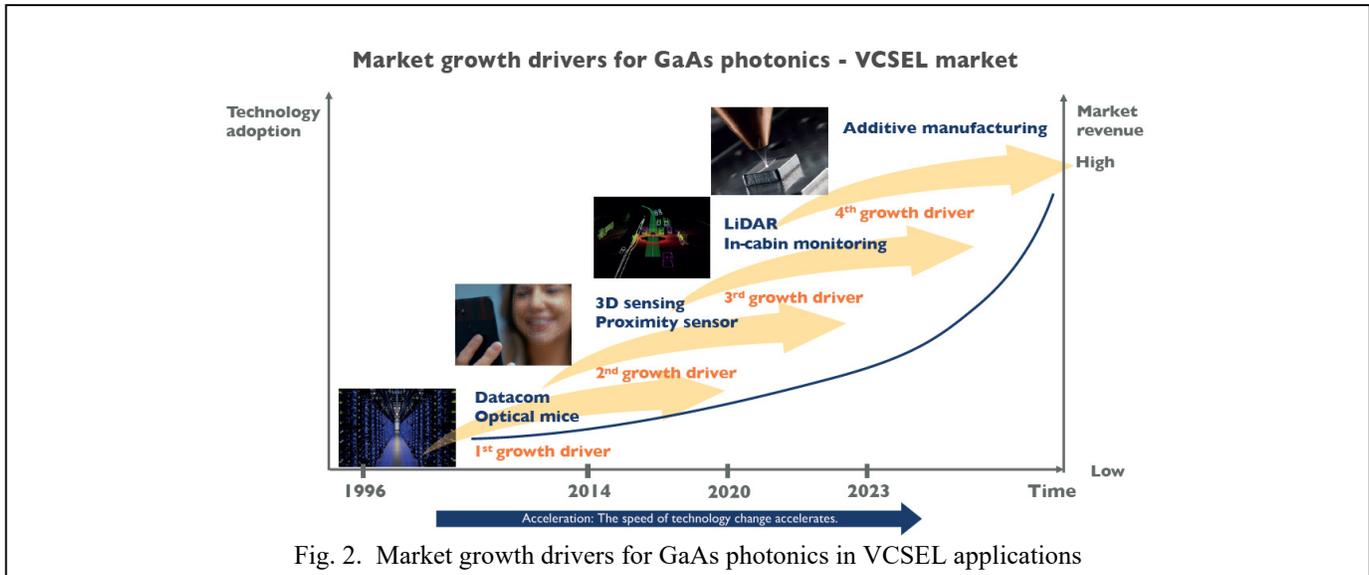


Fig. 2. Market growth drivers for GaAs photonics in VCSEL applications

component in this application, Light Distance and Ranging (LiDAR), is now focused on by a large number of suppliers. There are a wide range of LiDAR technologies to choose from, making the field as a very competitive one.

GAAS WAFER AND EPIWAFER INDUSTRY

Historically, GaAs wafer and epiwafer market for photonics were relatively small markets mainly focused on datacom applications. However, since the introduction of a 3D-sensing function in the iPhone X by sensing, VCSELs and EELs have great potential to be used in LiDAR technology for automotive applications, where they are both competing for short and mid-range detection. Today, VCSELs have paved the way for the GaAs wafer market to grow at a remarkable CAGR of 18% from 2019 to 2025.

Following the remarkable entry of GaAs VCSELs in the consumer market, the GaAs epiwafer supply chain has been constantly changing. In the photonics market, the epiwafer business model is application dependent. In datacom, it is mostly integrated, dominated by Finisar, Avago and II-VI. However, for 3D sensing and other VCSELs for smartphones, manufacturers prefer to outsource the epitaxy, a more flexible strategy adopted by Apple, which is supplied by IQE. IQE remains the biggest epiwafer supplier, with 61% photonic epiwafer market share in 2019. But, with increased adoption of 3D sensing, numerous players such as VPEC, II-VI Epiworks, Sumitomo Chemicals and Landmark are ramping up their production.

However, the 3D Sensing applications are not the only drivers for GaAs market growth. The direct view display market has seen growth driven by applications such as control rooms, corporate and indoor home theatre. In this context, MicroLED microdisplays emerged as a potential technology

that can provide high performance, in terms of brightness, form factor, color and contrast. The fast progress in the prototyping of microLEDs is appealing to many manufacturers. MicroLEDs have the possibility of driving GaAs wafer market growth, with a conservative case of \$46M in 2025, and an optimistic case where microLEDs could contribute tenfold more in 2025.

CONCLUSIONS

The increase in VCSEL demand for 3D sensing paved the way for the growth of other high-volume applications such as LiDAR. The rapid evolution in the VCSEL as well as microLED applications, GaAs wafer/epiwafer market industry in coming years in the form of investment, new entrants and mergers and acquisitions (M&A).

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ACRONYMS

- VCSEL: Vertical Cavity Surface Emitting Lasers
- EEL: Edge Emitting Lasers
- LiDAR: Light Detection and Ranging
- ToF: Time-of-Flight
- CAGR: Compound Annual Growth Rate
- DOE: Diffractive Optical Elements
- AGV: Automatic Guided Vehicles
- ADAS: Advanced Driver Assistance Systems