

苹果进军硅光子¹

除了通信之外，硅光子正打入消费和汽车领域

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内容概览：

- 市场预测：
总体上，硅光子收发器市场将在2026年达到46亿美元，2021年至2026年的CAGR²为25%。
整个硅光子芯片市场总额将规模在2026年应可超过10亿美元。
截至2035年，硅光子市场可能还会进一步增长，其中很大一部分来自于消费医疗保健领域。
未来，硅光子传感技术将令汽车和自动驾驶受益。
- 技术趋势：
硅光子的主要应用是光通信。
2020年已有新的应用进入市场，如免疫分析、FOG³等等。
硅光子的新型应用预期将在未来五年内进入市场。
有三家大公司正在为CPO⁴做准备：思科、英特尔和博通。
- 供应链：
Rockley Photonics已宣布计划采用硅光子技术与苹果联手在智能手表中嵌入生物传感器。
随着越来越多的晶圆厂、代工厂和越来越多的公司涉足封装、模型化、PDK⁵和设计，硅光子生态系统正在不断扩大。
在硅光子产业格局中有三种显而易见的发展趋势：垂直集成、SPAC⁶和新兴代工服务。

¹摘自：

《2021年硅光电报告》，Yole Développement

《英特尔硅光子 100G CWDM4QFSP28 收发器》，System Plus Consulting, 2020

²CAGR：年均复合增长率

³FOG：光纤陀螺

⁴CPO：共封装光学

⁵PDK：工艺设计工具包

⁶SPAC：特殊目的收购公司

“自1998年Bookham公司发布第一款使用硅光子平台的产品以来，硅光子技术的主要应用领域一直是光通信”，**Yole Développement (Yole)**的高级分析师**Alexis Debray**博士称。他补充道：“在Luxtera（现为思科子公司）于2008年发布第一款使用硅光子技术的光收发器之后，硅光子光收发器市场规模已增长至5.81亿美元，出货量近500万。”

在这样充满动态的形势下，同属Yole企业集团的Yole和System Plus Consulting两家公司对颠覆性光电技术及相关市场进行了深入调研，从而指出最新的创新技术并突出重要商机。

- Yole今天发布的《2021年硅光电报告》提供了硅光子芯片、SOI晶圆，以及收发器的市场数据，并描述了消费、汽车和计算领域中的新型硅光子学应用。它还包含对硅光子市场截至2026年的全面分析，并按应用和技术类型对收益、出货量和平均售价进行了细分。

这份技术与市场报告是与**Jean-Louis Malinge**先生合作撰写的，他对这一产业有深入涉猎。**Jean-Louis Malinge**和Yole长期合作，以深入了解硅光子技术并明确相关应用和细分市场。

- 此外，定制反向成本分析公司System Plus Consulting也发布了《英特尔硅光子100G CWDM4QFSP28收发器》，通过这项专注于英特尔硅光子收发器的专题案例研究来说明这家领先企业的最新创新成果和技术选择。该报告介绍了英特尔在封装和光子技术方面的潜力。

Yole和System Plus Consulting通过这两项分析对硅光子产业提出了独特的见解。

硅光子是一个平台，因此当下已有许多大量的应用，而且各研究中心和大学已经提出了许多应用。

2020年有两项新的应用进入了市场。位于加州的公司Genalyte由Luxtera的联合创始人之一成立，并发布了基于硅光子元件的免疫分析系统。此外，KVH公司也发布了基于硅光子的FOG，计划用于机器人汽车导航。

Yole的市场研究总监**Eric Mounier**博士这样认为：“硅光子的新型应用有望进一步渗透市场。2021年3月，另一家总部位于加利福尼亚的公司Aeva已上市，初始估值为17亿美元。”

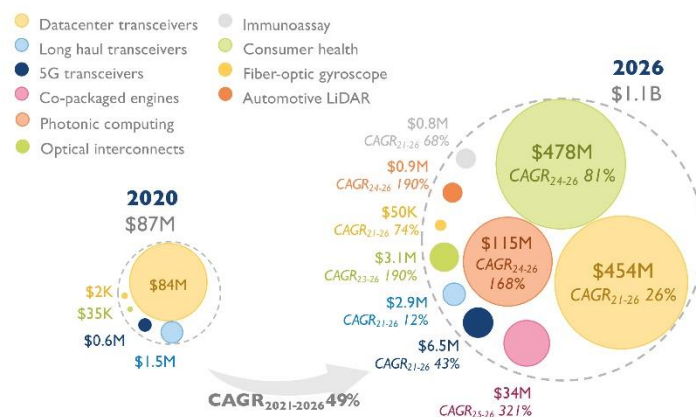
该公司的目标是将FMCW⁷激光雷达推向市场，该产品让硅光子技术服务于自动驾驶。同样在2021年3月，美国公司Rockley Photonics宣布计划在2021年第二季度上市，初始估值为12亿美元，该公司以获得由苹果支持的分光光度计项目，产品将用于智能手表。

⁷FMCW：频率调制连续波

除了免疫分析、FOG、激光雷达和消费医疗保健领域中的传感应用之外，硅光子技术的其他应用还包括电子鼻、OCT⁸和心血管诊断设备。通过光子计算和量子计算，以及松耦合数据中心中的光学互连（这样可以用光连接高性能计算中的各种元件），硅光子技术也能令计算受益。

2020-2026 silicon photonics die forecast by application

(Source: Silicon Photonics 2021 report, Yole Développement, 2021)



苹果自2017年开始与Rockley Photonics合作至今，已成为Rockley Photonics的最大客户，迄今为止已承诺投入的NRE⁹达7,000万美元。2019年和2020年，Rockley Photonics有两家主要客户，分别占其收益的100%（2020年）和99.6%（2019年）。迄今为止，Rockley Photonics已获得3.59亿美元的投资。

Rockley Photonics致力于开发和生产（基于硅光子技术的）光子模块，可以测量大量生物参数，如血氧水平、乳酸、酒精和葡萄糖等。该项目被称为“手腕上的诊所”，依靠一个小型化分光光度计工作。此前已有多所大学展示了此类分光光度计，但要实现用于Apple Watch的工业化水平会是一项艰难的挑战。

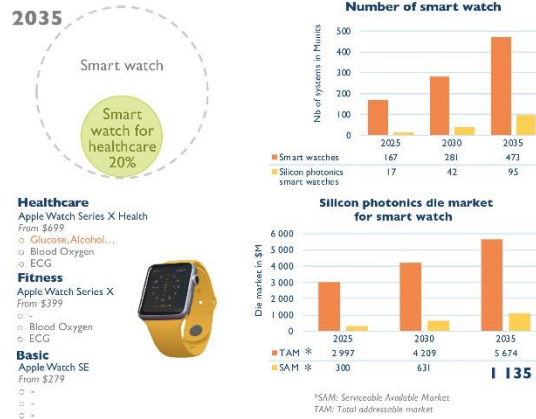
据Yole公司的Alexis Debray看来：“根据硅光子芯片18美元的估价，该模块的预估售价可能为45美元，可能适配于一款具有医疗保健功能的新型高端Apple Watch，售价为699美元。如果智能手表医疗保健功能的采用率截至2035年能达到20%，则相关的硅光子芯片市场可能达到11亿美元。相比之下，2020年用于光收发器的硅光子芯片市场规模估值为8400万美元。”

⁸OCT: 光学相干层析成像

⁹NRE: 一次性工程（成本）

Long-term opportunities for silicon photonics in consumer healthcare

(Source: Silicon Photonics 2021 report, Yole Développement, 2021)



英特尔正在为其服务器做市场宣传，该公司2020年在数据通信用的硅光子收发器市场上拥有53%的市场份额¹⁰。毫无疑问，英特尔是硅光子领域的领先企业之一。在此背景下，Yole的合作伙伴System Plus Consulting发布了一项针对英特尔硅光子 100G CWDM4QFSP28 收发器的详尽分析。

System Plus Consulting的首席技术与成本分析师Sylvain Hallereau博士表示：“短短几年内，英特尔的100G可插拔收发器出货量已超过3百万。而且英特尔已凭借其CWDM4 100G技术成为全世界首家提供高达10km的硅光子解决方案的公司。100G PSM4和CWDM4只是第一步，英特尔的200G和400G产品预期将于2020年下半年进入量产。”

包括System Plus Consulting和Yole Développement在内的Yole企业集团全年发布大量报告和行业监测资料。此外，专家们还会进行各种重要讲演并组织关键性会议。



借此机会，我们诚邀您参加将于2021年9月2日在中国深圳举行的“2021年光收发器与硅光子论坛”，以下专家将做讲演：

- Alexis Debray, Yole新兴技术业务部高级分析师
- Martin Vallo, Yole固态照明业务部技术与市场分析师
- Sylvain Hallereau, System Plus Consulting首席技术与成本分析师
- Sven Otte, Sicoya首席执行官

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¹⁰市场份额基于市场价值计算，单位为美元。

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About our analysts

Alexis Debray, Ph.D., is a Senior Analyst at Yole Développement (Yole), dedicated to the production of technology & market reports and custom consulting projects in the fields of Photonics, Sensing, and Semiconductors. Before joining Yole, Alexis spent 17 years in Japan. He worked for 2 years developing expertise in MEMS technologies and then for 15 years at Canon Inc. as a research engineer, where he contributed to numerous developmental projects focused on MEMS devices, lingual prehension, and terahertz imaging devices. Alexis is the author of various scientific publications and patents. He graduated from ENSICAEN (France) and was awarded a Ph.D. in applied acoustics.

With more than 25+ years' experience within the semiconductor industry, **Eric Mounier PhD.** is Director of Market Research at Yole Développement (Yole). Eric provides daily in-depth insights into current and future semiconductor trends, markets and innovative technologies (such as Quantum computing, Si photonics, new sensing technologies, new type of sensors ...). Based on relevant methodological expertise and a strong technological background, he works closely with all the teams at Yole to point out disruptive technologies and analyze and present business opportunities through technology & market reports and custom consulting projects. With numerous internal workshops on technologies, methodologies, best practices and more, Yole's Fellow Analyst ensures the training of Yole's Technology & Market Analysts. In this position, Eric Mounier has spoken in numerous international conferences, presenting his vision of the semiconductor industry and latest technical innovations. He has also authored or co-authored more than 100 papers as well as more than 120 Yole's technology & market reports. Previously, Eric held R&D and Marketing positions at CEA Leti (France). Eric Mounier has a Ph.D. in Semiconductor Engineering and a degree in Optoelectronics from the National Polytechnic Institute of Grenoble (France).

Jean-Louis Malinge collaborates with Yole Développement (Yole) to investigate the silicon photonics technologies and market evolution. Jean-Louis is strongly involved in this industry for many years and as an expert, he is an accomplished business management executive with extensive experience as a General Manager and CEO in France and the United States. He serves on numerous Boards of Directors. Amongst his experiences, he has formulated successful strategies to position or reposition lot of businesses, led numerous acquisition projects, and managed the creation of a successful joint-venture in Asia. Jean-Louis' academic credentials include an Executive M.B.A. from MIT Sloan School in Boston, Massachusetts. He also holds an engineering degree from the Institut National des Sciences Appliquées (INSA Rennes, France).

Sylvain Hallereau is Principal Technology & Cost Analyst at System Plus Consulting, part of Yole Développement (Yole). Working in close collaboration with the laboratory teams, Sylvain produces reverse engineering & costing reports while also contributing to custom projects, especially focused on solid-state lighting components, sensors, biotechnology devices, and ICs. Together, they define the objectives of the analysis and the most relevant methodology to gain a detailed understanding of the structure of the device. Sylvain then analyzes the results to describe the technology choices made by the leading semiconductor companies and the related process flows and also calculates the cost structure. In parallel, based on his significant technical and industrial knowledge, Sylvain supports the development of the semiconductor device activities and the related team at System Plus Consulting. He also contributes to the strategies of this department. Sylvain daily runs a strategic watch within the semiconductor community. Through his investigations, his aim is to identify innovative components and new manufacturing processes. In this way, Sylvain supports System Plus Consulting with the setting up of new methodologies for analysis and the updating of advanced simulation tools, especially those developed internally by System Plus Consulting's experts. Sylvain regularly contributes to numerous media articles, using his technology and industry expertise to analyze and comment on the latest innovations. He holds a master's degree in Microelectronics from the University of Nantes (France).

About the reports

Silicon Photonics 2021

Beyond communication, silicon photonics is penetrating consumer and automotive – heading to \$1.1B in 2026. – Performed by Yole Développement

Companies cited:

Acacia, Accton, Aeva, AIO Core, Alibaba Cloud, Alpine Optoelectronics, Amazon, amf, ams, Analog Photonics, Anello, AOI, Aryballe, AT&T, Axalume, Ayar Labs, Bra-Ket Science, Broadcom, Broadex, Caliopa, CeliO, Ciena, Cisco, Cloudlight, Elenion, Ericsson, Facebook, Fiberhome, ficonTEC, Finisar, Fujitsu, Fujitsu Optical Components, Genalyte, GlobalFoundries, Google, Hengtong, HPE, Huawei, Hyperlight, IBM, II-VI, Infinera, InPhi, Intel, iPrionics, IQE, Iris Light Technologies, Juniper, Kaiam, KVH, Leoni, Lightelligence, Lightmatter, Lightwave Logic, Lumentum, Luminous, Lumiphase, Luxtera, MACOM, Microsoft, Molex, NEC, NeoPhotonics, Nokia, and many more...

Intel Silicon Photonic 100G CWDM4 QFSP28 Transceiver

A deep analysis of the world's first 100G CWDM silicon photonic transceiver, covering new technologies and the main differences from the Intel 100G PSM4. – Performed by System Plus Consulting

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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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