

China's Photonic Chips Mass Production

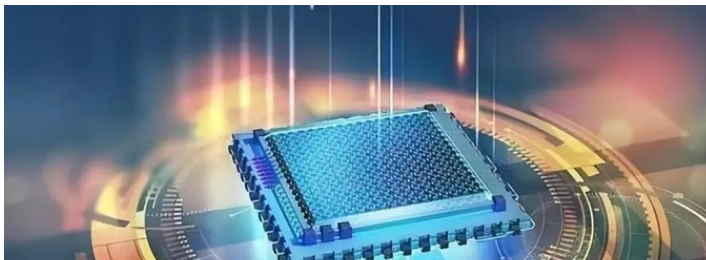
Description

Mass production of photonic chips in China is imminent; this would be a Game-changer. The “Made in China 2025” initiative, which calls for 70% self-sufficiency in core components for critical technologies by 2025, would be achievable.

And by 2030, China would dominate the projected one trillion-dollar chip industry like the way TSMC, Samsung, ASML, Qualcomm and Intel dominate the global market today!

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China's Mass production of photonic chips is a Game Changer!

After the Chinese Academy of Sciences reported the breakthrough of 3nm photonic chip transistor technology, Zhongke Xintong announced the news: the first multi-material photonic chip production line in China will be put into production in 2023.

This means that China has bypassed the stuck EUV lithography machine and found a way to achieve Chips supremacy by changing lanes and overtaking.

(1) The first domestic photonic chip production line is about to be mass-produced

In October 2022, “Beijing Daily” reporter Sun Qiru interviewed Sui Jun, the legal representative and president of Zhongke Xintong Microelectronics Technology (Beijing) Co, Ltd, and reported:

Zhongke Xintong is currently preparing to build the first domestic “multi-material, cross-dimensional” photonic chip factory. The photonic chip production line will be completed and put into production in 2023.

By that time, it will be able to meet market demand in the fields of communications, data centers, lidar, microwave photonics and medical testing.

After the completion of the production line, it will fill China’s gap in the field of optical quantum chip wafer foundry, and is expected to accelerate the large-scale process of domestic photonic chip production and the elimination of other means of production.

## (2) China’s chip industry has gone through a difficult development process

Looking back at China’s chip industry, there are four main stages:

The first stage is the initial R & D from 1965-1978

The second is the introduction and improvement from 1978-1990

The third is the key development and construction of 1990 to 1999

The fourth is 2000 to our current stage of rapid development

After decades of development, China’s chip industry is responsible for the packaging and testing links downstream of the industrial chain, while the design and manufacturing links upstream of the industrial chain are concentrated mainly in South Korea, Japan, Taiwan, the Netherlands and the United States.

Although the Kirin 9000 high-end chip independently developed and designed by Huawei HiSilicon represents the world’s most advanced chip level, its key core technology, key equipment and materials of chips have been under the control of foreigners.

For example, EDA tools, wafers and lithography machines are monopolized by developed countries for import. As a result, after the United States decided to sanction Huawei in 2018, Huawei, as the global leader in 5G technology, has been unable to ship Huawei 5G mobile phones because TSMC refused to manufacture 5G chips.

## (3) Breakthroughs in photonic chip technology by changing lanes to overtake.

In 1969, Bell Laboratories in the United States first initiated and proposed the concept of photonic chips.

By 2016, China successfully launched the world's first quantum experiment satellite into space. The quantum satellite was developed independently by China, and it also achieved the first quantum call with Austria. This marks the official launch of photonic research in China.

In 2018, Jin Xianmin's team at Shanghai Jiaotong University successfully developed China's first photonic computing chip.

In 2018, the United States sanctioned Huawei, a global leader in 5G communications. After the chip supply channel was cut off, Huawei launched the research and development of optical quantum chips. At present, it has successfully developed photonic chip design software, which is also the fastest quantum logic gate software in the world, helping the industry to develop on a large scale.

Huawei has never given up on research and development in the chip field. Huawei has taken the initiative to invest in Weiyuan Photonics and Everbright Huaxin. The Kirin chip is expected to return next year, a combination of silicon-based chips and photonic chips.

On May 27, 2019, Hong Kong's "South China Morning Post" website reported that Yin Huaxiang, an expert in the field of microelectronic equipment and integration technology at the Institute of Microelectronics, Chinese Academy of Sciences, and his team have developed a 3-nanometer transistor.

In July 2020, the Chinese Academy of Sciences issued a chip mobilization target, requiring a 70% self-sufficiency rate of domestic chips by 2025. For this purpose, the "Chip University" was established, the "Oriental Chip Port" was built with huge sums of money allocated: subsidies, tax-breaks, grants and numerous other incentives.

## The Results

Among them, it includes simultaneous breakthroughs in the two technical routes of photonic chips and traditional electronic chips. In February 2021, the Tsinghua team discovered a new light source that can be used in photonic chips.

In August 2021, Guo Guangcan, an academician of the Chinese Academy of Sciences, led a scientific research team to a major breakthrough in the core technology of photonic chips.

In 2022, according to the "Peking University News Network," the latest Nature article reported by Professor Wang Xingjun's team has made a major breakthrough in photonic integrated chips and microsystems; that is, optoelectronics integrated system on a chip.

Pan Jianwei, an academician of the Chinese Academy of Sciences, said in an interview that with the breakthrough of photonic chip technology, China will get rid of the chip stuck in the past and lead the development of the global semiconductor industry in the future.

(4) Domestic photonic chip "lithography machine" is available

The NDPT-100 non-destructive probe electrical measurement platform, which is 100% independently developed by Hefei Benyuan Quantum Computing Technology Co Ltd, has a minimum measurement

range reduced to the micron level, and the minimum diameter of the film scar caused by the probe is within 1 micron, and the measurement process does not affect the coherent performance of superconducting qubits has the advantages of high stability and high motion precision.

Dr Jia Zhilong, deputy director of the Quantum Computing Engineering Research Center, said that this non-destructive probe station is like a lithography machine on a traditional chip production line.

Accurately identify which qubits are unqualified and where they are unqualified, which greatly shortens the research and development cycle of photonic chips and effectively improves the yield rate of photonic chip manufacturing. The use of this equipment proves that China has completely opened up the photonic chip production line.

#### NDPT-100 Nondestructive Probe Electrical Measurement Platform

##### (5) The performance of photonic chips is far superior to electronic chips

The biggest difference between a photonic chip and a traditional electronic chip is that it uses light as a carrier, replaces electricity with light, and uses micro-nano processing technology to integrate a large number of photonic quantum devices on the chip. Compared with electronic chips, this photonic chip is more integrated, more accurate, more stable, and has better compatibility.

Because of the different manufacturing processes, optical quantum chips can be produced without a lithography machine. This means that the current most advanced 5nm and 3nm chip manufacturing processes will no longer be the top chip technology, and the pursuit of smaller nanometer chips will be completely meaningless.

The limit of electronic chips is 0.1 nanometers, which is the physical limit of electronic chip manufacturing equipment lithography machines.

Compared with electronic chips, photonic chips have lower requirements on the structure, generally on the order of hundreds of nanometers, thus reducing the dependence on advanced technology. This means that China's current 14nm-level production technology can fully meet the production needs of photonic chips.

## Photonic chips herald a larger application space

In terms of performance, photonic chips can compute about 1,000 times faster than electronic chips. The ability to quickly transfer large amounts of information makes optical processors well-suited to handle the massive calculations that drive artificial intelligence models.

For example, the artificial intelligence photonic chip is a chip design that highly matches the photonic computing architecture and artificial intelligence algorithm, and has the potential to be widely used in autonomous driving, security monitoring, speech recognition, image recognition, medical diagnosis, games, virtual reality, industrial Internet of things, enterprise servers and data centers and other key areas of artificial intelligence.

At the same time, photonic chips consume less power than electronic chips. Under the same circumstances, the power consumption of photonic chips is 1/100 of that of electronic chips, or just one

percent.

In 2020, the annual power consumption of domestic data centers was estimated to be 204.5 billion kWh, accounting for 2.7% of the electricity consumption of China, while the power generation of the Three Gorges Power Station in that year was 111.8 billion kWh.

In other words, the electricity consumed by data storage for one year is close to the power generation of two Three Gorges Power Stations. Electricity alone accounts for 60%-70% of the total operating cost of the entire data center. If photonic chips are used instead of electronic chips, only one item of data is stored, and 200 billion kWh of electricity can be saved in a year!

Combining the above advantages, the photonic chip is considered to be one of the most promising solutions in the fields of large-capacity data transmission and artificial intelligence accelerated computing in the future, and it also provides a good opportunity for the domestic chip industry to “change lanes and overtake.”

Upgrading from electronic chips to photonic chips is a major strategic opportunity for China's chips to change lanes and overtake

(6) The transformation of chips from electronic (or electricity) to light is a strategic opportunity for China to overtake

In terms of basic theory, China and the United States are basically at the same level. American scientists invented the world's first ruby ??laser in 1960. In 1961, the Changchun Institute of Optics and Mechanics of the Chinese Academy of Sciences developed China's first ruby ??laser.

In terms of technology, both China and foreign countries have their own advantages. For example, in terms of photonic integration technology research, Xi'an Institute of Optics and Mechanics, Chinese Academy of Sciences, Institute of Microelectronics, Chinese Academy of Sciences, Shanghai Institute of Microsystems, Shanghai Jiaotong University, Tsinghua University, Zhejiang University, Huazhong University of Science and Technology, etc. have conducted long-term research.

In terms of the sales market, 1.15 trillion chips was be sold worldwide in 2021, a record US\$555.9 billion, a year-on-year increase of 26%. China remains the world's largest chip consumer market, with sales up 27.1% year-on-year to \$192.5 billion. The semiconductors market is projected to reach [\\$726.73 billion by 2027](#); and research by [McKinsey & Company](#) to become a trillion-dollar industry by 2030.

The decisive force for the development of photonic chips is the market. Only strong market demand can bring huge technology research and development funds for photonic chips. The massive investment is the guarantee for the development of photonic chip technology.

In terms of industrial chain, China has the most complete industrial chain in the world. Once the commercial market in the field of photonic chips is opened, Chinese companies are bound to become the major force in this field.

Recently, Huawei took a stake in Weiyuan Photonics and Everbright Huaxin, GlobalFoundries launched new silicon photonics technology, and New Cisco launched the world's first open silicon

photonics platform... A group of domestic and foreign manufacturers have accelerated their exploration of the “optical chip” track.

From this point of view, China is fully capable of seizing the major strategic opportunity of upgrading from electronic chips to photonic chips, so as to realize the overtaking of Chinese chips in the global market, both in production and application. History will once again confirm the classic quote that Bill Gates once said: “Suppression will only accelerate China’s growth and surpass.”

“Woe to the crown of pride, to the drunkards of Ephraim, whose glorious beauty is a fading flower, which is on the head of the fat valleys of them that are overcome with wine!” Isaiah 28:1

“And I will cast you out of My sight, as I have cast out all your brethren, even the whole seed of Ephraim” Jeremiah 7:15

“The crown of pride, the drunkards of Ephraim, shall be trodden under feet” Isaiah 28:3

### **Category**

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3. Science-Tech-AI-Medical & Gen. Research

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