

Advance in Compound Semiconductor of China

Qi Huang and Junming Zhou

Institute of Physics, Chinese Academy of Sciences, Advanced Chinese Epitaxy Ltd.

8th South 3rd street Zhongguancun, Beijing 100080, China,
qhuang@iphy.iphy.ac.cn, 86-10-82649214

Keywords: Compound semiconductor, PHEMT, HBT, LED, LD.

Abstract

This extended abstract provides general information of compound semiconductor development in China.

I. General introduction

With its accession to the World Trade Organization (WTO), China has entered a new stage in its opening up and overcame the adverse effects the Asian financial crisis and world economic fluctuations had on China. The national economy has maintained a sustained, rapid and sound development. The strategic adjustment of the economic structure has been crowned with success. The position of agriculture as the foundation of the economy has been strengthened. Traditional industries have been upgraded. High and new technology industries and modern services have gained speed. A large number of infrastructure projects in such areas as water conservancy, transportation, telecommunications, energy and environmental protection have been completed. Significant headway has been made in the large-scale development of China's western region. Economic returns have further improved. National revenue has kept growing. Reform and opening up have yielded substantial results. In 2001, China's GDP reached 9.5933 trillion yuan, almost tripling that of 1989, representing an

average annual increase of 9.3 percent. China came up to the sixth place in the world in terms of economic aggregate.

II. IT industry in 2002

IT industry in China is in its infancy stage and grows rapidly. The total products market was worth RMB 1197.66 billion (\$145 billion) in Q1-Q3 of 2002, an increase of 20.6% since 2001, which is almost triple of an increase of China's GDP (7.4 %). The main IT product's sectors increase rapidly listed in table 1.

Table 1.
IT product's sectors increase

Products sector	Q1-Q3/2001 Increase in %	Q1-Q3/2002 Increase in %
Mobile handsets	60.1	29
Color TV	-3.2	41.4
PC	1	51.9
Color CRT	-1.5	42.8
Integrated circuits	-5.5	43.7
Exchange	73.7	-47.5

Color TV exported increased in 52.8%, \$1454

million and DVD in 85.2%, 2333 million.

Table 2
Communication Market Increase

	Q1-Q3/2002 Increase in subscribers	Q1-Q3/2002 Total subscribers
Telephone	26,633,000	207,001,000
Mobile handsets	45,169,000	190,391,000
Internet	8,477,000	45,044,000

Table 3
Driving action of three main sectors in Q1-Q3 2002

	Production increase	Contribution to IT industry	Driving increase in IT
Invest products	12.5%	29.5%	5.9%
Consumer products	30.6%	40.3%	8.1%
Devices	24.7%	30.1%	6.2%

Table 4

	Production increase	Contribution to IT industry	Driving increase in IT
Public	9.7%	18.9%	3.9%
Joint Venture	24.9%	68.4%	14.1%
Non-public	39.3%	12.5%	2.6%
Total			20.6%

China clearly recognizes that their IT products have many weaknesses compared with advanced countries. Domestic companies supplied less than 30% of the demand in the market and almost all sophisticated semiconductor products needed by Chinese companies were imported. Therefore China issued preferential policy to develop integrated circuits and software industry in order to enhance high scientific and technological

content in IT products.

III. The national developing strategy

China is in the primary stage of development. Her productive forces, science, technology and education are still relatively backward, so there is still a long way to go before she achieves industrialization and modernization. China still feels pressure from developed countries as they have the upper hand in such fields as the economy, science and technology.

For the country, the first two decades of the 21st century are a period of important strategic opportunities, which offers bright prospects and serves as an inevitable connecting link for attaining the third-step strategic objectives for her modernization drive as well as a key stage for improving market economy and opening wider to the outside world. On the basis of optimized structure and better economic returns, efforts will be made to quadruple the GDP of the year 2000 by 2020, China will in the main achieve industrialization and establish a full-fledged market economy and a more open and viable economic system. In light of the new trends in the economy, science and technology of the world and the requirements of the national economic development in the new period, China should basically accomplish industrialization, energetically apply IT, accelerate modernization, and maintain a sustained, rapid and sound development of the national economy in the first two decades of this century. Take a new road to industrialization and implement the strategy of rejuvenating the country through science and education and that of sustainable development. It remains an arduous historical task in the process of her modernization drive to accomplish industrialization. IT application is a logical choice if industrialization and modernization of the country are to be accelerated. It is, therefore, necessary to persist in using IT to propel

industrialization, which will, in turn, stimulate IT application, blazing a new trail to industrialization featuring high scientific and technological content, good economic returns, low resources consumption, little environmental pollution and a full display of advantages in human resources.

China press ahead to optimize and upgrade the industrial structure so as to bring about an industrial pattern with high and new technology industries as the leader, basic and manufacturing industries as the kingpin and the service industry developing in all areas. China gives priority to the development of the information industry and applies IT in all areas of economic and social development. China also emphasizes to develop high and new technology industries to provide breakthroughs in stimulating economic growth. It is necessary to transform traditional industries with high and new technology and advanced adaptive technology and invigorate the equipment manufacturing industry. In taking a new road to industrialization, China gives play to the important role of science and technology as the primary productive force and pay close attention to improving the quality and efficiency of economic growth by relying on scientific and technological progress and raising the qualities of labor force. China strengthens basic research and high technology research, promotes key technological innovation and systems integration so that technology will develop by leaps and bounds. China encourages scientific and technological innovation and acquires key technology and independent intellectual property rights in key areas and a number of domains in frontier science and technology. China presses ahead with the building of a national innovation system and plans to improve the system of intellectual property rights protection.

IV. National key measures

China will carry out five key IT

application projects for industry modernization. The ministry of electricity will invest RMB 600 billion for reconstructing electrical power network. The ministry of transportation will invest RMB 360 billion for expanding railway network. There are 296 broadcast stations, 653 TV station and 1300 cable TV stations will be digitalized and unified with wide band access. The digital TV subscribers will blow up from 2003 to 2006 and reach to 26,700,000 in 2008 at least. STB requirement will be huge. Expanding mobile network, reconstructing telecommunication network, establish data network will be started by investment of RMB 230 billion. The national targets in 2005 are as follows. The communication revenue will reach RMB1000 billion, average increase rate 23%. China will be in the first place of capacity in telephone and mobile handsets. The huge telecommunication network construction will bring extremely large market requirement in the near future. Table 5 shows the market forecast.

Table 5.
2005 Communication Forecast

	2002 subscribers	2005	
		Subscribers	Popularization rate
Telephone	179,000,000	500,000,000	37.5%
Handset	145,000,000	300,000,000	22.5%
Internet	30,000,000	200,000,000	15%

China conceived third generation mobile technology with TD-SCDMA standard (Chinese backed time division synchronous code division multiple access). It is one of three 3G standards approved by the International Tele-communication Union. Commercial handsets using dual mode TD-SCDMA/GSM chipsets will be available in China by early 2004. The ministry of Information Industry has approved "Scheme of frequency Division of 3G Antenna", in which 60MHz symmetric band has

been saved for W-CDMA and CDMA1x and 155MHz non-symmetric three bands has been saved for TD-SCDMA. It means 3G market will start soon in China. 3G technology based on chips level is bottleneck problem in China. Therefore manufacture alliance formed by eight domestic companies, included Datang Mobile Communications (Beijing, China), Guangzhou Soutec (Group) Technology Co. Ltd, Holley Group Ltd, Huawei Technologies Co. Ltd, Legend Group Ltd, Zhongxing Telecommunication Equipment Co., Ltd (ZTE Corporation) and China Putian, has been established in 2002. At same time Philips Semiconductors (Eindhoven, The Netherlands), Datang Mobile Communications and Samsung Electronics (Seoul, South Korea) today (Monday 20th January 2003) formally announced a joint venture company, dubbed T3G, to design and license core chipsets and reference designs for mobile terminals operating on TD-SCDMA 3G standard.

V. Semiconductor manufacture

With the domestic companies increasing their products and companies in telecommunication industry relying less on foreign imports all sectors are expected to benefit substantially. Semiconductor manufacture as a core high technology, such as Integrated circuits, discrete device, grows up with 30% increase in China recently. There are three IC manufacture bases formed in Zhujiang Delta Changjiang Delta and around Bohaiwan Bay. The main technology of IC products is $0.25\mu\text{m}$ - $0.18\mu\text{m}$. Before 2010 China will have second IC market in the world.

Therefore compound semiconductor manufacture meets good opportunity in China also. The research works in GaAs crystal growth; GaAs based and InP based epi-layer growth by MBE and MOCVD; MESFET, PHEMT, HFET discrete devices and MMIC fabrication; LED and LD fabrication with different wavelength

and power have a pedigree dating back to 60s, 70s and 80s last century.

Now these technologies start to transfer to production. There are two 4 inch GaAs lines will open in early 2003 in Nanjing and Shijiazhuang and one GaAs 6 inch line will be under construction in the middle of 2003 in Beijing and another GaAs 4 inch line will be set up in Shenzhen in 2003. There are several LED companies, especially HB-LED appeared. To satisfy these demand there are three companies have established to produce GaAs and InP substrate and two company has set up to produce compound semiconductor Epi-wafers for GaAs based, InP based materials and GaN based HB-LED wafers respectively. In fact research and development of GaAs and InP crystal growth, GaAs based and InP based Epi-wafer growth as well as fabrication of GaAs and InP discrete device (MESFET, PHEMT, HBT, QWIP, Photon detector, LED, LD,) and MMIC have been continue to do for twenty years. Therefore China has their own technological base and personnel resources.

VI. Conclusion

The good economic environment, stable political situation and demand of industrialization and modernization provide historic opportunity for developing compound semiconductor in China.

ACKNOWLEDGEMENTS

The authors would like to thank the people who provide all the useful information to this paper.

REFERENCES

- [1] Telecom Market Vol.2 (2003) in Chinese
- [2] China IT Market Analysis and Forecast 2003