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Analysis on the application and development of microelectronic technology

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Abstract. The advancement of science and technology, as well as the passage of time, have resulted in an increase in the use of high-tech products in our daily lives, with microelectronics playing an important role as a fundamental technology. Today, the microelectronics industry is the world's sunrise industry. China is rapidly expanding its microelectronics industry. Microelectronics technology is one of the world's fastest growing technologies, and it is the foundation of the information industry in the information age. Now, microelectronics technology has become a standard for measuring a country's level of science and technology. This paper, using a method of literature review, focuses on discussing and summarizing the development and application of microelectronics technology in China, as well as providing some possible correct solutions.

Keywords: Microelectronic Technology, Current situation, Application, Development.

1. Introduction

The technology of microelectronics is actually modern physics, particularly the new high-tech technology developed from integrated circuits. In today's information age, the continuous development of various semiconductors, microelectronics technology with integrated circuits as the core has had a significant impact on people's lives and production. Chips have an irreplaceable role and status in the development of the information industry as an important carrier of storage, processing, and information processing. Because chip manufacturing technology is microelectronics technology, microelectronics technology has become a key production factor for the development of the science and technology industry in the new era of information age. However, due to physical law constraints, material constraints, and process technology constraints, the development of microelectronics technology will be limited. This paper uses a literature review to discuss and summarize the development and application of microelectronics technology in China, as well as provide some possible correct solutions. To some extent, this paper still contributes to research in the field of microelectronics and makes some recommendations with reference value.

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2. Current situation and development

2.1. The development of Microelectronics technology

The current state of China's microelectronic integrated circuit industry is primarily reflected in the following aspect, according to China. First and foremost, there is a conflict between supply and demand. According to the General Administration of Customs, the import volume of integrated circuits surpassed crude oil for three consecutive years from 2015 to 2017, totaling more than $250 billion USD, with semiconductor memory accounting for more than 35% of the total. The first imported commodity was integrated circuits [1].

Second, there are international constraints on China's high-end integrated circuit chips. Third, the domestic integrated circuit industry has grown at a rapid pace. For example, from 2012 to 2020, the market size of China's integrated circuit industry increased by an average annual compound growth rate of 19.29%, from 215.850 billion yuan to 884.800 billion yuan. Finally, the effect of domestic integrated circuits on regional agglomeration development is more visible. According to statistics, the integrated circuit industry is primarily distributed in the Yangtze River Delta, the Pearl River Delta, and the Beijing-Tianjin Rim Bohai Sea three regions, with sales accounting for more than 90% of the country's total scale; however, the central and western regions such as Chongqing and Chengdu have also accelerated development [2]. In terms of the development characteristics of China's microelectronics technology, China's ultra-deep sub-micron integrated technology research has approached the international advanced level, the level of integrated circuit design has reached the world's advanced level, and the promotion and application of large-scale integrated circuits in the social field is becoming increasingly widespread. China's chip design level has significantly improved in recent years, with further research and development of microelectronics technology by Chinese researchers, and the range of chip products designed for application has become increasingly extensive, primarily used in CPUs, digital signal processors, high-end IC cards, digital television and multimedia, 3G mobile phones, information security, and other fields.

Among these have been new breakthroughs in the development of core chips with independent intellectual property rights and their industrialization. Traditional microelectronics technology in China is transforming products from "low-end imitation" to "high-end substitution." At the moment, although China has made new advances and breakthroughs in the research, development, and application of microelectronics technology, many core technologies have not yet been fully mastered, and the gap with the international advanced level remains significant, requiring China to strengthen policy support and capital investment in microelectronics technology research and development [3].

2.2. The current limitation of microelectronics and possible solutions

2.2.1. A big technology gap compared with that of western countries. The birth of the transistor in 1947 laid a crucial groundwork for the development of microelectronics technology, and the decade that followed—the 1950s—was also when microelectronics technology formally emerged and experienced its fastest growth. This was quickly followed by the introduction of integrated circuits, which themselves represented a near-innovative step forward, and this, in turn, paved the way for even more rapid advancements in the field until the 1970s. Then came the microcalculator, and now, in the twenty-first century, microelectronics technology is used in many different kinds of high-tech, high-tech equipment, and it has finally made its way into each of our everyday lives, in everything from transportation to communication to entertainment. Currently, the integrated circuit serves as the backbone of microelectronics technology; as the field advances, the degree of integration increases (to the tune of five million times greater precision) and the volume decreases, allowing hundreds of millions of integrated tubes to be gathered on a single integrated film. There are many examples of China's microelectronics technology being at the forefront of its field around the world [4]. This trend began with the reform and opening up of the country, which led to an increase in the domestic level of various technologies. However, China's research and capital investment in microelectronics

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technology is still somewhat lacking, and even some aspects have a huge gap, so that in some aspects will be "stuck neck" by Western countries. China also needs to formulate some relevant policies to support relevant enterprises and retain relevant talents in order to further develop its microelectronics technology.

2.2.2. Current Limitations of Microelectronics technology. There is a limit to how far microelectronics technology can advance; in fact, there are currently three main constraints on the field's ability to advance. To begin with, there are physical constraints; for example, current research and development in microelectronics focuses on increasing the number of integrations on each integrated component chip in order to shrink the size of electronic components and boost their performance, but doing so becomes increasingly difficult as one approaches the limits of physical law. Second, and no less important, is the problem of material constraints; while silicon crystals are widely used, the technology can only advance so far because of its inherent characteristics. Fortunately, thanks to the efforts of scientists and academics, new materials with improved performance have been developed [5]. The third limitation is that of process technology; this limitation has four subpoints. The first is the size of the lithography machine equipment; the lithography machine is an exposure tool; as the most critical process equipment of microelectronic technology, its price is very high and the manufacturing process is very complex; and there are extremely high requirements for precision. This is one of the main justifications. Second, the issue of interconnect leads has become a major process technology limiting factor as a result of the continuing effects of temperature and reaction time on the development of microelectronics technology brought on by the continuous shrinking of the integrated circuit version and the continuing increase in the number of transistors per unit area [6-7]. Furthermore, there is a reliability issue, as with the advancement of microelectronics technology, while the operating efficiency of the device is improved, the life of the device is decreasing, for which some research has also been done [7]. There's also the issue of heat dissipation, which necessitates better packaging technology in order to be resolved. This is because, as integration levels rise, so does the complexity of components' functions, making heat dissipation an increasingly pressing concern. BGA packaging technology, 3D packaging technology, and surface packaging technology are all subsets of the packaging technology field [8].

Microelectronics development is generally characterized by a focus on shrinking the size of the process and increasing the level of integration, but also on maintaining a commitment to research, the active application of new materials, and the resolution of material limitations. More than that, however, the protection of the environment and sustainable development depend on the active development and application of green microelectronics technology.

2.2.3. Possible solutions to development restrictions. First, there is room for enhancement in the production procedure. From the plane distribution of the flat layer to the current multi-functional high-density process of multiple layers, the microelectronics manufacturing technology has come a long way, and it will continue to advance in the direction of multi-function. The artificial superlattice process yields a superlattice semiconductor device, the primary benefit of which is a speed that is anywhere from ten to one hundred times that of conventional silicon semiconductors. It is possible to save money and significantly increase the circuit's stability by reducing the size of the control device in sensitive integrated circuits. Improvements in integration level coincide with advances in lithography technology.

Microelectronic product performance can be enhanced to a greater extent thanks to developments in lens resolution, lithography technology, and the targeted resolution of problems in lithography. Modern integrated circuits will reveal Moore's Law's structure over time, evolving from the traditional two-dimensional integration to the more advanced three-dimensional integration that can bring about a significant advance in integrated circuits. In addition, the future of microelectronics technology is green; this shift is at the heart of the field, and it reflects the way society is shifting its priorities. Microelectronics energy consumption will be effectively managed, and green environmental

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protection will become a driving force in the field going forward, both of which are necessary for China to build a sustainable society [9]. The second is to enhance circuit manufacturing materials.

Currently, oxides like gallium arsenide are being used as conductor materials, which greatly improves the performance of integrated circuits. For example, microelectronic integrated circuits made of indium phosphide as a superconducting material can increase the working temperature of the circuit, speed up the switching speed, and improve its radiation resistance. Finally, microelectronics technology can be developed in tandem with other technologies, strengthening its ties to fields like biotechnology and semiconductor research while also expanding the field's conceptual reach and encouraging long-term growth.

3. Application

A brief summary of the many uses for microelectronics technology can be broken down into four categories: the first is the application of life, which is true and true to each of our lives; for example, today no one can live without their mobile phone, and there are many different types of cards and cards that can be used for various purposes around the home and in smart homes. For instance, in a large city's microelectronic bus stop, the most recent release of a new kind of bus real-time query system, this stop sign is installed on the BRT2 bus platform, a small blue stop sign, is divided into four functional areas, with the role of querying a QR code or a WeChat public number. Swiping through WeChat or QQ on a mobile device is all that's required for passengers to receive up-to-the-minute bus arrival information [10].

Second, it's becoming increasingly difficult to meet society's production needs using the same old, tried-and-true methods of production. This is because the times are always changing and the requirements for industrial production are rising in tandem with demand. Application of microelectronics technology in industrial production, thus bringing industrial production into the modern era, has greatly improved the efficiency and safety of industrial production lines and product safety and adaptability in many areas, including the production of automobiles. This is especially true in the field of automobile manufacturing applications, particularly in the body control system; if a car has been stolen, the electronic prevention and control system can help recover it. Connecting the car's anti-theft system to the owner's smartphone means that the owner will always know exactly where their vehicle is, even if it is stolen [11].

It is precisely the support of microelectronics technology that has strengthened the national military strength, also modernized national defense, and transformed modern warfare into informationized warfare [12]. As the nature of future wars is increasingly expected to be electronic information, microelectronic technology can be used to clarify the location, method, and contact of combat. Microelectronic processors can use their powerful computing capabilities to fit the current environment with appropriate mathematical models in order to achieve the best shooting effect [13]. Such technology can also be used in life-saving medicine, through the development of a wide variety of cutting-edge sensors made possible by microelectronics research and development. The use of biosensors in the medical field is on the rise. Enzyme electrodes are the first and still most common type of sensor used in clinical medicine. Microbial sensors, which use microorganisms with different biological characteristics in place of enzymes, are widely used in many fields, including drug analysis, tumor monitoring, blood glucose analysis, etc [14].

4. Conclusion

Finally, this study discovered that microelectronics technology has a wide range of applications in many aspects of the world and has also advanced rapidly in recent years. However, technology limits the development of microelectronics in some ways, so it can only maintain the status quo and no further technological take-off. So we must now increase our efforts to cultivate microelectronics professionals, and the government and state have increased their efforts to assist microelectronics companies in fundamentally solving technical problems, obtaining more innovation and technology,

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and making microelectronic technology more developed globally. This can benefit both the world and the people.

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