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Research on the application status of microelectronics technology in different fields

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Abstract. The main focus is on the current status of the application of microelectronics in different fields. The current state of research in microelectronics is shown more visually through two experiments with diodes and MOS transistors. Then through its application in integrated circuits and automatic control shows the importance of microelectronics in today's information age, and finally through the prospect of future prospects, rational analysis of the development trend in the field of artificial intelligence, and put forward certain ideas, microelectronics can make artificial intelligence more accurate calculation compared to the larger integrated circuit boards. The aim of this paper is to provide the reader with an understanding of the current state of microelectronic applications and to simulate the actual situation through physical experiments on semiconductors and experiments on microelectronics and integrated circuit processes. It also discusses the application of microelectronics in automatic control, and thus obtains the current status of microelectronics research and future development prospects.

Keywords: diodes, MOS field-effect transistors, automation, microelectronics.

1. Introduction

Since the twentieth century, as automation technology has become more and more sophisticated, the microelectronic technology with which it is affiliated has become more and more diverse and has played a huge role in many fields. The application of microelectronics in automation control examines the automation process of microelectronics. In some areas of mechanical technology systems in which microelectronics form an integrated electromechanical device, tiny dimensions and intelligence and integration are the unique advantages and characteristics of microelectromechanical systems [1]. The rest of the research, microelectronics in automatic control technology, it seems that it can do on the integrated circuit to control the output of some command signals, microelectronics technology in the application of research status, mainly consists of the above part.

It is well known that the development of microelectronics in various fields is closely related to the integrated circuit, without the early research on integrated circuits there would be no relatively mature microelectronics. The first person to introduce the concept of the integrated circuit was Jack S. Kilby in the USA [2], who proposed that this miniature solid assembly of semiconductor components be called an integrated circuit. In the following years, Dr. Moore first introduced Moore's Law in 1965, and it is arguable that the boom in integrated circuits came after Dr. Moore's Law, which suggested that the components on an integrated circuit would grow steadily every 18 months [3]. This has facilitated subsequent research and Moore's Law has guided subsequent development and research in

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microelectronics. This law has been refined to date in the pursuit of greater precision. According to Craig Barrett, former president of Intel, Moore's Law will be valid for at least another 20 years [4]. In this article, the current status of the application of microelectronics in different fields is discussed in more detail than in previous studies, the development of microelectronics and the impact of Moore's Law on integrated circuits are discussed in more detail [5].

The main objective of this paper is to provide the reader with an understanding of the current state of application of microelectronic technology. The aim of this paper is to provide the reader with an understanding of the current state of microelectronic applications and to simulate the actual situation through physical experiments on semiconductors and experiments on microelectronics and integrated circuit processes. It also discusses the application of microelectronics in automatic control, and thus obtains the current status of microelectronics research and future development prospects.

2. Methodology

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2.1. Physical model

Figure 1 shows a three-dimensional structural model of a diode and Figure 2 shows a plan view of a diode. Figure 3(a) shows the three-dimensional structure of a MOS field-effect tube, and Figure 3(b) shows two-dimensional plans of two types of field-effect tubes. From the current level of research, diodes still have a wide range of applications in integrated circuits, and MOS field effect transistors also occupy a large proportion of the current state of research in microelectronics today, which is divided into N-channel types and P-channel types. MOS tubes control the conduction in integrated circuits, and when the voltage reaches a standard, as seen in model Figure 3(a), the g-point will be on, which is MOS tubes are now mainly used in various amplification circuits, impedance transformation and, as mentioned earlier.

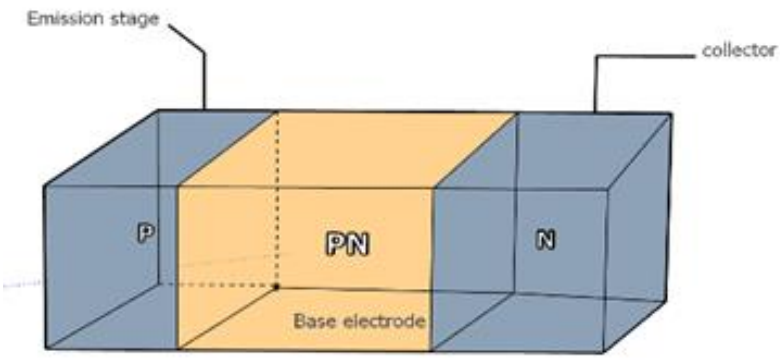

Figure 1. Three-dimensional structural model of a diode.

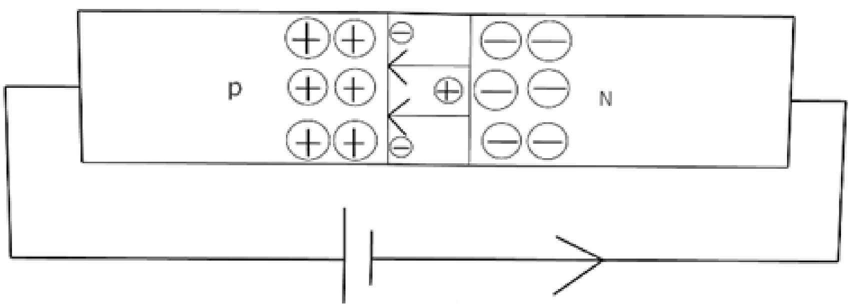

Figure 2. A plan view of a diode.

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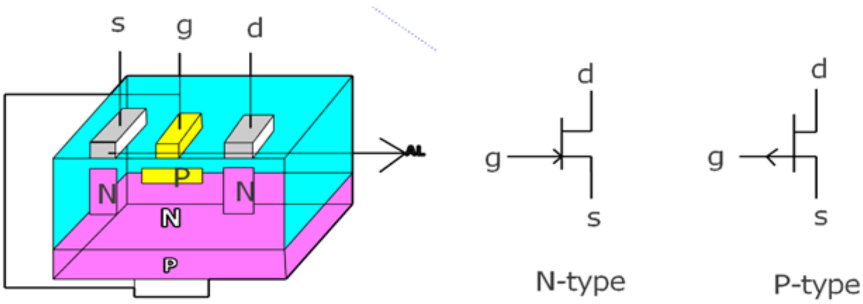

(a) (b)

Figure 3. Overall structure composition of the circuit ((a) Structure of a MOS field-effect tube; (b) two-dimensional plans of two types of field-effect tubes).

2.2. *Experimental principles*

2.2.1. Diode DC parameter test. The aim of this experiment is to become proficient in the use of a transistor diagrammer, to master the various parameters of the secondary DC and to know the effect of temperature on the various parameters of the diode.

In this experiment, the forward and reverse electrical characteristics of the diode are observed and the diode DC parameters to be measured include the forward conduction voltage drop and reverse breakdown voltage of the diode. This experiment requires the use of a transistor diagrammer, which allows visual observation of the diode's various parameters and makes the experiment more convenient. This experiment was carried out with a DW4822 transistor [6].

(1) First turn on the transistor plotter and after preparation connect the diode's forward lead (Figure 4), then adjust the x and y axes of the plotter to anticipate the measured voltage and current range and make the appropriate adjustments. The x-axis can be set between 0.1 and 0.5 V because the diode has a low forward pass voltage drop. The voltammetric curve of the diode is then measured by the grapher (as the diode's forward turn-on voltage is too low, adding 0-5V to the scan voltage is sufficient), simulating the circuit diagram (Figure 5), and the measured voltammetric curve is shown in the Figure 6.

(2) Make the connections for the reverse breakdown characteristics of the diode and then adjust the x and y axes of the grapher, as the reverse current of the diode is small, the scale of the y-axis can be set at a smaller range. Similar to the experimental forward conduction, after connecting the circuit, the voltammetric characteristic curve of the reverse breakdown characteristics can be obtained (Figure 7), Where each major cell of the x-axis represents 5V and each major cell of the y-axis represents 50mA.

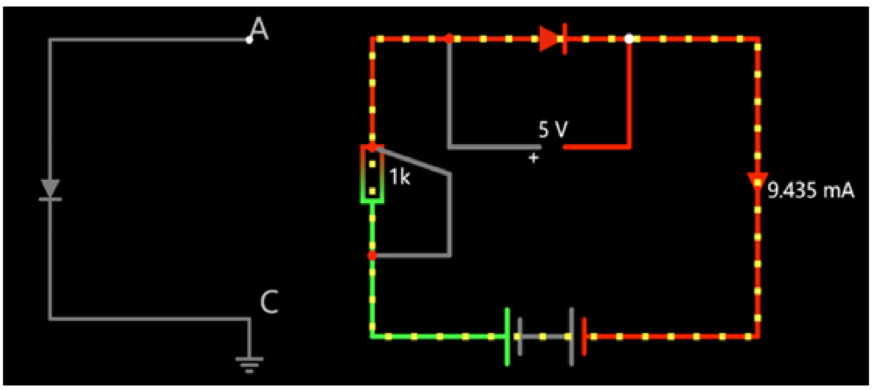

Figure 4. Transistor plotter.

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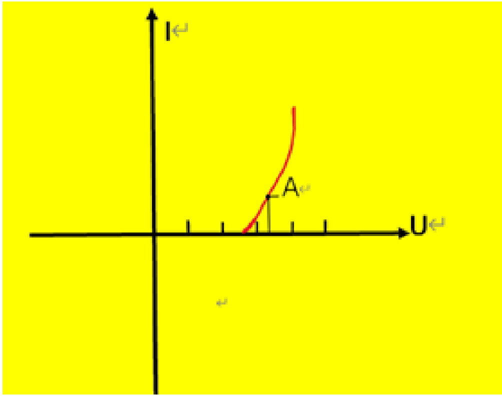

Figure 5. Circuit diagram.

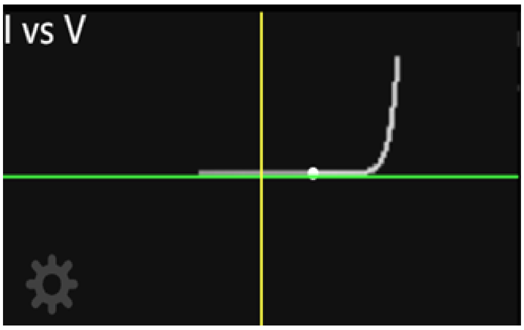

Figure 6. The measured voltammetric curve.

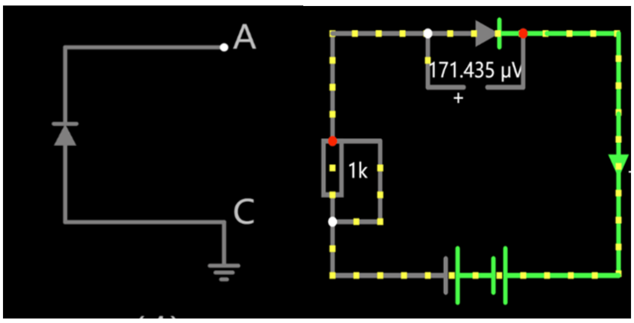

Figure 7. The voltammetric characteristic curve.

(3) Reading of the reverse breakdown voltage. In the reverse breakdown characteristic curve, the voltage corresponding to the turning point where the current increases sharply is the reverse breakdown voltage. The breakdown voltage can also be determined by reaching a certain pre-determined value of the reverse current. It is possible to set a current pre-determined value at which reverse breakdown can be achieved and then find the corresponding reverse breakdown voltage at this current pre-determined value.

(4) Effect of diode temperature on the electrical parameters. By varying the temperature and observing the change in value of the forward drop and reverse breakdown voltage at different temperatures, it can be seen that as the temperature increases, the forward drop decreases and the reverse breakdown voltage remains constant.

2.2.2. MOS field effect transistor DC parameter testing. In order to master the electrical parameters of MOS tubes and the corresponding reading methods, and to master the operating principle of MOS tubes and their differences from BJTs. The principle of the output characteristics of this experiment is similar

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to that of the common emitter BJT, which is tested in the following two-dimensional planar circuit diagram (Figure 8). The voltammetric curves are then obtained by varying the bias voltages at the gate and drain terminals to obtain the voltammetric characteristics of the MOS tube and the various parameters.

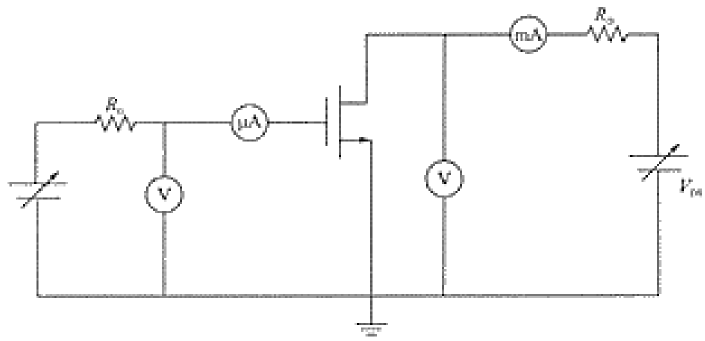

Figure 8. Shows a two-dimensional planar circuit diagram that obtains the volt-ampere characteristics and various parameters of the MOS transistor.

Since there are two types of MOS tubes, N-channel and P-channel, each of which is divided into enhancement type and depletion type, the enhancement type of N-channel and the enhancement type of P-channel were chosen for this experiment.

(1). N-channel enhanced MOS tube (tested with 2N7000 model)

First connect the pins of the 2N7000 with the source to the emitter and the gate to the gate. Since the MOS tube is a voltage contorlled component, the input current is changed to the input voltage for the measurement. For the convenience of this experiment, the base step can be selected as the voltage step. Then gradually increase the voltage to obtain the corresponding voltammetric curve (Figure 9). Table 1 analyzes the V-A characteristic curve parameters of N-channel MOSFET output.

Table 1. Specific analysis of the volt ampere characteristic curve parameters of N-channel MOSFET output.

parameter	Numerical range
Peak voltage	0-80V
X-axis collector voltage	1V/check
Y-axis collector current	0.1A/check
Ladder selection	1V/level

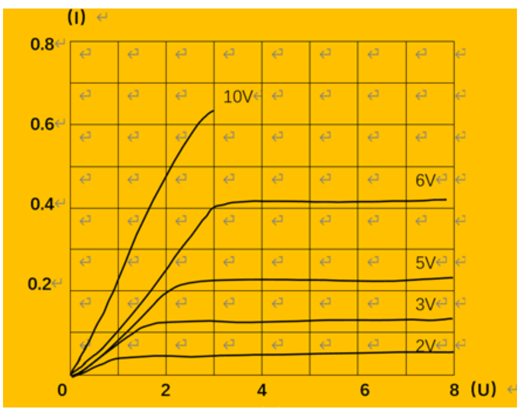

Figure 9. N-channel enhanced volt-ampere characteristic curve [4].

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(2). P-channel enhanced MOS tube (experiments with 2N7000 model).

First connect the pins of the 2N7000, source to emitter and gate to gate. The other steps are approximately the same as for the N-channel type, and the corresponding voltammetric curves are then obtained (Figure 10). Table 2 analyzes the V-A characteristic curve parameters of P-channel MOSFET output.

Table 2. Specific analysis of the volt ampere characteristic curve parameters of P-channel MOSFET output.

parameter	Numerical range
Peak voltage	0-10V
X-axis collector voltage	2V/check
Y-axis collector current	0.2A/check
Ladder selection	1V/level

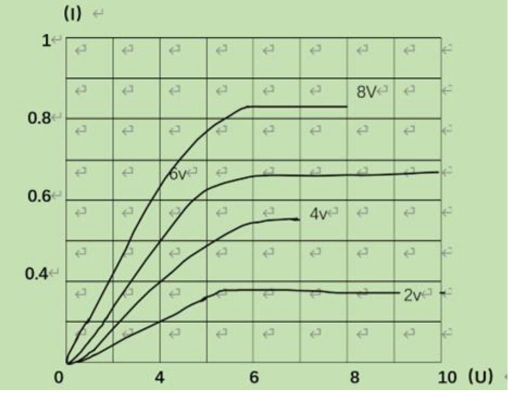

Figure 10. P-channel enhanced volt-ampere characteristic curve [4].

2.3. *Application of microelectronics in integrated circuits*

It can be said that the integrated circuit is included in microelectronics technology, microelectronics technology with the integrated circuit as the core of the development of. 1947 in Bell Labs was born in the world's first transistor, miniature electronic devices to meet its era. This also set the stage for the development of the integrated circuit in the future. In the 11th or 12th year after the transistor was born, Jack Kilby and Robert Noyce [7] invented the integrated circuit, which laid the foundation for the information and data technology of modern society. Since the birth of the integrated circuit, it can be said that a huge industrial transformation has taken place, and since then, microelectronics technology has also entered a phase of dynamic development.

An integrated circuit is a miniature circuit system made up of transistors, resistors, capacitors and other circuit components on a very small wafer. Microelectronics is based on integrated circuits. Transistors are widely used in integrated circuits, including diodes, MOS tubes and diodes, and play an important role in controlling voltages, conducting and blocking, and opening the way for the development of larger scale integrated circuits.

In everyday life, in the military and in industrial manufacturing, the application of integrated circuits is also very large, and the corresponding microelectronics technology is also very widely used. The smart phones and computers used in everyday life all have integrated circuit boards and need the support of microelectronics; in the military, modern drone technology, radar technology, missile positioning systems are also inseparable from the application of microelectronics; industrial manufacturing of some precision parts, remote control of machines for subtle operations are inseparable from the microelectronics technology with integrated circuits as the core. Above all, microelectronic technology has a wide range of applications, and it is needed in today's information age [8]. Improving the precision of integrated circuits and striving for larger scale integrated circuits are the main issues in the field of microelectronics in China today.

2.4. On the application of microelectronics in automatic control

The concept of automatic control today is a branch of cybernetics that arose in the mid-20th century [9], with the basic theory first proposed by Norbert Wiener and Rudolf Kalman. Automatic control has gone through five generations of control systems. In the fifth generation of control systems, it was finally possible to control equipment with some precision, using microelectronic technology to control the equipment, making it much more efficient.

With the continuous development of technology, a new term has gradually emerged for automatic control-modern control. With the further application and development of microelectronics in automatic control, the electronic components in automatic control are becoming smaller and more precise. There are so many electronic components and circuits used in automatic control that it would be easy to make mistakes when stringing together so many components to form a system. The small size of microelectronic wafers not only allows for precise control, but also saves energy and is environmentally friendly.

Moreover, when microelectronics was not used in automatic control technology, if researchers want to add some new features, they need to use several large plugins, which is laborious and time-consuming and the control accuracy will be further reduced, and the creation of microelectronics has solved this problem, a few small chips instead, not only solved the problem of size, but also solved the problem of control accuracy, which can be said to be a multi-benefit.

3. Results and discussion

3.1. Current status of microelectronics research

Today's microelectronics technology also focuses on improvements in materials, dimensions and manufacturing processes. Firstly, the disadvantages of existing silicon crystal-based integrated circuit wafers are gradually being exposed, with peaks in temperature tolerance, operating speed and smoothness of circuit operation, which can be significantly improved by replacing the corresponding silicon crystal with diamond. On 12 February 2000, the University of Essen and the University of Hannover announced that they had jointly developed a germanium semiconductor grown on a silicon plate, which will enable integrated circuits to be switched much faster than silicon integrated circuits. Some progress has also been made in the development of "biochips" using technology that stores information in chemical chains of organic atoms [10]. Secondly, for size improvements, a corresponding increase in usable area could lead to a reduction in cost and, although less accurate, an overall improvement in cost effectiveness. For the improvement of the manufacturing process, the industrial equipment should be upgraded, and some of the existing two-dimensional production equipment for components should be replaced with three-dimensional equipment for better results.

3.2. Prospects for the development of microelectronics in the field of automation

Closer integration with automation, through the more sophisticated control of integrated circuits, to complete some of the higher level of automation instruments, the future can be deeper research into the field of artificial intelligence. Some areas of artificial intelligence, such as Alpha Dog, are extremely intelligent and have a large proportion of integrated circuit chips in their components. In the future, artificial intelligence is definitely a key development in the field of microelectronics [11].

4. Conclusion

In this paper, the current research status of microelectronics technology is studied and the future development prospects of microelectronics technology are appropriately proposed, and the current research status of microelectronics in semiconductors is visualized through the diode DC parameter

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experiment and MOS tube DC parameter experiment. The main working principle of MOS tubes can be obtained through the MOS tube experiment. MOS tubes are now widely used in digital circuits and analog circuits, and are very important circuit components in microelectronics. Secondly, through the application of microelectronic technology in integrated circuits and in automatic control, the benefits of microelectronics technology and some bottlenecks encountered. Finally, through the future prospects of microelectronics technology, microelectronics technology will play an important role in the future of artificial intelligence. In the current outlook on the future, the field of artificial intelligence requires the use of microelectronics technology occupies a large proportion of the application of integrated circuits and automatic control of many, especially for the use of tiny chips. In the future, microelectronics technology will certainly have a unique development and research in the field of artificial intelligence. and secondly, in the field of artificial intelligence robotics, automatic control needs to be more accurate, which also shows that the miniaturization of integrated circuits must be synchronized with the times, the study of smaller chips has become the main problem of microelectronics technology, as well as the main points of future progress. I also believe that the research of microelectronics will become more and more in-depth.

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