THE PLACE OF ELECTRONICS IN EDUCATION AND ITS FUTURE PROSPECTS

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Abstract
This article examines the importance of electronics science today, the development of modern science and technology, as well as the development of electronics and nanotechnology. The importance and prospects of electronics science in teaching in higher educational institutions are also analyzed.

Keywords: Electronics, technology, integration, Nan electronics, element, electronic device, device, nanotechnology, education.

Introduction

Electronics is a science that studies the interaction of electrons with electric fields and the methods of creating electronic devices and devices used in the transmission, processing and storage of information. Electronics is primarily, intended to meet the information needs of human society. Currently, all information transmission, processing and storage devices are used by human society.

The transition to a new method of information transmission has always led to a sharp increase in the productive forces of society. Electronics has dramatically increased the speed and volume of information transmitted over long distances. Currently, one of the most important tasks in the education system is to prepare young specialists who are mature and competitive, highly intelligent and imaginative, in line with world standards. Therefore, the educational process is gaining special importance in terms of both content and style.

One of these is to reflect the innovations in science and technology that are rapidly entering our lives in the content of education. The main goal of the electronics course in the continuing education system is to instill in the minds of students, along with basic knowledge, knowledge of modern electronics. For example, at this time, the field of nanotechnology is gaining importance in the development of any society. In the field of semiconductor low-dimensional current carriers, such branches of science as nanophysics, nanotechnology, Nano-optics and even Nano medicine have emerged and are being, rapidly developed by specialists.

Depending on the composition of the element base, the development of modern electronics can be divided into four main periods:

The first period (1904-1950s) is characterized by the fact that the element base consists of electronic lamps, electron-vacuum tubes and gas-discharge indicators.

The second period (1950-60s) is characterized by the fact that the element base consists of semiconductor devices (diodes, transistors, thrusters).

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The third period (1960-80s) is characterized by the emergence of integrated microcircuits of varying complexity and their element base consists of semiconductor devices (diodes, transistors, thrusters).

The fourth period (since 1980) is characterized by the rapid development of microelectronics, the emergence of large-scale integrated microcircuits, and their small size and extreme economy.

The first stage was created in 1895 by A.S. Popov's invention of wireless telegraphy - radio.

The second stage began in 1906 with the creation of the first active electronic device - the triode lamp by L. de Forest.

The third stage began in 1948 with the discovery of the bipolar transistor, the main active (amplifying) element of solid-state (semiconductor) electronics, by J. Bardeen, W. Brattain and W. Shockley.

The fourth stage began with the creation of devices and systems based on integrated circuits (ICs) and is called the era of microelectronics.

Integrated circuits appeared in the late 60s. Currently, IMS are created in three different constructive and technological ways: thick-film and thin-film hybrid integrated circuits (GIS) and semiconductor integrated circuits.

The first IMS were created in 1958. IMS are compact, lightweight, low power consumption, and high reliability, and are currently being created in three constructive and technological options: thick and thin-film, semiconductor and hybrid. Since 1965, the development of microelectronics has been proceeding in accordance with G. Moore's law, that is, the number of elements in modern IMS is doubling every two years. Currently, ultra-high (UUIS) and gigs-high (GUIIS) IMS are being produced with the number of elements of 106÷109.

In recent years, important practical results have been achieved in non-electronics, namely, the creation of high-efficiency lasers and light-emitting diodes based on heterostructures, which constitute the basic elements of modern telecommunications and information systems; photodiodes, ultra-high-frequency transistors, single-electron transistors, various sensors, etc. The production of Nano electronic OTIS and GYIS microprocessors has been launched.

Nano electronics is the electronics of semiconductor structures with dimensions from 0.1 to 100 nm, and is a logical continuation of microelectronics on the path of microminiaturization. It forms part of solid-state technology based on the latest achievements in solid-state physics, quantum electronics, physical chemistry and semiconductor electronics.

The Royal Swedish Academy of Sciences awarded the Nobel Prize in Physics to scientists J.I. Alferov, G. Kremer, and D.S. Kilby, whose scientific work laid the foundation for modern information and communication technologies by developing fast transistors, lasers, integrated circuits (chips), etc.

Nano electronics is based on the use of scientific and technological methods of nanotechnology.

Nanotechnology is a field of science and technology that deals with the development and production of Nano objects based on the control (manipulation) of individual atoms and molecules, as well as the necessary theoretical and practical tests for this.

The object of nanotechnology is primarily particles called "nanoparticles" with an average size of 12÷100 nm. Nanoparticles are interesting as catalysts and adsorbents. Nanoparticles have interesting properties when interacting with proteins and nucleic acids. Nanoparticles can form a certain system that exhibits new properties on their own.

The following types of nanoparticles are known:

- Three-dimensional objects obtained by detonation of conductors, plasma synthesis, thin film formation and other methods;
- Nano layers formed by molecular and atomic beam epitaxy, gas phase epitaxy, ion deposition and other methods - two-dimensional objects;
- One-dimensional objects - whiskers;
- zero-dimensional objects - quantum dots.

One of the most important issues facing nanotechnology is the self-assembly of nanoparticles, similar to the self-assembly of biopolymers found in nature.

When moving to nanoscale, the properties of matter (the properties of Nano objects) change. First, atoms whose chemical bonds are unsaturated on the surface of nanoparticles have different properties compared to atoms in the bulk of the material. In micro particles, the relative density of surface atoms is negligible, while in nanoparticles it is significant and even high. Second, at sizes smaller than 12 the object of nanotechnology is primarily particles called "nanoparticles" with an average size of 12÷100 nm. Nanoparticles are interesting as catalysts and adsorbents. Nanoparticles have interesting properties when interacting with proteins and nucleic acids. Nanoparticles can form a certain system that exhibits new properties on their own.

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When moving to nanoscale, the properties of matter (the properties of Nano objects) change. First, atoms whose chemical bonds are unsaturated on the surface of nanoparticles have different properties compared to atoms in the bulk of the material. In micro particles, the relative density of surface atoms is negligible, while in nanoparticles it is significant and even high. Second, at sizes smaller than 12 micrometer, the classical theory of electrical conduction is incorrect, and since the size of nanoparticles is smaller than the mean free path of electrons, Ohm's law is violated. The motion of electrons becomes ballistic. Thirdly, various quantum-scale effects are observed in nanostructures, which are related to the quantum nature of electron motion and the small size of nanostructures close to the de Broglie wavelength $\lambda=h/(\mu v)$., the classical theory of electrical conduction is incorrect, and since the size of nanoparticles is smaller than the mean free path of electrons, Ohm's law is violated. The motion of electrons becomes ballistic. Thirdly, various quantum-scale effects are observed in nanostructures, which are related to the quantum nature of electron motion and the small size of nanostructures close to the de Broglie wavelength $\lambda=h/(\mu\nu)$.

Microelectronics has been developing in accordance with Gordon Moore's law for the past half-century, reducing the size of IMS elements. In 1999, microelectronics overcame the 100 nm threshold of technological separation and became Nano electronics. Currently, the 45 nm technological process is widespread. It is worth noting that this process is based on optical lithography.

Traditional methods of creating microelectronic devices (IMS), such as the planar process, may reach their economic, technological and intellectual limit in the next 10 years, while an exponential increase in costs is observed with a decrease in the size of devices and an increase in the complexity of their structure. The problem must be solved at a new qualitative level using nanotechnology methods.

In MDYA transistors, SiO2 is traditionally used as a gate dielectric, when switching to 45 nm technology; the dielectric thickness becomes less than 1 nm. In this case, the leakage current through the gate increases. The energy dissipation on the surface of 1 cm2 of the crystal reaches 1 kW. The problem of current leakage through a thin dielectric is solved by replacing SiO2 with other dielectrics with a large dielectric absorption coefficient ε, for example, hafnium or zirconium oxides with $\varepsilon\sim20\div25$.

In the future, when the transistor channel length is reduced to 5 nm, quantum phenomena in the transistor will begin to have a significant impact on its characteristics, and in particular, the tunneling current between the source and the source will increase the energy dissipated on the surface of 1 cm2 to 1 kW.

It should be noted that the achievements of planar technology in the creation of modern processors, memory devices and other digital IMS have made it possible to create working elements of IMS with dimensions of 90 nm, 45 nm and even 28 nm, which is now considered by many researchers because of the application of nanotechnology.

CONCLUSION

Nowadays, automation of production control systems is mainly solved using electronic devices. This requires that our graduates with higher education, regardless of their specialization, have sufficient knowledge and training in electronics in order to successfully solve problems in various fields.

Presenting the above information to students when studying the topics of electrical conductivity of semiconductors in electronics will lead them to understand that it is necessary to study these topics, and that this knowledge will play an important role in studying the electrical conductivity of Nano-sized semiconductors in the future. In addition, students will realize that the science of electronics is constantly developing and its great importance for the development of humankind.

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