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Study of the Technology of Obtaining Thin Films in the Field of Microelectronics

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Abstract: This article gives information about the field of microelectronics, its historical formation, several complementary directions of microelectronics, integral electronics, vacuum integrated circuits, functional microelectronics and the production of thin films and the study of their properties.

Keywords: Microelectronics, integrated electronics, vacuum integrated circuits, functional microelectronics, thin films, thin surface.

First of all, before commenting on the topic, I think it would be appropriate to dwell on the field of microelectronics.

Microelectronics is the field of electronics that deals with the creation of electronic nodes, blocks, and devices in the form of very tiny integral devices. This field emerged in the 60s of the XX century. Solid state physics is the foundation of microelectronics.

Some devices use several thousand specially designed electronic lamps, transistors, capacitors, resistors, transformers and others. As a result of welding or assembling them, huge rough devices appeared. With the creation of print assembly, micromodule, integrated circuit, these shortcomings were almost eliminated.

Microelectronics can be divided into several complementary disciplines: integral electronics, vacuum microelectronics, optical electronics, and functional electronics.

Integrated electronics are the most widely developed. The emergence of this industry has made it possible to microminiature (dwarf) radio electronic devices. Integrated circuits (micro schemes) are used in both computing and space systems, as well as in household appliances. Semiconductor integrated circuits were created in 1959-1961. Such integrated circuits have a high degree of integration (up to 10,000 and more elements in a single semiconductor crystal).

Improving the technology of production of active (diode, transistor) elements in the plates of semiconductor materials through the transition to the method of group preparation, the development of printing assembly technology and technology for the creation of passive microminiature components, this, in turn, led to the development of film integrated circuits.

In addition to semiconductor and film integrated circuits, mixed integrated circuits are prepared. The degree of integration of a mixed integrated circuit is close to that of a semiconductor integrated circuit. Later, vacuum integrated circuits were developed and a new direction was created - vacuum electronics.

Vacuum integrated circuits can be manufactured in the form of a film integrated circuit in which all components are vacuum-mounted devices and suspended microminiature electrovacuum devices.

Such an integrated circuit has a high durability. All integrated circuits are divided into numerical (logical) and linear types, depending on the performance characteristics. Digital integrated circuits are designed for use in computers, while linear integrated circuits are mainly designed to convert electrical signals (amplification, modulation, etc.) into linear quantities.

Microelectronics has developed in two main directions:

1. increase the level and density of integration of integrated circuits,

2. Search for new physical principles and phenomena to create electronic devices for circuitry or system engineering.

This field is generally called *functional microelectronics*.

The creation of integrated circuits, microprocessors, ultra-high frequency detectors, solar cells, lasers, electronic computers and ultra-high memory systems and other unique electrical devices, which are the products of modern electronics, is a thin and ultra-new feature. requires the creation of thin multi-component layer systems. Therefore, in

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recent years, there has been a sharp increase in attention to the technology and physics of the formation of thin and ultra-thin layers. In addition, work is underway around the world to obtain and study the properties of films that form the basis of nanoelectronics, with a thickness of a few nanometers (1nm = 10-cm).

Such films can be used for the production and multiplication of active and passive elements for the fields of nanoelectronics and optoelectronics. Today, three-dimensional systems have been developed that can accommodate hundreds of thousands of millions of elements based on 1 cm thin films. The formation of thin layers that can be used for the desired purpose, the study of their composition, crystal and electronic structure, physical and chemical properties, determines the importance of science. The use of the obtained thin films as a tool reflects its application in the national economy and technology.

The formation of a thin layer is mainly carried out by vacuum evaporation, molecular light epitaxy, solid phase epitaxy, ionization and other methods.

At the heart of these methods is a principle: the atoms of the desired material are transferred to the surface of the base, then a film with a specific property is formed by treating the system with temperature, laser light, electrons or ions. It is known that there are several ways to study the electrophysical and photoelectric properties of semiconductor devices and solar cells.

Molecular light epitaxy studied the electrophysical and photoelectric properties of thin silicon films grown on various monocrystalline substrates, including capacitance, darkness, and light volt-ampere characteristics, sensitivity to spectral light, and other properties. For this purpose, to study the electrophysical and photoelectric properties of p-n structures, methods were used to determine the darkness and light volt-ampere characteristics of the samples and their sensitivity to spectral light.

It should also be noted that nanotechnology is a transition from working with substances to the control of individual atoms: in nanoscale, the state of many mechanical, thermodynamic, magnetic and electrical properties of matter changes. For example, gold nanoparticles differ from bulky gold particles in their catalytic, phrenomagnetic, rectifying optical properties, and ability to self-assemble.

They absorb and scatter light well, are non-toxic, chemically stable, and biomass. In their intensive staining (glare), visual and biomedical objects are now used for detection, quantification. Gold nanoparticles are promising in the development of all types of instruments, from diagnostic tools to various types of sensors, optical fiber and computer nano schemes.

Due to these properties, the easy-to-understand universal object model with the basic methods and concepts of gold nanoparticles can play a convenient role in introducing nanoparticles.

The management of modern technical systems and tools and the development of science and technology are closely linked with the training of qualified specialists in the field of microelectronics, one of the leading branches of electronics, and emerging nanoelectronics.

There are traditional methods of obtaining thin films and studying their properties, which have been used since the 70s of last century.

The thickness of the films obtained by these methods is usually from a few microns to tens of microns, they are still used successfully in solid-state electronic devices today.

By now, thin ($d \approx 10^2 \div 10^3$ nm) and very thin ($d<100$ nm) films can be generated by modern molecular light epitaxy (MNE), solid phase epitaxy (QFE), ion implantation, and the most advanced (nanoassembler) methods of obtaining films.

Modern film-making is mainly carried out under very high vacuum conditions, use of well-cleaned bases and atomic (molecular) sources, perfection of films (high flatness, homogeneity, smoothness, monocrystalline) is radically different from the old (tradistion) methods.

Nanoelectronics is currently evolving, meaning that electronics are tens of nanometers thick (1 nm = 10^{-9} m) underway to use existing films. Such films can be placed on top of each other, layer by layer and used to form active and passive elements. Science and technology are evolving to create three-dimensional systems. In such systems 1 sm^3 hundreds of thousands to millions of thin-film elements can be placed in size. Integrated circuits based on them are debated in *large and ultra-complex circuits*.

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In conclusion, while the study of the *formation of thin films*, their composition, crystal and electronic structure, physical and chemical properties, which can be used for the desired purpose, determines the importance of science, the use of the obtained thin films as a tool reflects its application in agriculture and technology.

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