THE INFLUENCE OF SEMICONDUCTOR MATERIALS AND DEVICES ON THE BASIS OF ENERGY SAVING

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Annotatsiya: maqolada yarim o‘tkazgich materiallarining energiya tejamkorlikka ta’siri ko‘rib chiqilgan. Yarim o‘tkazgich materiallarning asosiy xossalari va ularning fizik, kimyoviy, texnik parametrlari bayon qilingan. Shu bilan birgalikda yarim o‘tkazgich materiallarning muqobil energiyada foydalanish, ulardan foydalanib tayyorlanadigan elektr qurilma va jihozlari haqidagi ma’lumotlari tahlil qilingan.

Kalit so‘zlar: yarim o‘tkazgich, elektr, kremniy, germaniy, fotorezistor, fotoelementlar, quyosh batareyalar, diod, tranzistor.

Аннотация: В статье рассматривается влияние полупроводниковых материалов на энергоэффективность. Описаны основные свойства полупроводниковых материалов и их физические, химические и технические параметры. Кроме того, была проанализирована информация об использовании полупроводниковых материалах в альтернативной энергетике, электрических устройствах и оборудовании.

Ключевые слова: Полупроводник, электротехника, кремний, германий, фоторезистор, фотоэлементы, солнечные элементы, диод, транзистор.

Abstract: The article discusses the impact of semiconductor materials on energy efficiency. The main properties of semiconductor materials and their physical, chemical and technical parameters are described. In addition, information was analyzed on the use of semiconductor materials in alternative energy, electrical devices and equipment.

Keywords: Semiconductor, electrical engineering, silicon, germanium, photoresistor, photocells, solar cells, diode, transistor.

It is no coincidence that today the whole world pays special attention to the use of alternative energy sources. This is primarily due to the growing demand for fossil fuels, as well as the negative impact of harmful gases on the environment. In this regard, it is well known that the use of alternative energy is now a cost-effective and efficient way. Biogas technology, wind, water and solar are the main sources of alternative energy production. $567 * 10^{23}$ J of energy falls from the Sun to the Earth in a year. Given that our country has 300 days of sunshine most of the year, it is clear that our chances are very high. It should be noted that the Presidential Decree "On measures to further develop alternative energy sources" is a program to accelerate the work in this direction.

Of course, in today's fast-paced world of engineering and technology, the demand for electrical materials is growing. Semiconductor materials are widely used in this field, along with dielectric and conductive materials. Semiconductor materials include silicon, germanium, phosphorus, arsenic, sulfur, selenium, tellurium, and iodine. Semiconductor chemical compounds are SiC, InSb, GaAs, GaP, InP, InAs, GaSb, CdS, CdSe, PbS. The most common semiconductor complexes are tyrite-clay soil-bound SiC seeds and silite-liquid glass-bound SiC seeds [1].

Semiconductor materials can be crystalline or amorphous, solid or liquid. Most semiconductors form a crystalline solid. Despite their differences in structure and chemical composition, all semiconductor materials can dramatically change their electrical properties as a result of external energy influences [1].

In semiconductor diodes, the p-n junction can be in the form of a welded contact between two semiconductors of different conductivity, or in the form of a contact between a semiconductor wafer and a metal triple. In the first case, the contact surface of the two semiconductors is formed. Such diodes are called flat surface diodes. In the second case, a 2×2 mm semiconductor wafer (germanium or silicon) touches the end of a thin metal wire. Such diodes are called point contact diodes. They have a very small p – n junction and are used at high frequencies.

Let's take a look at some of the features of semiconductors.

The conductivity of some semiconductors (such as selenium) can change dramatically under the influence of light. This is because the wavelength of a certain amount of light gives the semiconductor electrons enough energy to be released freely. This dramatically reduces the resistance of the semiconductor. This property of the semiconductor is used to create photoresistors - devices that are sensitive not only to the visible part of the spectrum, but also to infrared light.

When a semiconductor is partially illuminated, with illuminated and unlit areas on its surface, the photo-E.YU.K. appears. This phenomenon is used to create sources of electricity: photocells and solar cells. Solar batteries convert solar energy directly into electricity.

Some semiconductors (such as silicon) change their electrical resistance dramatically when exposed to pressure (tensor-resistance effect). This property of semiconductors is used to make sensitive pressure gauges.

Because semiconductors have two regions with different temperatures, the free charges move from the heated part to the cold part. For example, if the current carriers are electrons, they will move to the cold region and charge it with negative electricity. The heated part of a semiconductor loses some of its electrons and becomes positively charged. As a result, between the hot and cold parts of the semiconductor, the thermo-E.YU.K. occurs. This phenomenon is used to create thermocouples and thermogenerators that convert heat energy into electrical energy.

In the middle of the last century, a semiconductor device was developed that could act as a transistor - an electronic lamp. It had a non-homogeneous semiconductor with two p-n junctions. The r-n junction is one and a half micrometers thick. This means that the transistor can be very small. Modern complex electronic devices, such as personal computers, consist of millions of diodes and transistors.

They are made at the same time on a single sheet on the surface of a single semiconductor crystal. Integrated circuits (IC) are obtained by electrically connecting transistors. Silicon is widely used in the manufacture of IC. In some cases, gallium arsenide and phosphide and other semiconductor compounds are also used [3].

Today, the role of semiconductors in the efficient use of solar energy is invaluable. Of these chemical elements, silicon and germanium are the most common in our country, and silicon is the most widely used substance in the manufacture of semiconductor devices and systems. It ranks 14th in the Periodic Table of the Elements. It has an atomic weight of 28, a maximum valence of 4, a melting point (at normal pressure) of 1414 ° C, a density of solid silicon of 2.33 g / cm^3, and a dielectric absorption dust of $\varepsilon_r = 11.7$ diamagnetic.

In nature, silicon occurs only in the oxidized state. Technical silicon is obtained by the reduction of silicon dioxide (SiO_2) in an electric arc. This silicon has a content of 1% and cannot be used as a semiconductor. It is the first raw material for the production of pure silicon semiconductors. The output percentage of a suitable semiconductor device depends mainly on the degree to which the semiconductor is cleaned of foreign matter. Most semiconductor devices (transistors, diodes) use specially refined monocrystalline materials. Photoresistors use thermistoric amorphous substances.

Silicon is used in more industries than germanium because silicon-based semiconductor devices have a high operating temperature of 130–200 ° C and germanium-based semiconductor devices have a high operating temperature of 80–100 ° C. It is also used in radio electronics in integrated semiconductor circuits.

Silicon production is currently in full swing.

Many inorganic and organic semiconductor materials with monocrystalline and polycrystalline structures are used in electrical engineering, mainly germanium, silicon, selenium and silicon carbide. They are widely used in the manufacture of semiconductor devices.

Silicon and germanium are diamond-shaped semiconductors because they have a crystalline structure similar to a diamond. It is a cube with carbon atoms at the ends and centers of its edges. In addition, four of the eight small cubes (octants) also have carbon atoms at their centers (a large cube is divided into eight small cubes).

Germanium. There is not much germanium in the earth, only $7 \cdot 10^{-4}$%. In chemical processing, germanium tetrochloride is formed, and in the next step, a white powder of germanium dioxide (GeQ_2) is obtained. It is grayed in a hydrogen furnace at a temperature of 650-700°C. The technology is often derived from atmospheric sulfur fumes ($GeCl_4$).

Germanium (Ge) is an element of the fourth group of the Mendeleev periodic table. Zinc and sulfide ores are the primary raw materials for its production. As a result of complex chemical processes, germanium alloys are obtained, but they can not yet be used for the manufacture of semiconductor devices, because they contain a mixture and do not have a single crystalline structure [4].

Initially, this is cleaned of impurities by the casting zone liquefaction method. The content of impurities in the cleaned semiconductor material should not exceed 10^{-6}-10^{-30}%.

The monocrystalline structure is liquefied in a vacuum or in an inert gas atmosphere to obtain germanium. A donor or acceptor is added to the dilute pure germanium to obtain p-or r-type electrically conductive germanium. The pure monocrystalline germanium is then drawn from the liquid at a certain speed in the form of a single cylinder of the desired diameter. Germanium is a light silver color with a density of 5320 kg / m^3 and a liquidus temperature of 937.2 ° C. The electrical characteristics of unalloyed refined germanium are as follows: specific electrical resistance p = 60–68 Om·cm; 6 = 16.3. The almond varieties of germanium with n-type electrical conductivity have p = 0.003–45 Om·cm, and the electrical conductivity of p-type alloys has p= 0.4–5.7 Om·cm. All varieties of Germanium are very hard and brittle.

Germanium is widely used in the manufacture of diodes and photocells.

More recently, photoelectric cells have been made in the form of thin films from amorphous silicon, cadmium-telluride, or copper-indium-selenium. Their efficiency is about 8%, but they are cheaper to make than photovoltaic cells made of mono or polycrystalline silicon. Currently, research is being conducted to increase the efficiency of photocells by 30-60%. To do this, you need to stack the films 4 - 8 times on top of each other. As a result of these studies, the capacity of the device will be increased and the cost of production will be sharply reduced. The photovoltaic system generates direct current and converts direct current into alternating current using an inverter.

Photo effect is an instantaneous process. The electron comes out of the metal surface instantly. This regularity of the photoelectric effect was the second problem of classical physics. The third problem for classical physics was that the electrons emitted from the metal surface depended only on the frequency of the incident radiation. Because in the arsenal of classical physics, there was no idea that energy depends on frequency. These three problems of the photoeffect have challenged classical physics theory. It was impossible to explain the phenomenon of the photoelectric effect within the framework of classical physics. It takes a new imagination, a new idea, a new understanding to explain this phenomenon. **A.**Einstein was the first to suggest that the photoelectric effect could be explained on the basis of Planck's hypothesis. Based on the above, Einstein completely explained the phenomenon of the photoeffect.

The photon theory of light confirms that the photoelectric effect is a corpuscular phenomenon, in modern parlance, a quantum phenomenon. The process of photoelectric effects plays an important role in the study of quantum physics. Solar cells (photocells) are mainly made of semiconductor materials. Therefore, knowing the optical and photoelectric properties of a solar cell requires studying the structure of semiconductor materials, their differences from metals and dielectric materials, and the properties that are directly fundamental to semiconductor materials [5].

The design of common silicon-based solar cells is formed by the close connection of p and n - materials of opposite types. The transition area (boundary zone) between p and n-type materials within a semiconductor material is called the electron-hole or p-n junction. In the case of thermodynamic equilibrium, the Fermi level, which determines the equilibrium state of electrons and holes, must be the same in the material. This condition creates a double charge layer in the p - n transition region, which is called the volumetric charge layer, and the corresponding electrostatic potential appears. The optical radiation incident on the surface of the p-n structure forms electron-hole pairs whose concentration decreases perpendicular to the p-n transition direction from the surface to the material. If the distance from the surface to the p - n junction is less than the penetration depth of the beam (from 1G‘ά), the electron pair is also formed inside the p - n junction. If the p - n junction is at a distance of or less than the diffusion length from where the pair is formed, the charges can be separated by an electric field as a result of the diffusion process reaching the p - n junction [6]. The electrons pass to the part of the p-n junction where the electron is present (n-part), and the holes pass to the p-part. At the electrodes (contacts) connecting the outer p and n fields, a potential difference is formed, as a result of which an electric current begins to flow through the connected load resistor [7,8].

A number of conditions must be met for solar cells to work effectively:

- the optical absorption coefficient of the active layer of the semiconductor must be large enough to compensate for the absorption of most of the sunlight energy within the layer thickness limit;

- the electrons and cavities generated in the illumination must be efficiently collected at the contact electrodes on both sides of the active layer;

- in a semiconductor transition, the solar cell must be high enough;

- the total resistance (excluding voltage resistance) connected in series with the solar cell must be small to reduce the power of the power stabilization (Joule heat) during operation;

- the thin coating structure should be cohesive across the entire active area to reduce shunt resistance and eliminate the effect on element characteristics.

In short, the most efficient way to obtain energy today is solar energy, and the role of semiconductors silicon and germanium in its use is invaluable. Today, the total potential of solar energy is 99.97% of the total renewable energy potential studied so far. Our country has enough experience in the use of solar energy. These experiments suggest that pursuing a policy of “greening” through the use of non-conventional renewable energy sources will reduce the share of hydrocarbons in total electricity generation to 50% by 2050.

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