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TO STUDY THE ELECTROPHYSICAL PROPERTIES OF CDTE LAYER ON SILICON BASE AND THE EFFECT OF CREATED HETEROSTRUCTURE ON MOISTURE

I.B. Sapaev
"Tashkent Irrigation and Agricultural Engineers Institute"
National Research University

B. Sapaev
Tashkent State Agrarian University, Ph.m.s.d., Professor

A. Abduraxmonov
Institute of Telecommunications and Informatics of Turkmenistan

N.N. Abdusattorov
Master's Degree of the National University of Uzbekistan

Annotation

In this article, we are talking about semiconductor materials science, creating heterostructures based on cadmium telluride films obtained on a Si substrate and obtaining contacts on the created system. The morphology of the obtained films, the number of elements in the films, their distribution, and the size of polycrystalline particles were studied using modern instruments. The change in the volt-ampere characteristics of the obtained heterostructures depending on the humidity has been studied.

Keywords: materials science, semiconductor, fundamental, metals, silicon, mechanical engineering, cadmium tellurium, solid solution, technology, vacuum electronics, moisture, sensor, epitaxial layer, diffusion

Introduction

At present, in the field of semiconductor devices, there are mainly basic materials such as Silicon (Si), Germany (Ge), and semiconductor compounds A^3B^5 and A^2B^6, for example arsenid galliy (GaAs), phosphid galliy (GaP), antimonid indium (InSb), cadmium telluride (CdTe), cadmium sulphide (CdS) and a number of other compounds and their solid solutions are being used. In some cases, it is possible to replace them with one – with the other, but in a number of cases there is no possibility to replace them with another.

At this time, while the study of the possibilities and properties of some solid solutions is in its initial state, theoretically, some classes of semiconductor solid solutions, which are said to be practically (by experience), were not taken at all. From this it follows that until now, in order to perfect certain semiconductor solid solutions, their method of cultivation and facilitate the management of their physical properties - simplification, as well as to clarify new areas of application, solid solutions with semiconductor properties izlash are considered an incredibly relevant direction.

It is also worth noting that the compounds A^3B^5 and A^2B^6, as well as the solid solutions obtained on their basis, are considered relatively expensive materials.

Proceeding from the above, the interest of the researchers at the next moment is focused on the study of volumetric and pleural heterostructures, consisting of various semiconductors.

Basically, this interest will undoubtedly be of great importance if these heterostructures are based on Silicon (Si), On which the technology of obtaining and electrophysical and photoelectric properties have been sufficiently studied. The field of application of plyoncal and volumetric semiconductor heterostructures is the creation of a variety of sensors [1-4] for example, there may be moisture sensors that monitor the environment or agricultural products in the process of cultivation or storage, respectively.

Relevance of The Topic

One of the future bright – looking materials in creating semiconductor devices (nuclear radiation detectors, photoconductors and generally different sensors) within A^2B^6 compounds is cadmium telluride and cadmium sulphide. From the point of view of the physics of the semiconductor solar elements, Si-CdTe, Si-CdS systems – pleural heterostructures – are of particular importance as a new object of study. It is worth noting that silicon is the most common element in the Earth's crust.

Currently, the technology of obtaining and cleaning silicon is well developed, so silicon is the main material for the microelectronics and electronics industry. Combining the advantages of the semiconductor properties of cadmium telluride and cadmium sulphide with silicon is an urgent task, in particular, the creation of heterostructures with an ideal Diapason diagram between cadmium telluride, cadmium sulphide and Silicon opens up new opportunities in semiconductor instrumentation.

The Experimental Part

Obtaining a wide class of compounds and solid solutions of silicon-based semiconductor materials undoubtedly plays an important role in semiconductor physics and semiconductor instrumentation.

Therefore, in this study, it is aimed at obtaining a layer of Telluride cadmium film at a pressure of ~ 10^{-4} Torr using the method of throwing in a vacuum into a poly - and mono crystal silicon base of different types and creating a heterostructure on its basis. The thickness of the base is 350 – 400 microns [5-6].

In Silica analysis of the CdTe layer was carried out and electrophysical and photoelectric properties, moisture sensitivity studies were conducted and results were analyzed.

Technological conditions for the cultivation of the Telluride cadmium layer in a vacuum to the silicon base (the temperature of the source to which the base and the throwing is required, the temperature interval, the intermediate distance between the base and the source, the ratio of the source and the legalizing primes material and other parameters) were determined by the experimental method. Prior to the cultivation process, Poly - and Silicon diapers were subjected to appropriate mechanical and chemical treatment. So, as a base, both n-type and p-type silicon soles were used.

For this situation, the semiconductor serves as a component of Silicon diapers (poly - or mono - silicon), heterostructures and semiconductor devices based on them.

For this reason, the inter-phase silicon base and the A^2B^6 joint layer formed in the process of growth will be particularly important in relation to the section boundary (transition area), the silicon base and the growing layers, that is, it will determine the subsequent characteristics of the extracted layers.

From a practical point of view, the use of Si-CdTe - heterostructure is considered to be a promising system in the creation of various semiconductor devices and devices, including moisture sensors, in a broad sense, according to our assumption.

The structural distribution of chemical elements on the surface of the resulting layer surface was investigated. The analysis was carried out using EDS LINK ISIS (energy – Dispersion spectrumometri) at microanalyticeksieksi Jeol – JXA – 8900, measuring error ±2%. S'yamga condition V=20gv, I=10nA. Etalons net Hale Si, Te and Cd. The results of the measurements and the microfotographs are presented in picture 1.

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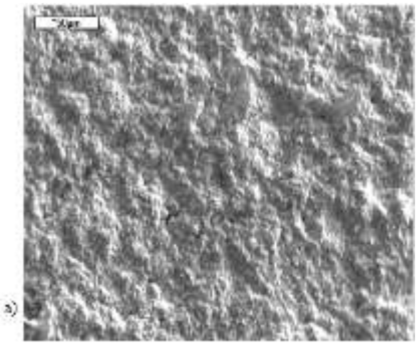
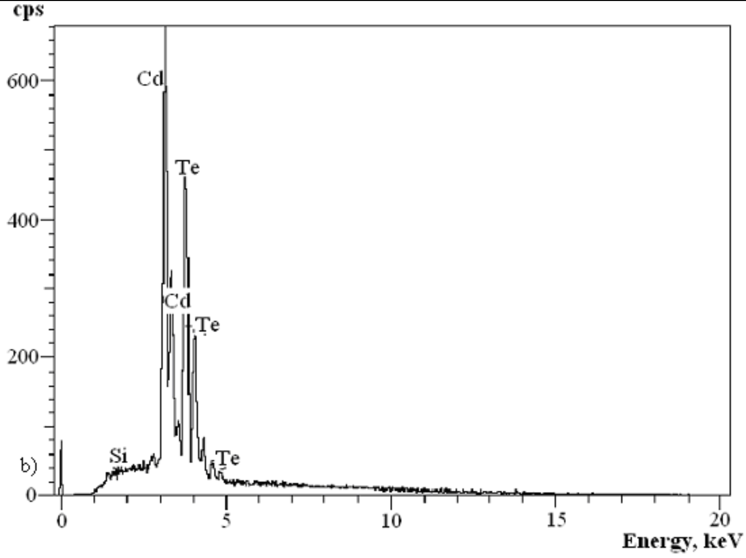
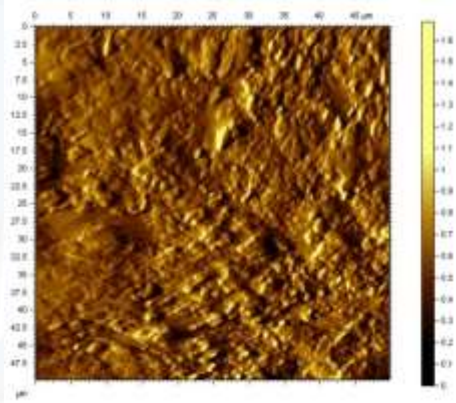
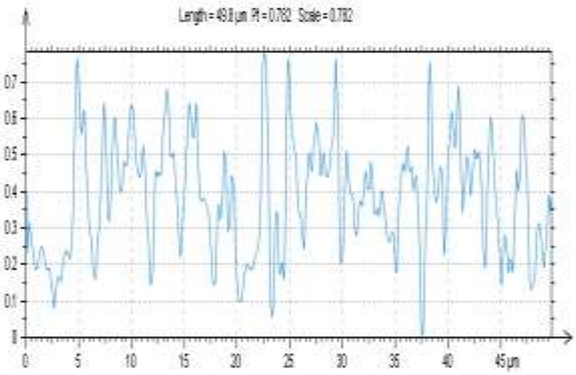
	
1a-picture. Microfotography of the layer surface	1b-picture. Distribution spectrum of layer elements by surface obtained from measurements

For the purpose of a clear understanding of the obtained layers, “Agilent Technologies 5500 AFM – Mode III – komplekt BA210” atomic power microscope shows the surface of the layer, the relief appearance obtained by the side of the layer, 3D photography and the dimensions of the polycystallic particles in the layer and the results of their distribution studies (picture 2).

	
2a-picture. Topography of polycrystalline film grown on Si-base (view from above)	2b-picture. Relief view of polycrystalline film on the side, which is grown on the Si-base

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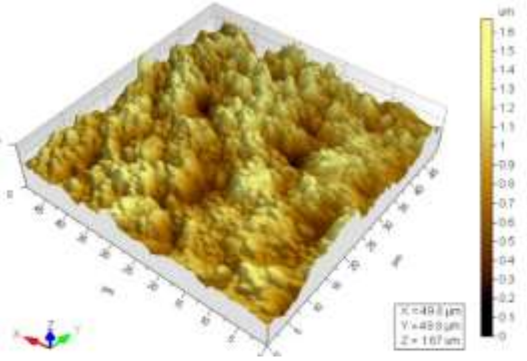
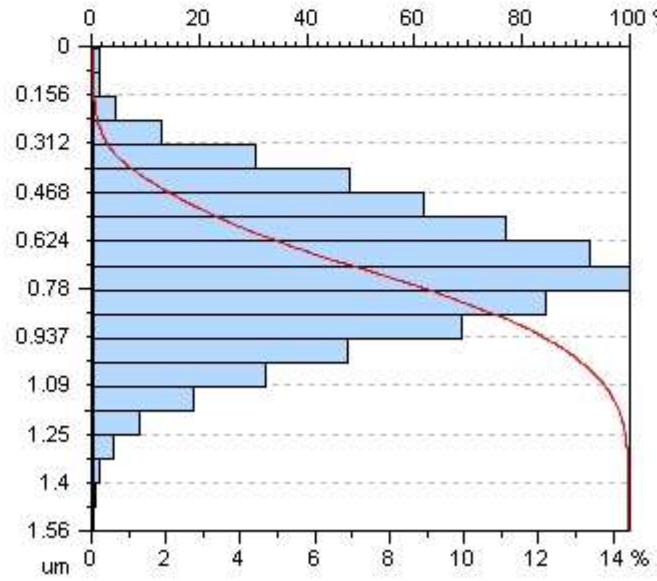


2d-picture. 3D view of polycrystalline sheet grown on Si-base



2E-picture. Distribution of the size of grown polycrystalline grains (the largest size is 780 nm)

Measurements were made on several points. From the measurements conducted on the dependence of chemical elements on the thickness of the layer, one can see that the conducted in all directions, the results from the measurements are almost the same, the average deviation is not more than 5%.

The results of the tests carried out show that in the transition layer a solid solution of Silicon – Telluride cadmium is formed in an area of thickness equal to 3 – 4 microns. In the process of layer growth, tellurium is diffused into the ~1,0-1,5 µm surface layer of the silicon base. In turn, the epithelial layer with a thickness of ~ 1 – 1.5 µm thick is also diffused. This phenomenon is due to the fact that in this case, the silicon base and the crystal lattice of the growing layer and other physico – chemical parameters are mutually coordinated, which subsequently leads to the growth of the CdTe - layer into the Si - base.

The obtained heterostructure was measured in volts – Ampere characteristic and sensitivity to moisture. to the p-Si-pCdTe - heterostruktura, a Shotki barrier (Barer Shottki) was created on account of the launch of indium in a vacuum (Figure 3). Strong legirled 500Å layer, CdTe-layer was taken over. In this case, the Si-CdTe temperature was kept in the range of 90-120°C.

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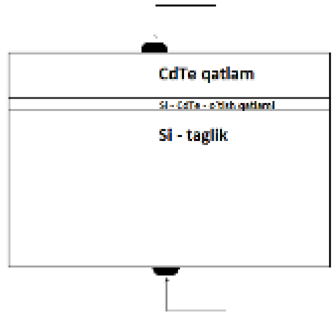
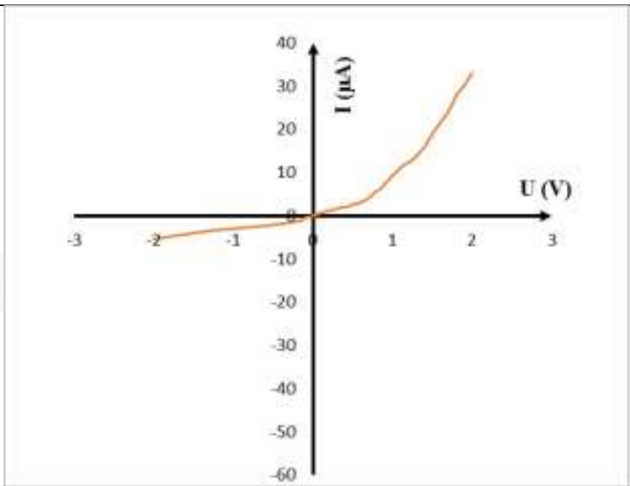


3-picture. An approximate view of the contact-received heterostructure from the side

At room temperature, the VAX of P/Si-p/CdTe heterostructures in the Dark was studied (picture-4). The analysis of VAX shows that heterostructures have the property of straightening in the form of the ratio of the correct current to the reverse current at a certain value of the voltage, and the coefficient of relaxation is determined in the form of $K = \frac{I_{forw}}{I_{rev}}$ For example,for 1,0 V, it would be around 2-2, 5 order.



4 – rasm. $p - Si - pCdTe$ geterostrukturaning xona temperaturasidagi VAX