PROSPECTS OF MICRO- AND NANO-SIZED SILICON-BASED THERMOELECTRIC MATERIALS

[1]Z.M. Sakhibova, [2]Sotvoldieva Maftuna
Andijan Machine building institute
1 Department of Alternative Energy Sources, Doctor of Philosophy (PhD) in Physical and Mathematical Sciences, 2 Faculty of Electrical Engineering, Department of Alternative Energy Sources, student of group K-93-21

Abstract: In this article, the role of granulated semiconductors in the development of science and technology, their microstructure, thermoelectric properties, semiconductor devices made on their basis, electrophysical and thermoelectric properties of solar cells, thermocouples and integrated microcircuits, as well as the influence of atoms entering them, are analyzed and illuminated. is dedicated.

Key words: semiconductor, electrophysical properties, thermoelectric properties, granules, powder metallurgy, single crystals.

Research of electrophysical and thermoelectric properties of micro- and nano-sized particles formed from semiconductors and their compounds is one of the priority tasks facing these directions.

Granular materials are a collection of spherical, cylindrical, irregular square or powdery solid microscopic alloy or metallic constituent particles that lose energy when their particles interact. Powder metallurgy is a branch of science and technology that includes the production of metal powder, as well as products made from them or powders of their mixtures with non-metallic substances. Powder technology has always occupied an important place in the development of technology, it made it possible to obtain new materials and products that could not be produced using other traditional technologies. The use of powder technologies in modern micro- and nanotechnologies has a number of advantages and has made it possible to obtain almost unlimited nanostructures with relatively inexpensive technologies. Although it should be noted that until now there are no clear methods for their separation and placement. Another advantage of obtaining nanostructures from semiconductor materials is the possibility of combining the physical properties of single crystals with the properties of polycrystalline and amorphous materials. In addition, compounds formed with carbon nanostructures opened up the possibility of creating unique devices made of organic materials with size heterogeneity, donor and acceptor. In recent decades, the importance of powder technology has increased significantly, as completely new materials with microcrystalline, nanoscale and amorphous structures have been created based on it. The possibilities of nanoscale silicon structures as promising elements of new generation electronics have increased significantly. These unique structures made it possible to increase the physical, mechanical and functional properties of the products. Powder technology has a 3500-year history, and during the Bronze Age, mankind used gold, copper, and bronze powders to make household items and jewelry. So far, many achievements have been made and scientific publications are being published by our Republic and foreign scientists in the study of properties and characteristics of granulated semiconductors obtained on the basis of powder technology. By now, powder technology, powder metallurgy, granulated semiconductors have covered all fields of science and technology. Studying the physical properties of micro- and nanoscale structures has become one of the main areas of condensed matter physics. The constant interest in nanostructures is related to the fact that certain materials partially or completely change their properties and properties during the transition to the nanocrystalline state. Granular semiconductor structures, consisting of nanometer-sized particles, serve as the basis for the creation of nanoelectronic devices, new types of solid-state catalysts, components for transparent electronics and transparent displays. The electrical properties of such structures largely depend on the size of nanoparticles and their arrangement density (volume or surface). If the average density of particles is small, the statistical conductivity of such a medium is also very low. Fabrication of nanosilicon multiphase quantum detectors using nanocrystalline silicon with a band gap of 1.12 eV with β-Si (1.1-1.3 eV) and α-Si:H (1.5-2.0 eV) gives the opportunity.

Increasing the efficiency of converting the non-photoactive part of solar radiation, i.e. natural and man-made thermal energy directly into electrical energy, is one of the urgent problems. In this context, a steady global trend in the development of photovoltaic materials is increasing attention to nanostructured and composite materials. Sometimes the useful properties of these materials can be combined, such combinations are called granular semiconductors, among which microgranular silicon is distinguished by its unique thermoelectric and thermovoltaic properties. In addition, the reason for the interest in various modifications of silicon, which is not a traditional thermoelectric material, was due to its high abundance in the earth's crust and the development of technologies related to "Big Alternative Energy" based on thermoelectric conversion. In general, the thermoelectric properties of granular semiconductors can be analyzed using Landauer's principle. The development of semiconductor electronics has increased the demand for small-sized composite materials, as well as micro- and nano-sized semiconductors in various fields of science and technology. New methods of studying their functional, physical, thermoelectric and thermovoltaic properties, in particular, the mechanisms of the appearance of heat-voltaic effects introduced in them, were created, which in turn increased the possibilities of creating semiconductor devices, solar cells, thermocouples and integrated microcircuits based on micro- and nano-sized semiconductors. The physical properties of granulated semiconductor silicon under certain conditions, the control of the processes occurring in two adjacent areas, the influence of intergranular boundary conditions or defects on charge transfer processes, as well as the potential barrier height (φ), electrical conductivity, which are considered the main electrical and thermoelectric quantities. (σ), electrical resistance (ρ), thermoEYuK, thermal conductivity (χ) are being studied on temperature dependence and significant progress is being made.

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