EURASIAN JOURNAL OF ACADEMIC RESEARCH
Innovative Academy Research Support Center
UIF = 8.1 | SJIF = 5.685 www.in-academy.uz

SOLAR CELLS BASED ON GALLIUM ARSENIDE

[1]**Mamarasulova Hanifa Dilshod qizi**
Termez State University, 2nd stage graduate student of Semiconductor Physics,
[2]**Halilova Dilshoda Obid qizi**
Termez State University, 2nd stage graduate student of Semiconductor Physics.
https://doi.org/10.5281/zenodo.7488102

ARTICLE INFO

Received: 18th December 2022
Accepted: 27th December 2022
Online: 28th December 2022

KEY WORDS

Semiconductor, physical parameters, photoelectric parameters, photosensitive devices, gallium arsenide.

ABSTRACT

Solar panels made using gallium arsenide (a compound of gallium and arsenic) are an alternative to traditional silicon solar cells. Gallium arsenide is a semiconductor that has the same solar energy properties as silicon, but is more efficient in terms of performance. Therefore, solar cells based on it have a much higher efficiency (up to 44%). However, such batteries are used very rarely and mainly in specialized sectors (for example, in the space industry). It is very simply explained. The fact is that the main disadvantage of gallium arsenide panels is a very high price. Both the material itself and the manufacturing process are more expensive than their silicon counterparts. In addition, gallium is a rare semiconductor. Therefore, despite the high efficiency and good performance of this type of solar cells, they are not mass produced. This article discusses gallium arsenide based solar cells and their performance.

INTRODUCTION

Currently, silicon and gallium arsenide (GaAs) are considered as the most possible materials for photovoltaic systems for converting solar energy in solar power plants, and in the second case, we are talking about heterophotoconverters (HFP) with the AlGaAs-GaAs structure. It is known that solar cells (photovoltaic converters) based on compounds of gallium and arsenic (GaAs) are known to have a higher theoretical efficiency than silicon solar cells, since their band gap is practically optimal for semiconductor solar energy converters, which corresponds to = 1.4 eV. For silicon, this indicator is = 1.1 eV.

LITERATURE ANALYSIS AND METHODOLOGY

Due to the high absorption rate of solar radiation recorded by direct optical transitions in GaAs, high efficiency of solar cells based on them can be obtained with a much smaller thickness of the solar cell compared to silicon. To obtain an efficiency of at least 20%, an HFP thickness of 5–6 μm is sufficient, and the thickness of silicon elements cannot be less than 50–100 μm without a significant decrease in their efficiency. This situation allows us to believe in the creation of light-film HFPs, the production of which requires a relatively small amount of starting material, especially if it is possible to use another material as a substrate, for example, synthetic materials rather than GaAs.

HFPs also have more favorable performance characteristics for SES converter requirements compared to silicon FEPs. Thus, in particular, the possibility of achieving low initial values of reverse saturation currents in p-n junctions due to the large band gap makes it possible to minimize the negative temperature gradients of the efficiency and optimal power of the GPA and, in addition, significantly expand the region. The dependences of the HF efficiency on the experimental temperature show that an increase in the equilibrium temperature of the latter to 150180°C does not lead to a significant decrease in their efficiency and optimal specific power. At the same time, for silicon solar cells, an increase in temperature above 60-70°C is almost critical - the efficiency is halved.

RESULTS

Due to their high temperature resistance, gallium arsenide solar cells allow them to be used in solar radiation concentrators. The operating temperature of the HFP on GaAs reaches 180°C, which is already the operating temperature for heat engines and steam turbines. Thus, to the 30% specific efficiency (at 150°C) of gallium arsenide HFPs, the efficiency of a heat engine can be added using the waste heat of the photocell cooling liquid. Therefore, the overall efficiency of the installation, which also uses the third cycle of low-temperature heat removal from the coolant after the turbine for space heating, can be even higher than 50-60%.

CONCLUSION

In addition, GaAs-based HFPs are much less susceptible to destruction by high-energy proton and electron currents than silicon PVCs due to the high light absorption in GaAs. In addition, experiments have shown that most of the radiative defects in GaAs-based HFPs disappear after heat treatment (annealing) at only 150-180°C. If GaAs HFPs are continuously operated at about 150°C, their radiative efficiency degradation is relatively small over the entire lifetime of the plants (this is especially true for lightweight space solar power plants).

References:

1. Васильев В.А., Тарнижевский Б.В. Расчётные технико-экономические характеристики солнечных комбинированных фототермодинамических энергоустановок // Известия РАН. Энергетика. 2005. № 3. С. 148-156.
2. Журкин Б.Г. Квантовый эффект Холла в гетероструктурах GaAs // Препринт АН СССР. М., 1985. С. 3243.
3. Кренэнелл А., Уонг К. Поверхность Ферми. М.: Атомиздат, 1981. 350 с.
4. Ландау Л.Д., Лифшиц Е.М. Квантовая механика. М.: Физматлит, 2004. 800 стр.
5. Искандеров А., Бустанов Х.Х. и др. Фоточувствительные структуры и солнечные элементы на основе арсенида галлия. Ташкент: Фан, 1986. 144 с.