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Radiation and Study Parameters of Photothermoelectrical Characteristic of the Base P-N Branches in Converters of the Solar Energy before 500 Temperatures Kelivina

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ABSTRACT: In article is studied and explored adjustment characteristic parameter p -n branches of Photothermoelectrical converter for fuel and solar radiations.

KEYWORDS: adjustment, photothermoelectrical converter, solar radiations, thermoelectric generator.

I. INTRODUCTION

At present, the main way of the direct transformation of the sunshine in electric energy is a photoelectric method, realized on the base semiconductor solar element. Modern technology has drawn near firm importance's performance such element to 25-30% depending on base material. In spite of so appreciable successes, factor, holding up broad practical application of the Photoelectric method, is its high cost. So central problem of solar energy are a development of the methods of the maximum selection to energy of the light in converter and reducing the price of converting device.

II. TEXT DETECTION

The first from delivered problems possible to solve by creation cascade converters, for instance, photothermoconverters (PhTC), in which photoelectric cascade will convert the light radiation, but thermoelectrically – associated overheads radiant and heat energy in thermo element. Herewith thermoelectric generator (ThEG) in addition executes the function of the cooling photoconverter.

The ways to decision of the second problem opens use as material for photocell comparatively cheap film amorphous silicon and join $A^{II}B^{VI}$, in which development and optimization of the technological methods can be reached high performance. Reducing the price of worked out electric powers possible to reach when use concentrator solar radiation. However in this case, because of essential heating photo convertor, noticeably fall the worked out power and performance. For instance, losses to solar energy in photoconvertion structure on base monocrystalline silicon form more than 50%. In this case loss to powers possible to compensate the additional generation to electric powers in thermoelectrically cascade.

The purpose of the work was a study performance PhTC on base solar element from semiconductor film and ThEG from polycrystalline hard solution based on Bi_2Te_3. In PhTC between photoelectric and thermoelectrically cascade is located dielectrically plate with high thermal conduction (the ceramics) for ensuring the good heat contact between them and galvanic uncoupling. Such a joining allows providing the tap of the heat from photoelectric converter that raises its energy factors reduces degradation photosensitivity of the element, because of simultaneous influence of the light and temperature, the conducted heat is used for the further transformation in electric energy of thermo generator. The heat with thermo generator leaves by means of air or heat cooling. Efficiency of PhTC can be increased by means of glass plates, covering Photosensitive element.

Under development in persisting work device is calculated on operating range of the temperature 300-500 K. For this interval of the temperature the most efficient and, probably, single for present-day thermo electrical material are Bi_2Te_3, Bi_2Se_3 and hard solutions on their base.

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The choice photo converting device for multifunction PhTC depends on construction particularities of the energy installation. Vicinity greatly reached efficiency in solar element on base different material (refer to, for instance, [1-3] does important under such choice not as much material itself as ease of manufacturing of the fabrication element, stability their characteristic, sufficient resource at fall of the powers with the temperature, stability to external influence and economy.

III. EXT INPAINTING

The decision delivered here problems more is effectively realized when use Photo converters on base amorphous silicon or join $A^{II}B^{VI}$ films. The most efficient PhTC is an element from photo-and thermo elements, prepared from isolator laying, having high thermal conduction. In this case there are load miscellaneous in circuit of each element. PhTC carries the name PhTC with prepared by load.

The energy of the radiation, falling on converter, is partly converted in electric power, but remaining portion of the radiation, converting in heat, warms photo convertor and hot end thermo element. The cool junction thermo element is supported under constant temperature.

In device with separate load coordination current (the voltages) possible produce selecting the number of elements in Photo-and thermobatteryes. Elements were used for study of the field-performance data solar element from ready pilot models solar battery on base $\alpha - Si$: H with maximum performance 9-12%. The elements on the base CdS/CdTe thin-film heterojunction were made on perfected technology [2-3]. The measurements were conducted on standard methods, user for study Photo generating structures [2].

The family of load VACh and dependencies W (U) thin-film photocell on base $\alpha - Si$: H under different temperature was submitted for fig. 1 Solar elements fitted on heating device, allowing is sailed to change its temperature. The temperature was measured by means of copper thermometer of the resistance. The power falling radiations was supported at a rate of 40 mW / sm^2, area to surfaces element was 1, 2 sm^2. Performance element under T=300K $\eta \approx$7, 5%. He falls before 6% under T-350K and 4, 5% under T=420K.

Reduction performance (power) is connected with significant fall worker voltages, because of heating of the photocell by solar radiation. The Warm-up factor of the voltage of the castrated move for amorphous silicon negative and can reach 0, 3-0, 4%/K. Opposite, warm-up factor of the current of the castrated move-positive and forms 0, 07-0, 08%/K. Fall worker voltage at heating solar element is partly compensated by growing of the current of the short circuit when increase the powers falling radiations (the voltage of the castrated move practically is not changed when change of luminosity). In any event, the heating element leads to reduction of the output power. The similar studies are organized for solar element on base CdS/CdTe. Family load VACh is shown on fig.2 under different level of the powers giving radiations, which was adjusted by means of concentrator. The elements were warmed to account of the increase to intensities of the illumination. Their temperature and in this case it was defined by means of copper thermometer of the resistance. The conditions of the experiment were following. The Solar element in two events was supported under room temperature by means of cooling device (running water) under different level of luminosity (the curves 1, 2 on fig. 1). Performance element herewith increased from 6% before 7, 5%. If photocell specially is not cooled then at powers falling radiations he is warmed before the temperature 350K, but its performance decreases to account of the heating on 1,5% (the curves 2,3). The further increase to powers falling radiations reduces performance before 5% (the curve 4). Thereby heating sample when increase the intensities of the solar radiation greatly influences upon amount worked out powers on load. Producing quantitative comparison result for Photocell from $\alpha - Si$: H and CdS/CdTe, possible conclude that really in solar element on base film $A^{II} V^{VI}$ exists the more low warm-up gradient of the fall to powers, as this and was noted in [4-9].

The photocells responsible for direct transformation of the solar radiation are going to in modules. The solar modules - a main part of any photoelectric system. The most spreading has got the modules from monocrystalline, polycrystalline or amorphous silicon element. However principles of construction modules for different material practically like.

The maximum power of the solar module from amorphous silicon W= (585 $\pm$ 5) mW is generated U= (490 $\pm$ 5) mV and I= (1, 18 $\pm$ 0, 02) A. Maximum power of THEG W= (190 $\pm$ 5) mW is generated under U= (240 $\pm$ 10) mV and I= (0, 80 $\pm$ 0, 02) A. Considering that falling radiation had a power W_S =5, 2 W (with provision for

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dissipations~20%), maximum performance solar module $\eta \approx 11,\ 3\%$. Since diffused by solar module power $W_d = W_S(1-\eta) \approx 4{,}6W$, performance of ThEG $\eta_{TEG} \approx 4{,}2\%$.

On fig.3 are presented warm-up dependencies performance component parts of PHTC and performance of "photo-thermo" as a whole. According to this given in all working range performance converter weakly depends on the temperature. Such behavior of performance is explained by opposite nature of the change to efficiency of the different converters with growing of the temperature.

Thereby for PhTC with module from amorphous silicon and ThEG from hard solution of bismuth telluride in interval of the Temperature 300-450 K performance PhTC practically does not depend on the temperature to account self compensation losses to powers with the temperature in solar module by increase to powers, worked out ThEG, to the account of the growing to differences of the temperature between the ends of thermoelements.

IV. EXPRERIMENTAL RESULTS

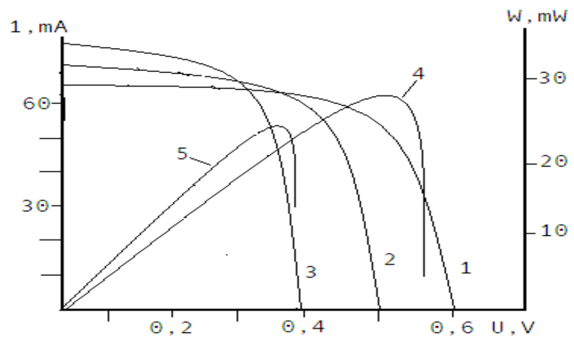

Fig.1. Load VACh (1, 2, 3) and output power (4, 5) of the photocell on base amorphous silicon under T, K: 300(1, 4); 350 (2); 400(3, 5).

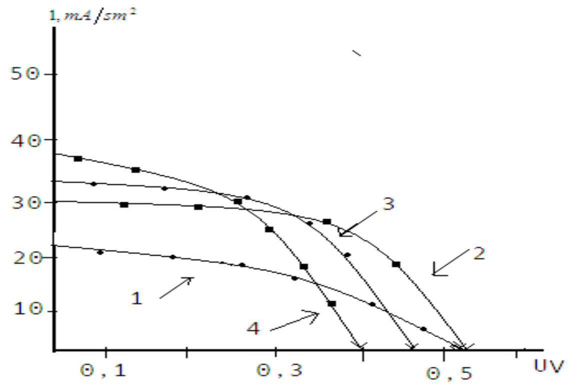

Fig.2. Load VACh solar element on base ($In_2O_3 + SnO_2$)/CdS/CdTe under different level of the powers falling radiations $W, mW/sm^2$:60(1), 140 (2,3) and 180 (4). The Temperature of the element T, K: 300(1, 2); 250 (3); 400 (4).

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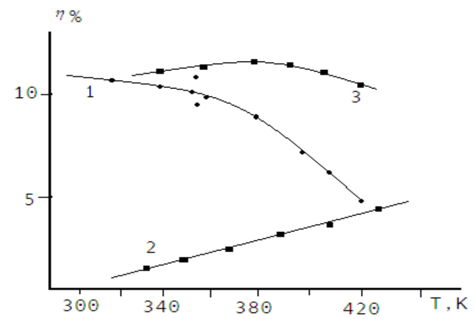

Fig.3. The warm-up dependencies of performance of solar module (1), ThEG (2) and PhTC (3). Temperature of the refrigerator was 295K.

VI. CONCLUSION

As to development material for ThEG, that possible note that exists the row a material on base hard solution Bi_2Te_3 for instance $Bi_2Te_{2,4}Se_{0,6}$ for m-branches and $Bi_{0,5}Sb_{1,5}Te_3$ for p-branches. Selecting corresponding to doping concentration of the carriers of the charge, possible provide optimum thermoelectric generation within the range of before 500K. The most suitable and cheap technology of the creation thermoelectrically material will see pressing a polycrystalls. The cardinal principles to such technologies are brought, for instance, in [4].

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