A SOLAR POWER PLANT WITH A HIGH PERFORMANCE SOLAR CELLS AND THIN CONCENTRATORS MADE OF ALUMINUM-BACKED EPOXY COATED POLYMERS

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ABSTRACT

The offered module of the solar cell includes light collected system on the basis of a cylindrical thin concentrator and the bar of silicon photocells with a radiator for air cooling. The concentrator is a light collecting system and is manufactured from epoxy with a depth of 5 mm coated from the inside by a polymeric film of depth 70 μm and of aluminium by depth 3 μm. Small depths of materials of the concentrator cause its low cost compared with the concentrators produced from glasses. The estimated cost of a concentrator with an area of 1 m^2 is 10 $.

Keywords: renewable solar energy, solar cell, concentrator, silicon photocells.

I. INTRODUCTION

As it is known, mankind uses mainly natural hydrocarbonaceous raw materials for producing power. However, the following two principal problems have forced people to search for other alternative energy sources:

1) Limitation of natural hydrocarbonaceous raw materials
2) Essential action on environment and on biosphere due to adverse effects of combustion of hydrocarbonaceous raw materials

Among all kinds of renewable energy sources for Azerbaijan and other solar locales of the world, the power of the Sun is especially interesting.

The amount of solar energy delivered to each square meter of Earth is approximately 600÷900 Watts. For a greater part of Azerbaijan, the solar energy is actually 850 W/m^2. Thus semiconducting solar photocells with the active square in 1 m^2 can make 60÷100 W of electric power in 6-8 hours.

The fast evolution of solar power engineering became possible owing to lowering the cost of photovoltaic transformers from 1000 $/W in 1970 up to 3÷5 $/W in 2000. Nowadays, the cost of an installed capacity of solar energy for 1m^2 is approximately 1.5÷3$/W.

In past few years, the solar power plants with concentrators of solar energy have gained a special evolution.

II. MAIN TEXT

The purpose of this project is to develop a helio-installation with solar cells on the basis of silicon (Si) with micro configurations on a surface. It is expected that with the new type of concentrator of solar energy, the electricity production will be at a very low cost. The diminution of cost of the gained power of solar power plant is attained by:

1) Diminutions of quantity of necessary photocells owing to the low-cost of light collecting systems
2) Usages of new semiconductor photocells with a higher conversion efficiency
3) Usages of thin and low-cost concentrators of solar energy

The cross-section of the developed solar photocell is presented in Fig.1. As a substructure the silicon p-Si with specific resistance 10 Ω-cm and depth of 200 μm is chosen. On the surface strip structures metallized by aluminum, and a surface between strips passivated by SiO_2 are established. The depth of n+-Si is 1 μm. The reverse of a substructure is ohmic contact from aluminum to which air-cooling radiators are bonded on. The solar cell on the basis of Si is produced by a method of a microelectronic planar technology.

The solar radiation enters from aluminum strips with a transparency of 90%. For diminution of reflection on a surface of a photocell a coating from SiO_2 by depth 0.05 μm is generated. The manufactured exemplar of a photocell has a quantum output at a level of known analogs in the world and is close to unity. In an operation mode the backward contact of a photocell is connected to a peripheral obverse electrode for a diminution of a sequential internal resistance of the solar element.

In fig. 2, the module of the solar cell with a thin multilayered concentrator and the module of silicon photocells is shown. The module has the following technical parameters: H=L=1m, d = 2.5 cm, radius of a concentrator = 2 m.

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III. CONCLUSION

For production of thin and low-cost concentrators of new type, the mechanical device will be developed and made. Below performance parameters of the module of a solar power plant are represented:

1) The active square of a concentrator - 100x100 cm
2) Sensitive square of the photocells bar– 2.5x100 cm
3) A spectral sensitivity range of $350 \div 1050 \times 10^{-9}$ m
4) Quantum efficiency of photocells > 90 %;
5) Efficiency of conversion of solar energy > 15 %.

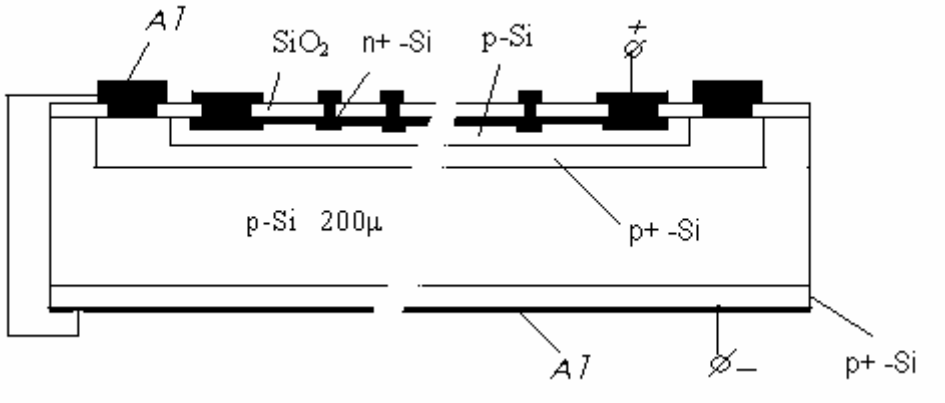

Fig. 1
Sectional view of the silicon photocell with high effectiveness of solar energy conversion

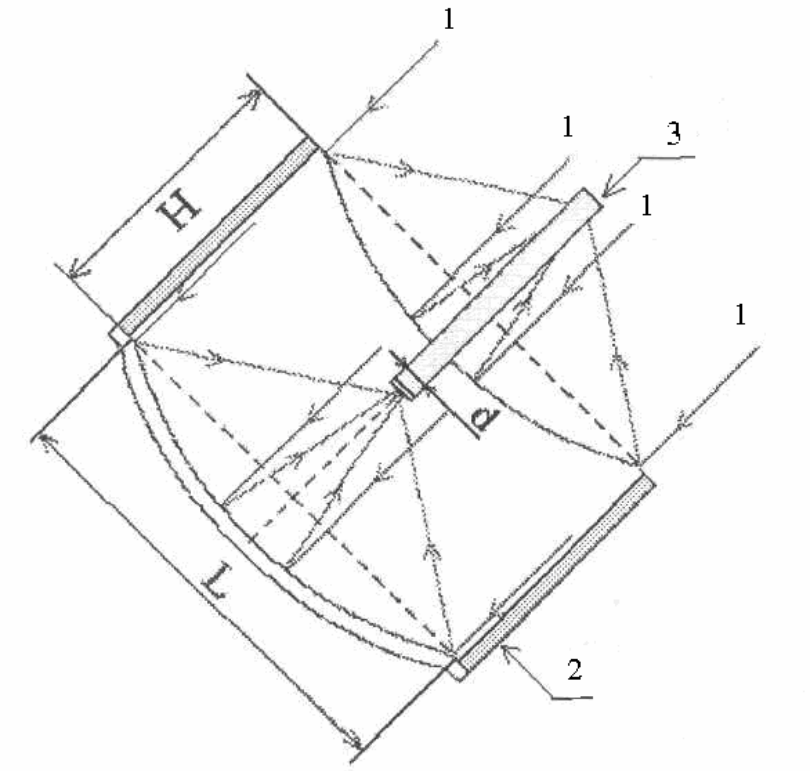

Fig. 2
The module of the solar cell with a thin concentrator.
1-direction of incident solar beams, 2-thin focalizing concentrator,
3-module of silicon photocells, H and L, length and width of a concentrator,
d-width of the module of silicon photocells.

On the basis of this module with an effective area 1 m^2 it will be possible to assemble the working block of a solar power plant of various power.

As preliminary estimations have shown, the cost of gained solar energy from the 1 m^2 of the concentrator area is less than 0.5 $/W. Also, the minimum quantity of made power per unit of the active square of a solar battery during a day (8 hours of light day) will make 8 kWh/1m^2/day. This is comparable to the world standards.

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