

XXIII INTERNATIONAL SCIENTIFIC AND PRACTICAL ONLINE - CONFERENCE
RENEWABLE ENERGY AND ENERGY EFFICIENCY OF THE XXI CENTURY
19-20 MAY 2022. 20a Gnata Hotkevycha Street, Kyiv, Ukraine 02094



FEATURES OF CREATION AND CHARACTERISTICS OF SOLAR MODULES WITH MULTILATERAL PHOTSENSITIVITY

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ОСОБЕННОСТИ СОЗДАНИЯ И ХАРАКТЕРИСТИКИ СОЛНЕЧНЫХ МОДУЛЕЙ С МНОГОСТОРОННЕЙ ФОТОЧУВСТВИТЕЛЬНОСТЬЮ

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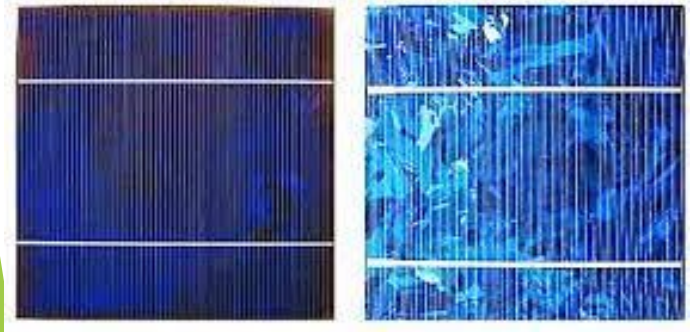
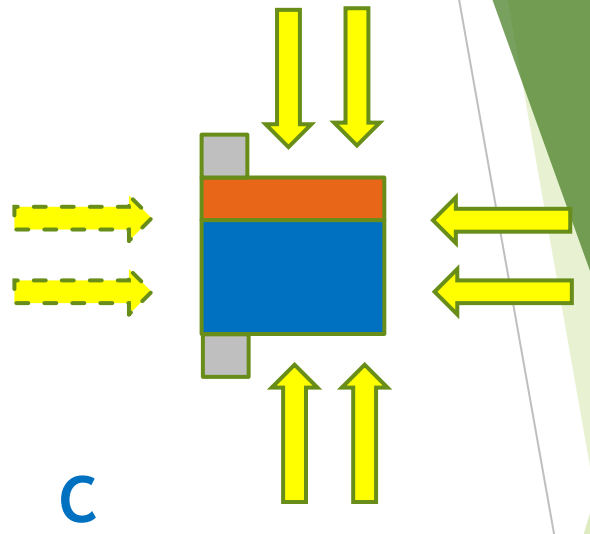
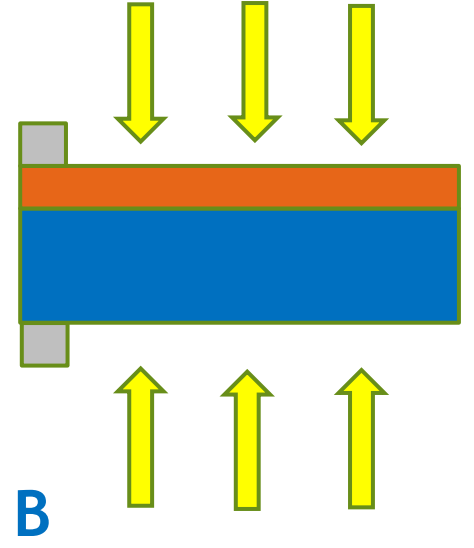
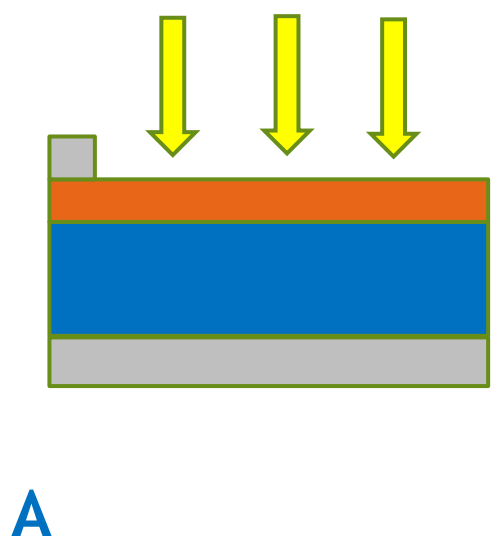
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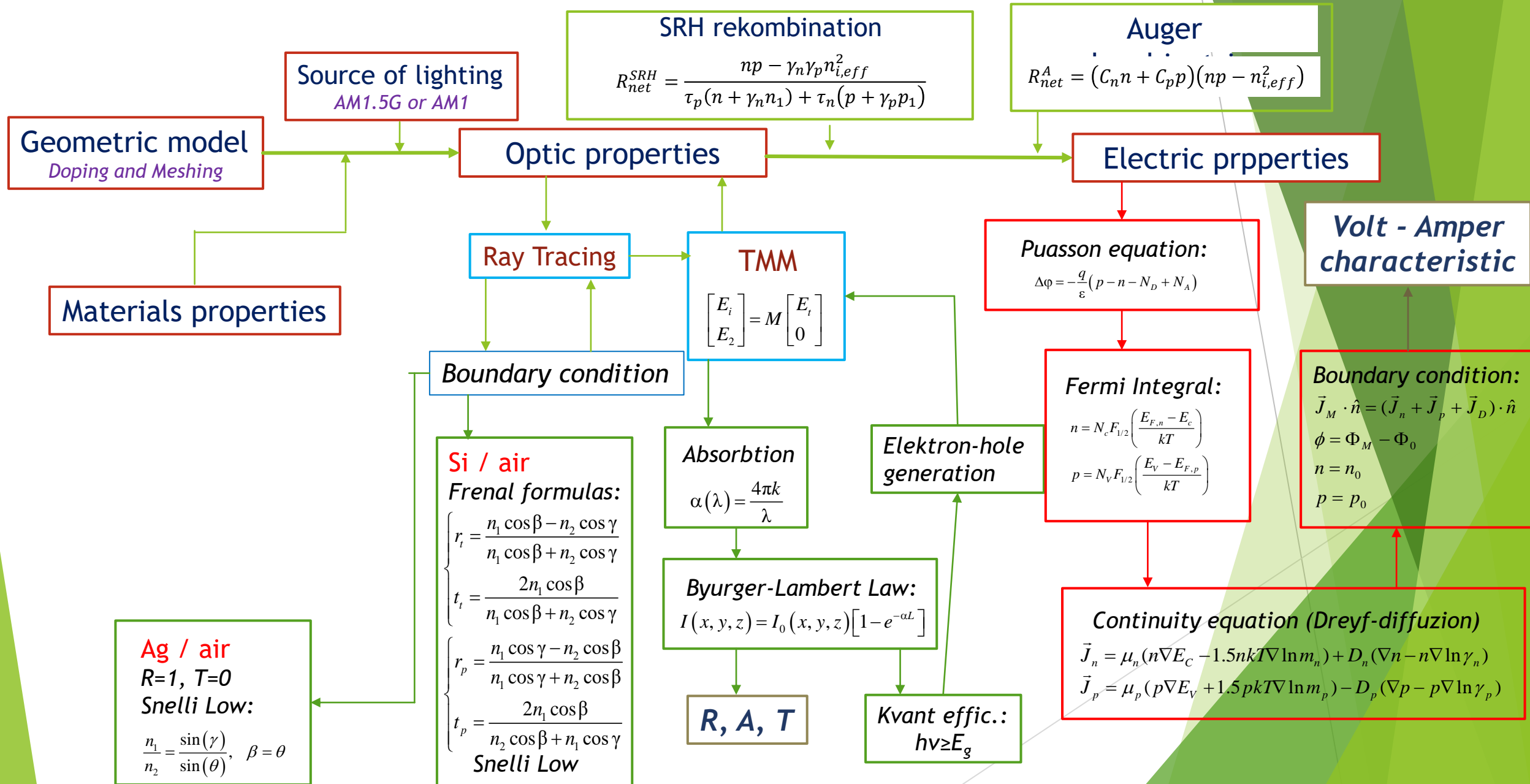


- ▶ **Introduction**
- ▶ **Conception:** Reality of Si Multifacial solar cells
- ▶ **Research methods:** Simulation by “Sentaurus TCAD”
Experimenting
- ▶ **Models:** Geometric model of Solar cells
Physics and mechanism of model
- ▶ **Results and Discussion:** Simulation and calculation
Experimenting and measuring
- ▶ **Conclusion:** Multifacial concentrator solar cells
Reduction of specific consumption of Si

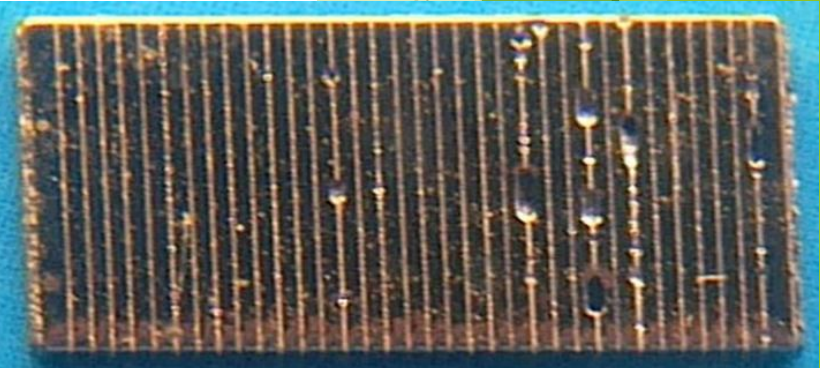
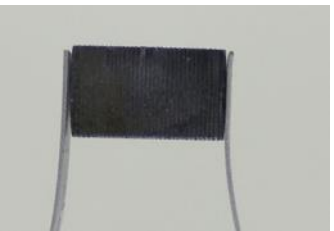
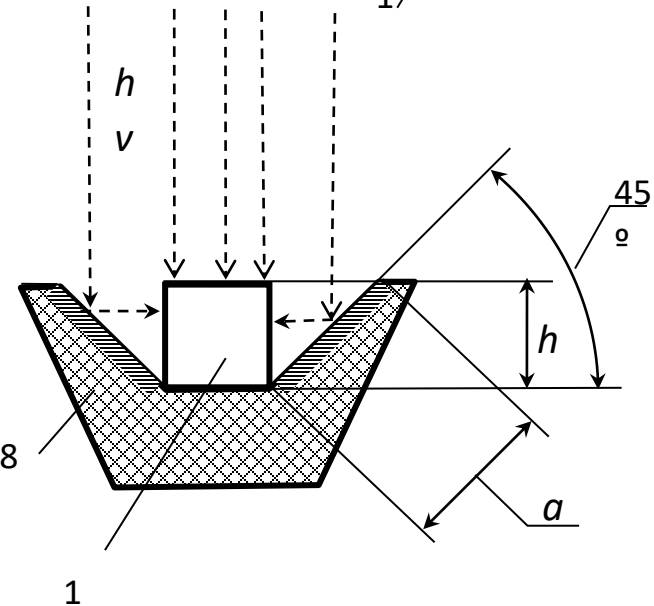
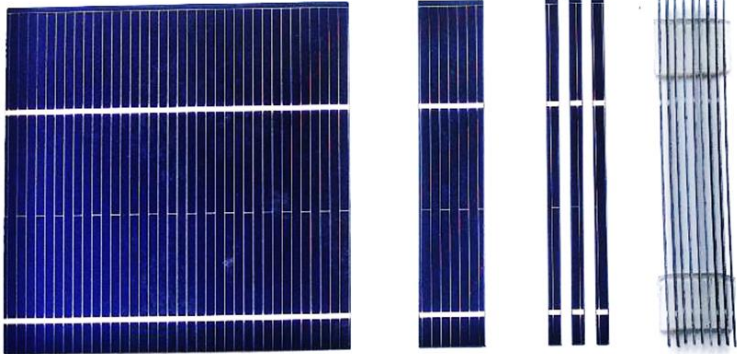
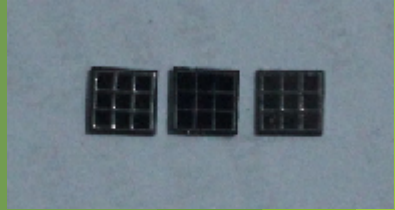
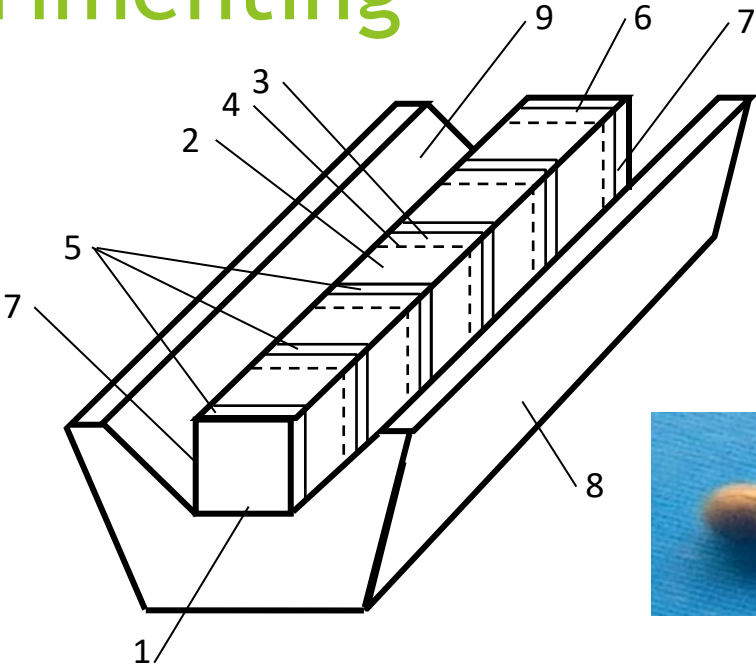
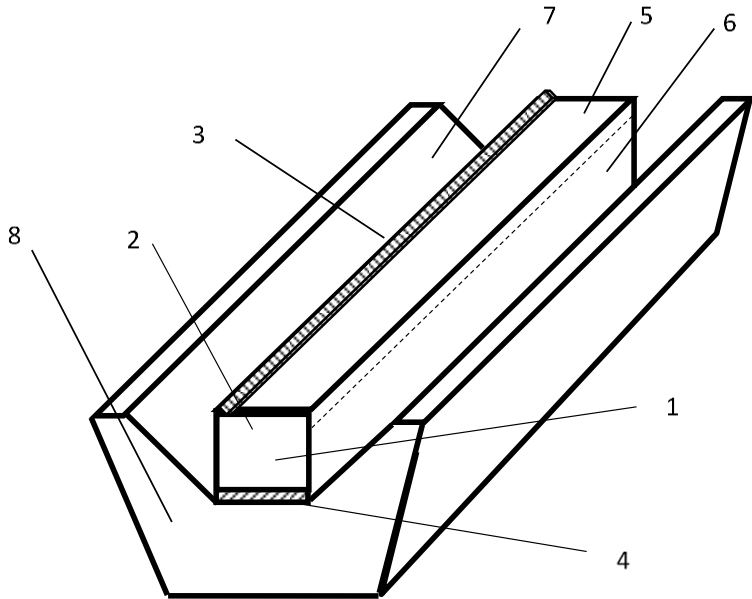
- ▶ According to official information from “International Energy Agency”, the contribution of renewable energy sources (RES) in 2021 reaches up to 276 GW. The widest circulation among different types of RES has evolved from sunlight to thermal and electric energy.
- ▶ For transformation of sunlight to electric energy, the semiconductor solar cells (SC) are generally used. More than 85 % of the produced by the industry SC are made on a silicon basis. For this reason, in our work we chose silicon SC as the main object of a research. The efficiency of silicon SC that agree with theoretical expectations does not exceed 29 %. But both industrial and laboratory silicon SC did not reach this value yet. Therefore, here is a need in researches on the increase in efficiency of SC and decrease in prime cost of silicon. Numerous theoretical and experimental works characterized by different scientific and technical approaches are carried out in this direction. For example, for the purpose of passivation of recombination activity and improvement of optical properties, a frontal surface silicon SC is covered with a layer of SiN by 75 nanometers thick or SiO by 100 nanometers thick.
- ▶ For the increase in the photovoltaic transformed energy, silicon bifacial SC were designed. However, in experiments, it was established that lighting the front side of the silicon bifacial SC showed the efficiency by 19.4 %, while lighting the back side of the silicon bifacial SC reached the efficiency equal to 16.5 %. In experiment, front and rear side of bifacial SC was 18.4 % and 18.1 %, respectively. So, the values for the efficiency of both sides reached symmetry. In the real work it is for the first-time studied silicon tri facial SC. Because physical processes of photovoltaic transformation of energy in it SC and, especially, influence of illumination conditions and temperature changes on them is not investigated yet.

Conception: Multifacial solar cells

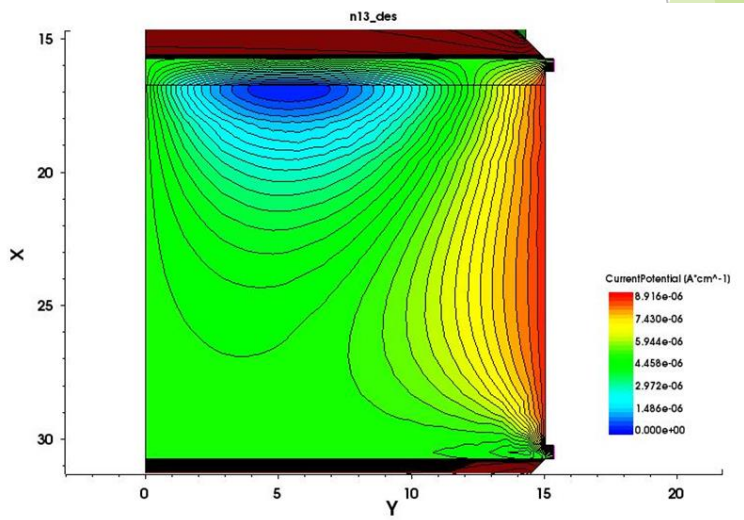
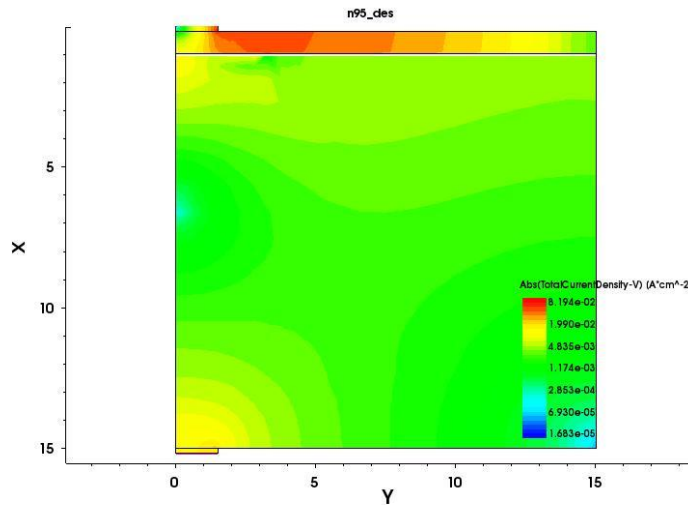
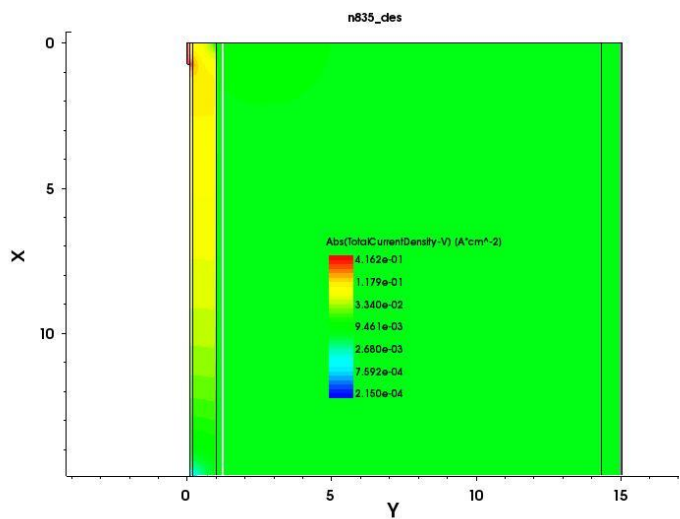
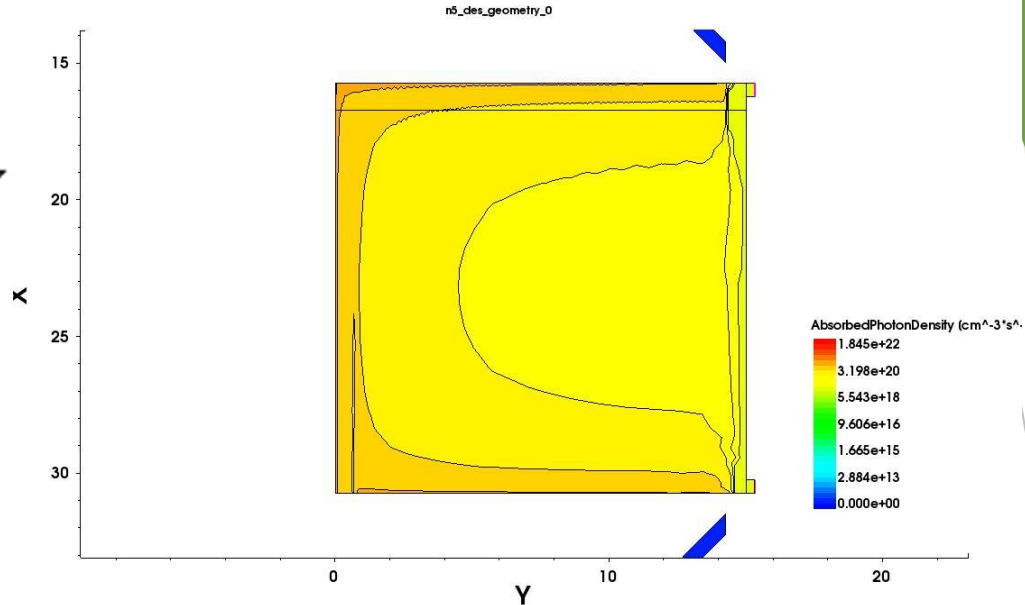
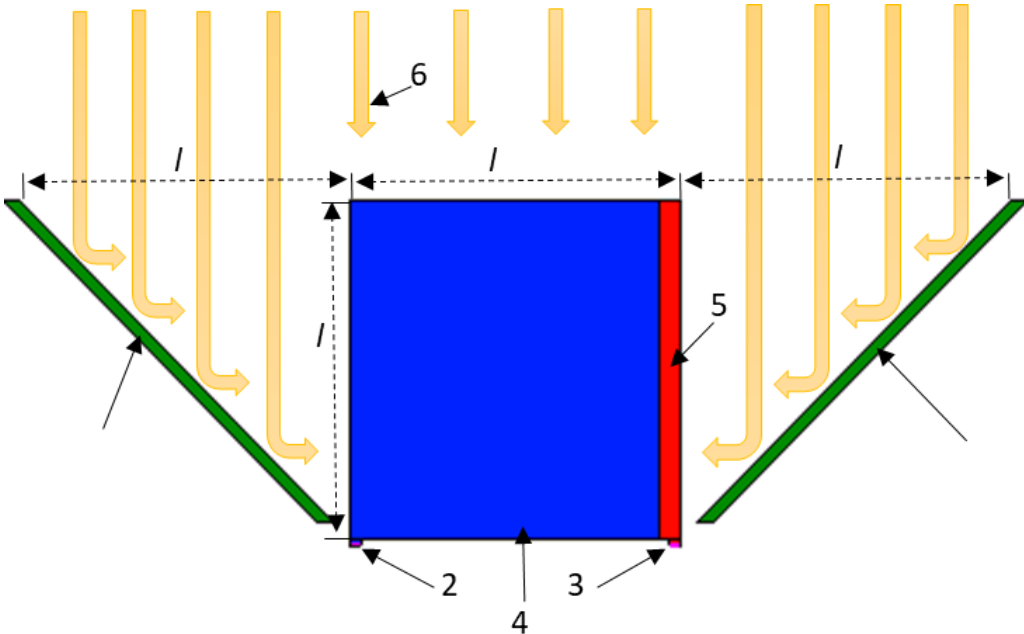




Research methods: Experimenting

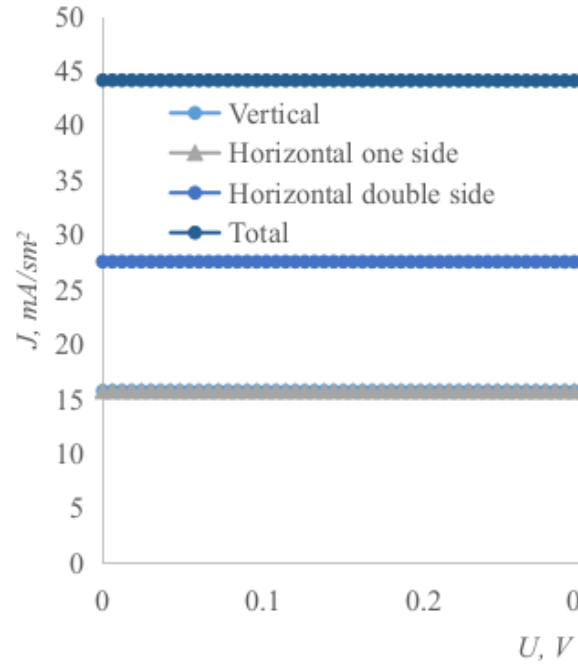
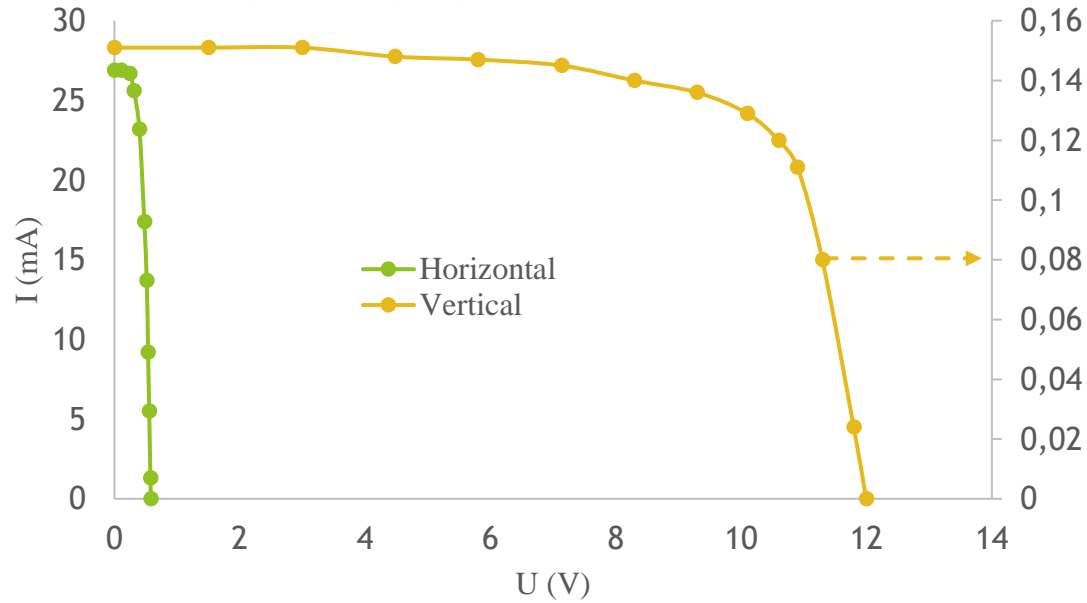
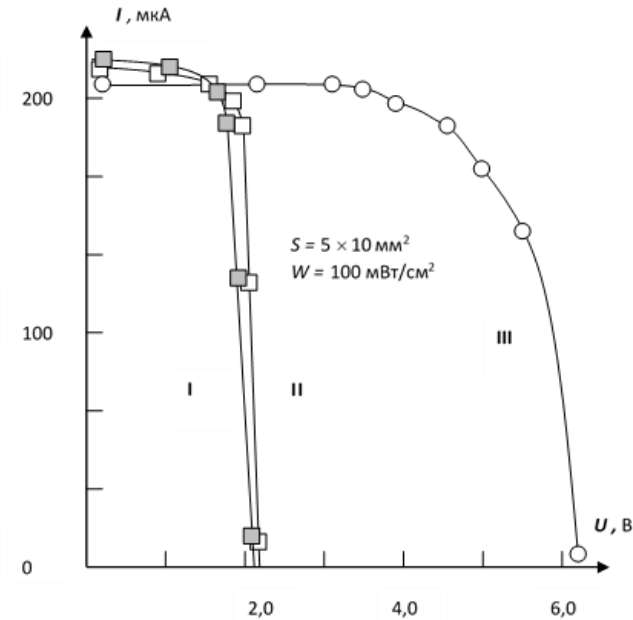


RESULTS OF SIMULATION

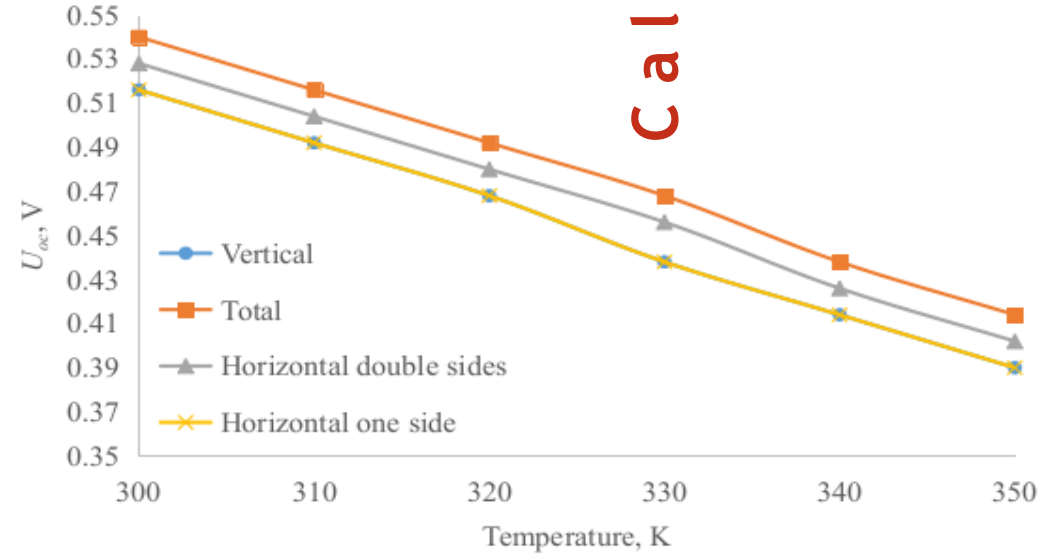


RESULTS AND DISCUSSION

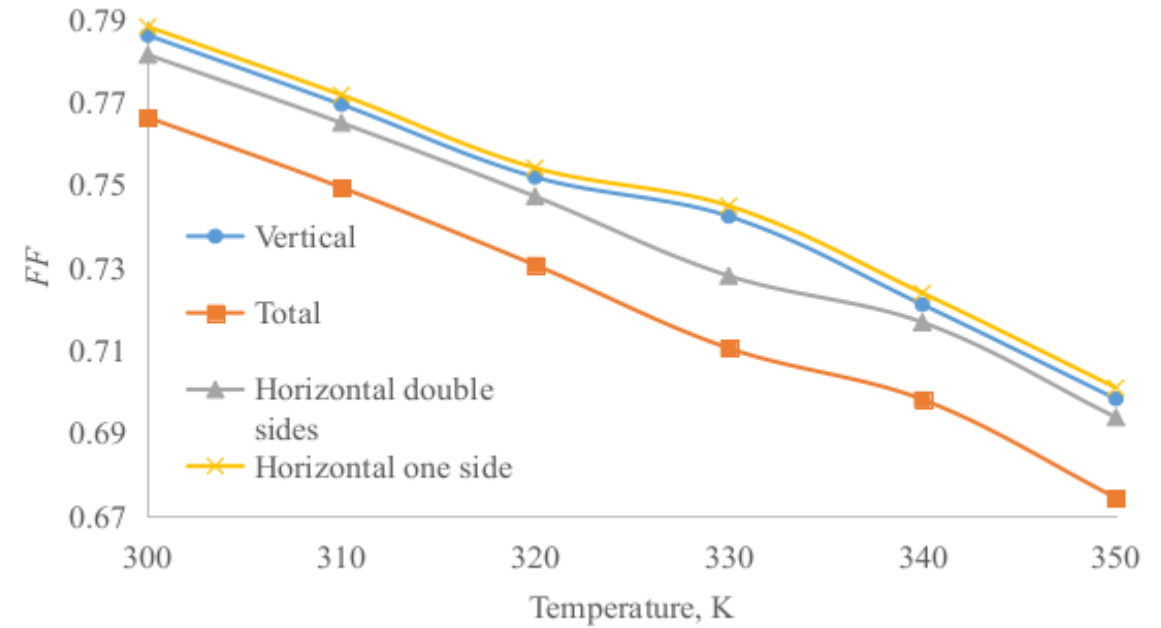
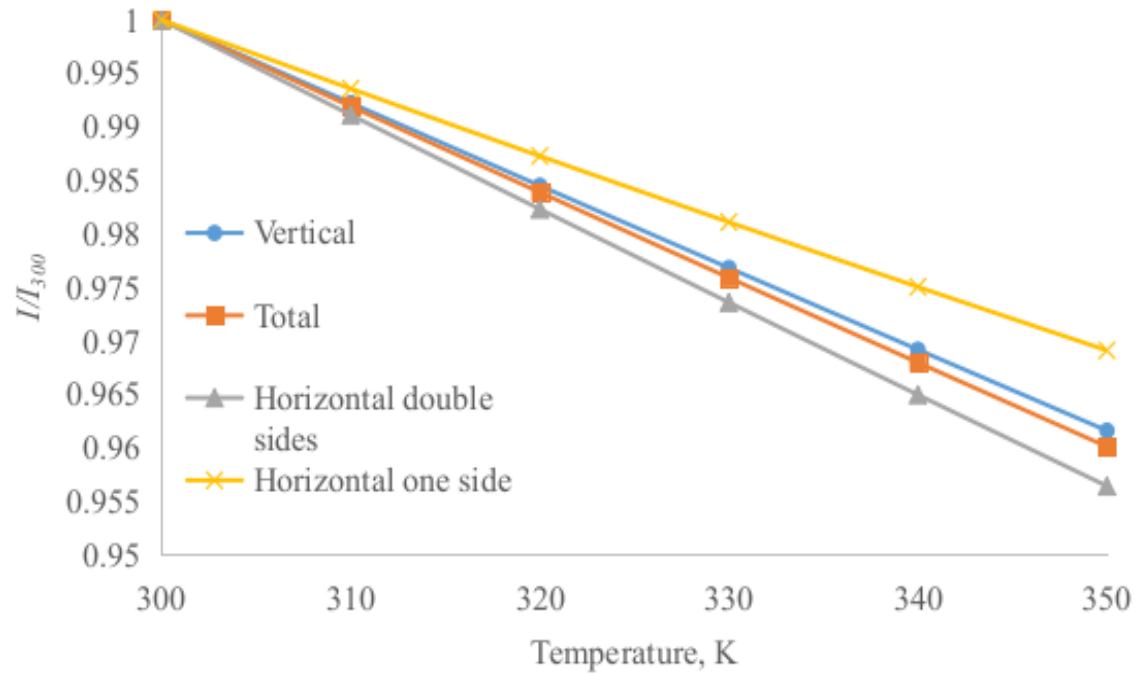
Experiment



Calculation



RESULTS AND DISCUSSION



No	Size of solar cell, mm ²	Size of micro-solar cells blok, mm ²	Quantity of solar cells in blok	J_{shc} , $\mu A/cm^2$	U_{oc} , B	P_{mm} , mBT/cm ²	Specific consumption of Si, Kg/W
1	10×3×2	10×1×1	32	232	13,5	3,1	1,9
2	10×3×2	10×3×1	32	79,5	13,5	1,1	14,9

- ▶ The increase of the area of SC causes the increase of the photons falling on its surface. Therefore, the short circuit current increases with the increase in the lighting area.
- ▶ Heating of a body of SC because of to absorption of all photons causes reduction of its efficiency. Illumination of SC with high intensity light makes the temperature of its heating an important.
- ▶ The nature of temperature coefficients change of the main photovoltaic parameters of silicon SC have been defined under various conditions.
- ▶ Temperature coefficients for three facial SC reached $2.52 \cdot 10^{-3}$ V/K for open circuit voltage and $1.8 \cdot 10^{-3}$ K⁻¹ for fill factor.
- ▶ Output power of SC at bifacial lighting by 1.72 times and three facial lighting by 2.81 times exceeds power usual monofacial lighting.
- ▶ At temperature change of SC from 300 K to 350 K, the density of short circuit current decreases by only 4 %.
- ▶ Comparison of material consumption for production of bifacial and three facial SC demonstrates the corresponding economy of silicon for obtaining significantly bigger photoelectric energy.

Thank you for attention!

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