FUNCTIONAL AND THERAPEUTIC MEDICAL HARDWARE

Phototherapeutic complex «GELIOS»

Description

Hardware-software complex "GELIOS" is intended for exposure on human with wellness, therapeutic and prophylactic purposes by electromagnetic radiation in the visible range in physiotherapeutic rooms, sanatoria and health resorts, at the patient's home. The basis of the therapeutic effect of the complex "GELIOS" is the ability of increase the activity of cell membranes by electromagnetic radiation energy. The composition of phototherapy complex "GELIOS" includes: the transmitter, the emitter's control system and the diagnostic unit. "GELIOS" performs procedures of common and complex phototherapy in standalone mode and under the control of the personal computer


The composition of phototherapy complex "Gelios"

Technical data

Parameter	Unit
Using wavelengths, nm	625, 605, 590, 525, 505, 470, 430
The number of LEDs of each spectrum, pcs	1050
Duration of the procedure, min	1-99
The range of the modulation frequency, Hz	0,1-100
The range scanning period, s	1-100
The range of the maximum output power, %	1-100
Measuring range of the pulse rate, pcs/min	3-240
Measuring range of respiratory rate, pcs/min	8-100

The distribution of radiation in the skin
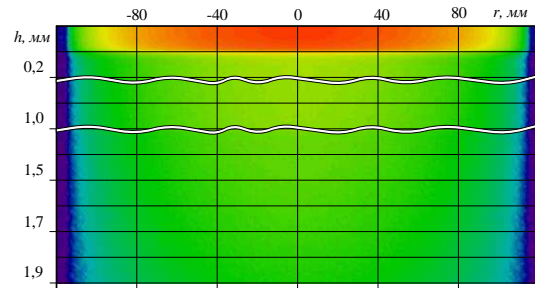
Impact based on physiological characteristics of the patient
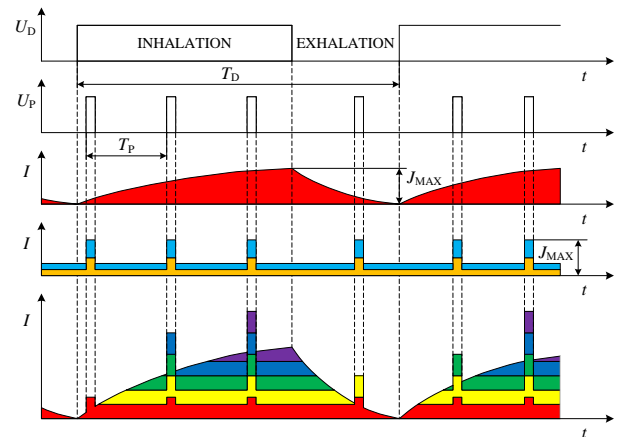
Indications for use

Recovery of the organism after suffering psychological, biological, and physical exertions, restoration of circadian biorhythm, normalization of metabolic processes, improves mood and appetite; reduction of seasonal mood swings.

Contacts

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FUNCTIONAL AND THERAPEUTIC MEDICAL HARDWARE

Digital portable spirometer DS-14/1

Description

Spirometer is intended for research of the function of external respiration at the clinic, at the enterprise and at the home by the patient. Spirometer automatically determines from performed tests the most authentic and calculates 10 basic indicators of respiratory function. Portable spirometer can save in memory the results of 20 tests with all the defined indicators, which is necessary during the screening research. As a sensor in the device can be used single or multiple turbine. Also in the accessory kit includes a removable mouthpiece, antibacterial filter, nose clip, charger, cable connection to a PC and specialized software.
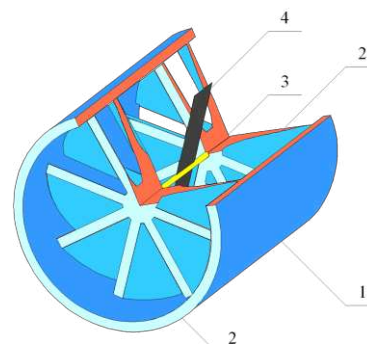

Components of digital portable
spirometer DS-14/1

Technical data

Parameter	Value
Measuring range of air flow rate during inhalation / exhalation, l/s	±14
Measuring range of air volume during inhalation / exhalation, l	0,1 - 10
Flow rate accuracy, %	3
Volume accuracy, %	3
Power supply from galvanic cell type AA, V DC	2 x 1,5

Structure of the sensor

The construction of the measuring turbine
(with radial cutout 1/4)

Measuring turbine is a hollow cylinder (1) that is made of organic glass. Gas flow acquires the rotating movement by means of guide impeller (2). On the way of the gas flow on the axis (3) is located a flat plate (4).

Definable indicators

– FVC – forced vital capacity – volume the full forced expiratory (l);
– $FEV1$ – forced expiratory volume (l) in the first second;
– $FEV1 / FVC$ – the index of Gensler (%);
– PEF – the peak value of the volumetric expiratory flow rate (l/s);
– $FEF25$ – the instantaneous value of volumetric rate (l/s) during exhalation of 25 % FVC;
– $FEF50$ – the instantaneous value of volumetric rate (l/s) during exhalation of 50 % FVC;
– $FEF75$ – the instantaneous value of volumetric rate (l/s) during exhalation of 25 % FVC;
– $MEF25\text{-}75$ – value of average volumetric rate (l/s) during exhalation from 25 to 75 % of FVC.

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ADJUSTING AND INTRODUCTION TO SERIES RAPID DIAGNOSTIC VIBRATE

It is well known that the majority of industrial equipment in the process of there work are created a mechanical vibration (60%) or worked in conditions of high vibration (90%). It was proved that the nature of the mechanical vibration with reasonable accuracy it is possible to determine the state of the industrial equipment and classified them as "fit-unfit"; and also determine the type of failure. By the scientific group of the Department "Information and measuring technologies and systems" of the NTU "KhPI" have been developed:

- algorithms for signal reception of mechanical vibration (see. Fig. 1), the statistical processing of the data (Fig. 2), make a decision on the suitability of the unit injector diesel for further use;

- prototype of rapid diagnosis of the status of the diesel injector assembly   (see. Fig. 3);

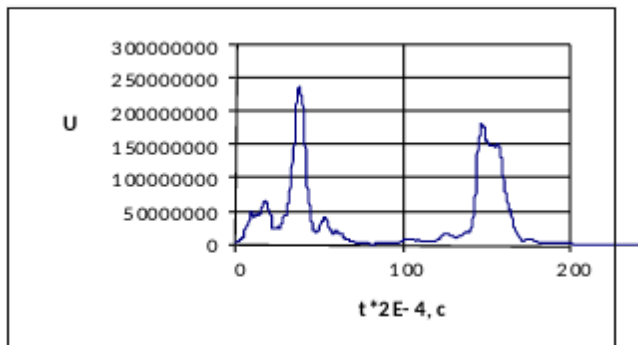- fragments of the software in C # (Fig. 3).
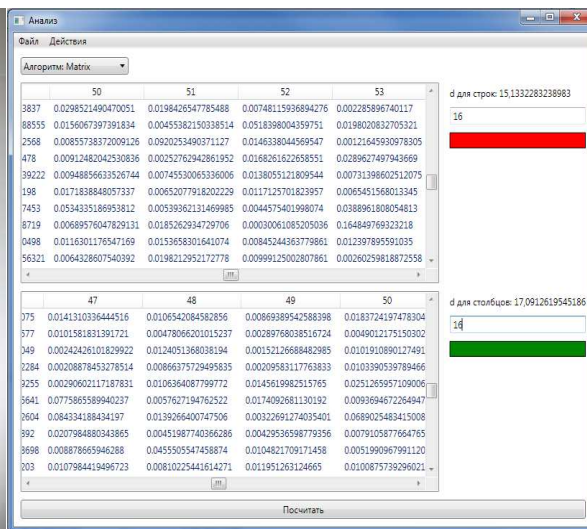

Fig.1

Fig.2

Fig 3

Fig.4

The proposed system of rapid diagnosis was tested at the plant named by Malyshev (in determining the type of fault injectors), the locomotive depot "Osnova" (the classification of the injectors on the "it-unfit "), Kharkov armored plant (detection of faults in the exhaust system) all were in city Kharkov.

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FLEXIBLE CDTE SOLAR CELLS

Description

High specific power is an important parameter for space solar cells. One approach to maximize the specific power is to substitute glass substrate with flexible thin substrate, such as polymer foils. This provides not only considerable weight reduction, but also flexibility which gives an opportunity to adapt solar panels to any kind of shape.

CdTe is the most suitable material for thin film solar cells (SC). Its band gap energy of 1.45 eV ensures an optimum adoption to the solar spectrum under terrestrial applications. Hence, the highest theoretical efficiency limit of over 29% is possible

Fig. 1 Vacuum chamber for thermal vacuum evaporation of CdTe and CdS films.

for single-junction cells.

The CdS/CdTe layers for the flexible solar cells with record specific power can be deposited on Poly/ITO substrate by thermal vacuum evaporation method (fig 1).

Polycrystalline CdTe thin film solar cells have shown long-term stable performance and high efficiency up to 16.5% under AM 1.5 illumination.

Innovative Aspect and Main Advantages

- Low cost if produced in large volumes (over 60MW/year – 0,4 $ USA/Wp).
- Simple deposition technology makes it very promising for industrial application.
- Considerable weight reduction due to use of only a few micrometers thick film layers on lightweight flexible substrate compared to glass substrate which represents over 98% of the total weight of solar cells.
- The CdTe SCs have the highest stability under proton and electron irradiation compared to other photovoltaic devices, which makes CdTe cells very prospective for space application.

Fig. 3 Flexible CdTe solar cells (in grams)

Fig. 2 CdTe solar cells on glass substrate(in grams)

Table 1. Comparison of conventional SCs on glass substrate and flexible SCs on polyimide

SC parameters	Glass	Polyimide
Open circuit voltage V_{oc}, mV	793	765
Shot current density J_{sc}, mA/cm^2	19,9	20,9
Fill factor FF	0,71	0,71
Efficiency η, %	11,2	11,4
Specific power, kW/kg	**0,025**	**2,5**

Areas of Application

Flexible cells give much more possibilities for space application, integration in buildings, and can be applied in small cards, consumer electronics, solar cars and boats.

Stage of Development

Laboratory technology, 4 Ukrainian patents and further international patent pending. Further development, licensing, and technology transfer is sought.

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APPLIED PHESICS (ELECTROMAGNETIC SAFETY)

Design, research and creation of the powerful lightning current generator artificial and its use, test facilities and equipment of aviation technology on the lightning resistant.

Basic characteristics, essence of elaboration: With the current high-voltage equipment experimental base NIPKI "Lightning" NTU "KhPI" - an object of national heritage of Ukraine, in 2007, developed, studied and created a powerful artificial lightning current generator, which has one-time power consumption of about 1 MJ and allows to create separately and in any desired combination of these standardized according to international standards components of total current lightning impulse for the total active-inductive load (test object), impulse A (amplitude at least 200 kA and up to 500 msec), intermediate B (with an average current of at least 2 kA and up to 5 ms), long C (amplitude of 200 A to 800 A and up to 1000 msec), shortened long C^* (with an average current of 400 A and up to 50 msec) and a second pulsed (amplitude at least 100 kA and up to 500 msec).

Economic appeal of the elaboration for market promotion, application and realization, parameters, price: a powerful generator of artificial lightning current passed trial operation and meets all international requirements for high-voltage equipment. This generator according to the international market parameters electro technologies has a value of at least 1 million USA dollars (the cost of 1 kJ electric energy high-voltage generator is powerful in this market at least 1,000 USA dollars).

Branches which can be developed, results of the development: electrical engineering; electricity; aviation and rocket-space equipment; electro equipment and high voltages and high impulse currents; higher current electronics.

Status of development: Development implemented as a powerful high-current higher voltage Research stationary sample "metal", which has the ability to conduct full-scale testing of aircraft and equipment on the electricity power of lightning resistance.

Results introduction: Development has allowed in 2007 to perform two self-financing topics of SPE "Stalenergo" and STCU in the interests of the American Aircraft Corporation «Boeing», provided an opportunity to participate in an international contract, which was concluded in 2007. SSAU "Yuzhnoye" (city Dnepropetrovsk) signed international agreement with the Chinese Space Corporation.

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APPLIED PHESICS (METROLOGY OF HIGH AMPLITUDE INPULSES ELECTRIC AND MAGNETIC FILDS)

STANDART COMPLEX:

- Units strengths of maximum values of impulse electric and magnetic fields (Standard REMP);

- Units maximum values of impulse voltage - volts, and currents - Amperes (Standard-CH).

The essence of development is to create a highly stable source of high voltage, of the over rapid communicator, coordinated TEM lines that are required for pulse generation unit voltage and current.

Table1.   Basic metrological and technical characteristics of the standard REMP

Working hours	Interelectrode gap working zone, m	Amplitude range		Duration of the impulse front on the level 0,1-0,9, нsec	Duration on the impulse on the level 0,5, msec
		E, kV/m	H, A/m		
1	0,48	1÷100	2,5÷265	6÷8	100
	0,24	2÷200	5÷530	6÷8	100
2	0,48	1÷70	2,5÷185	1	0,5
	0,24	2÷140	5÷370	1	0,5
3	0,48	0,02÷0,1	0,05÷0,27	1	0,1
	0,24	0,04÷0,2	0,1÷0,53	1	0,1

Table 2. Basic metrological and technical characteristics of the standard CH are given

Denomination and characteristic	Dimension	Type of field	
		Voltage	Current
1. Range of the maximal values	V, A	від $1 \cdot 10^3$ до $50 \cdot 10^5$	від 20 до 1000
2. Time of the front	sec	$9,5 \cdot 10^{-9}$	$8,3 \cdot 10^{-9}$
3. Time of the impulses	sec	$1,27 \cdot 10^{-4}$	$1,27 \cdot 10^{-4}$

Economic appeal of the elaboration for market promotion, application and realization, parameters, price, promotion is possible on the world market, in countries of the Pacific economic region. Price is determined depending on the goal.

Branches which can be developed: aviation and space industry.

The state of developments: Standards implemented as existing models.

Results of implementation: is used for research of metrological characteristics of measuring pulse voltages and currents.

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APPLIED PHESICS (MECHANICAL ENGINEERING)

Infinitely variable hydrostatic-mechanical transmission (GOST) for agricultural tractors and combines

Basic characteristics, essence of elaboration:

The prototype was first synthesized, developed in NTU "KhPI" and manufactured by JSC "KHTP" to increase productivity and significantly improve the ergonomics of the tractor. GOMT is a knowledge-intensive subject, protected by patents and scientific publications. Scientific support for the project GOMT and supervision in the manufacturing process was carried out with the participation of NTU "KhPI". The original continuously variable hydrostatic-mechanical transmission developed by NTU "KhPI" and JSC "KhTZ" for the first time in the former Soviet Union successfully tested on a series of tractors HTZ-170/240 and is designed for engines of 125 ... 176 kW (170 ... 240 hp) .

GOMT has 4 technology towing speed range in forward motion and 2 - in the reverse direction, each of which is infinitely adjustable speed and traction of the tractor.

Tractor HTZ-242K in forward motion the following speed ranges are realized:

Forward motion 0 ... 9.6 km / h; 0 ... 13.2 km / h 0 ... 22.0 km / h 0 ... 40.0 km / h, and in the reverse-0 ... 13.2 km / h 0 ... 40.0 km / h.

Circuitry GOMT provides summation of power flows, running up to hydraulic and mechanical branches on the output differential with further access to the transfer box, axles and drive wheels.

Synthesis of structural parameters of GOMT are accomplished according to the principle of maximum efficiency in the implementation of the basic technological operations at the tractor (plowing, disking, harrowing, cultivation, crop, transport trailer, etc.). This enables efficient operation of the tractor during engine operation modes in the implementation of maximum power and minimum fuel consumption.

Economic benefits:

Application of the GOMT gives the chance to receive new consumer qualities of the tractor, while maintaining its place in the budget segment of the market of wheeled tractors. Contract price

Areas of use:

Developed GOMT can be used for agricultural enterprises.

Results of implementation:

Prototypes GOMT are manufactured by JSC "Kharkiv Tractor Plant".

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NEW MATERIALS (CERAMIC MATERIALS)

Glass crystalline composite materials of the functional purpose

Basic characteristics, essence of elaboration:

In order to develop materials which are characterized by special physical, chemical and mechanical properties developed scientific basis structurally controlled synthesis Glass crystalline coatings and composite materials with have complex controlled properties. On the basis of the obtained patterns developed technology of composite materials for the intensified heat treatment regimes. Such materials are characterized by high technical parameters, for example heat resistance of 450 ° C; wear resistance no more 0.018 g/cm^2; Mohs hardness 6-6.5; TCLE · 10-6 K-1 - 4-5,7; Specific volume resistance 102-7,59 -1.2 · 102 ohm · m (coating); chemical resistance to acids - 99,8-99,9%, alkalis - 91.8 - 92.0%.

Comparison with world analogues:

New **Glass crystalline** composite materials are unique both in efficiency and production technology. At present there are no domestic and world analogues ceramic materials of such type. They contain a range of physical and chemical properties and performance characteristics inherent in both constructive and decorative ceramics and indicators are at best foreign analogues.

Economic appeal of the elaboration for market promotion, application and realization, parameters, price:

Introduction and manufacturing technology of the Glass crystalline composition materials allows to receive durable and environmentally friendly construction materials.
Price development is 75 thousand Dollars.

Branches, ministries, departments, enterprises and organizations, where the results of research can be realized:

Developed ceramic composition materials and coatings can be produced by modern technologies by using high-speed heat treatment regimens, on operating equipment of enterprises ceramic industry. These materials may find their application as structural and protective elements in the chemical, electronic and electrical industries, the products of high pulse technology.

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APPLIED PHESICS (RENEWABLE ENERGY)

Photoenergy system with a concentrator of solar radiation

Description

Based on a critical analysis of existing designs of heat exchangers the optimal design of the heat exchange unit for efficient conversion of solar energy into thermal energy will be calculated. For this heat exchanger the design must ensure turbulent flow of the coolant, which will increase the heat transfer coefficient over 20,000. To achieve the desired thermal characteristics a mathematical model of heat exchange processes will be established in a block to determine the conditions for the realization of the turbulent flow. A circuit solution will be developed to organize individual industrial samples of solar cells based on gallium arsenide with efficiency up to 36 % as parts of a mini solar battery. It is planned to develop thin film heterostructures for a thermal contact of solar battery with the heat exchange unit, which will provide the necessary adhesion to the module surface alongside with dielectric strength and thermal conductivity with the aim to create an experimental sample of the PV module. An optimal choice of for the accumulation of thermal energy components system required for the storage of certain power of the generated thermal energy and for its further use will be conducted. An optimal choice of components required for the storage of certain power of the generated thermal energy and for its further use will be conducted. Sketch project documentation for the experimental sample of thermal energy storage system will be prepared. According to the mathematical modeling results optimal structural and electrical circuit control system will be designed and created. The control system will include digital components and microprocessors. Algorithm of the control system will be developed. The advantage of the algorithm of this system is the orientation of its position relative to global coordinates obtained from GPS satellites, which eliminates the need for the customization and gives control systems without reprogramming of the installation when placed in different regions or if it changes its position.

Innovative Aspect and Main Advantages

The principal differences of the ideas of the Project to establish a photovoltaic installation are innovative economic and constructive approaches. In the last several years, China has mastered the industrial production of multijunction photovoltaic cells based on the structure In-GaP/InGaAs/Ge. Such devices with 1 cm^2 area of the frontal surface cost $ 10 have an efficiency level of 36 % and maximum power delivered to the load 17 W/cm^2 at 470-fold concentration of solar radiation on the surface of the photodetector. They differ in a stable operation under concentrated solar radiation and, most importantly, have a working temperature reaching 70 ºC. The last significantly reduces the requirements for the cooling system, allowing its simplification and reduction the cost of its construction. In the Project to reduce the cost of the concentrator while maintaining high optical characteristics an easy and cheap aluminum foil of Alanod brand with a reflection coefficient of 95 % will be used. Reducing the cost of the concentrator while maintaining the technical specifications for its use in the construction of the concentrator photovoltaic installation (concentration, diameter of the hub, incoming radiation angle, focal spot diameter) is planned to reach by the replacement of the massive metal edges and metal parabolic segments of the classical hub on the light polystyrene edges and by the mounting of the segments with parabolic-cylindrical shape made of thin metal foil of Alanod firm on their surface as reflective coatings. With their large-scale production and widespread use these advantages allow receiving solar power cost about $ 0,1 per kW·h. Price of one photovoltaic installation will be about $ 2000, taking into account the cost of production. Social benefits of the results obtaining in the Project is to build innovative photovoltaic installation on existing domestic enterprises, which competitiveness in the foreign market is provided by the electricity cost reduction, increase in its average daily generation and utilization of heat energy for the needs of the users.
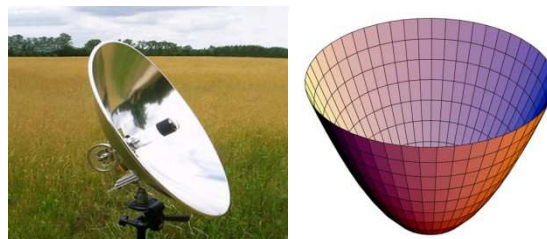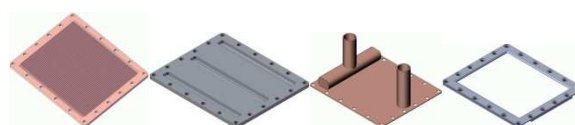

Fig.1 - Concentrator

Fig.2 - Heat exchanger

Expected results:

According to the results of the Project an industrial model of the photoenergetic installation based on photovoltaic cells on the GaAs compound basis will be created. The sketch design documentation for the photoenergetic installation including drawings of photovoltaic module and the hub, wiring diagrams of positioning and control system, a block diagram of algorithm of their operation, a set of documents of sketch design of the photoenergetic installation, electrical wiring of the hardware complex of the photoenergetic installation and block diagram of the operation will be created.

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Automated complex certification solar cells based on LED simulator with improved spectral characteristics and functionalities

Description

The development of cost-effective automated measuring complex, consisting of solar simulator based on light-emitting diodes, microcontroller control system, associated software, which allows certification of solar cells express on their current-voltage characteristics — is relevant. The Project will use modular design of the radiating element simulator whereby powerful super bright LEDs are included in the light-emitting cells, which are symmetrically arranged on the surface of the radiating element, which allows easy addition of additional cells to increase as the radiation power and the area in which implements the required irradiation modes. The device is supposed to perform as a prefix to the personal computer (PC). The device will provide conversion coming from the computer control of a digital signal to analog form and its subsequent submission to the actuators to create the desired physical measurement conditions. Device will be implemented at the hardware level optimal principles for physical parameters measuring of the test sample — current and voltage, and their subsequent conversion into digital form for transmission to a PC. Exchange of digital information with installed on your computer program control and data management, is expected to produce a standard interface for USB. The project is assumed to develop a computer program to determine the parameters of the equivalent circuit of diode structures, as well as the output characteristics of solar cells The basic idea, which is supposed to lay in the program, based on the approximation of the experimental light and dark current-voltage characteristics of solar cells using a known theoretical expressions for these current-voltage characteristics (CVC). As an optimization function is used functional obtained for the least squares method on the basis of the theoretical expressions for the CVC and the experimental data on the measurement of current-voltage characteristic.

Innovative Aspect and Main Advantages

The principal difference of the project ideas from the analogues is the use of previously proven authors modularity radiating element simulation, according to which the powerful (not less than 15 W power consumption) over bright LEDs included in the light-emitting cells, which are symmetrically arranged on the surface of the radiating element allowing easy addition of additional cells to increase as the radiation power and the area on which implement the required irradiation regimes. Each cell contains a light emitting from 4 to 6 LEDs with wide $450 \leq \lambda \leq 1000$ nm emission spectrum and is equipped with active cooling of the LED. To control the operation of the simulator and implementation of the automated measurement of current-voltage characteristics of solar cells will be used microcontrollers with ARM architecture. This will allow, using the programming language C+, implement an automatic power control and the LEDs mode in the composition of the simulator (from permanent to pulse). Program will also be implemented at the hardware level current and voltage measurements on

the investigated SC. Combined with innovative software for treatment of the solar cells current-voltage characteristics based on the application of the Nildera – Mead algorithm and the method of least squares this complex will automatically determine the output parameters, efficiency, light diode characteristics of solar cells, as well as the minority carrier lifetime charge in their base crystals. Use in the complex a relatively small number of powerful super-bright LEDs (200 pieces), microcontrollers with ARM architecture, as well as other standard parts and components in combination with energy-saving over bright LEDs allow several times to reduce the cost of automated complex and the cost of its operation. Impact of the received results on the development of science and technology will be expressed in circuit solutions receiving of the automated complex and work algorithms of control software and also work program algorithms for analytical processing of light-current-voltage characteristics of solar cells that can be used in the development of design and technological solutions to contemporary optoelectronics devices.

Expected results: An automated complex experimental sample of certification of solar cells based on LED simulator with improved spectral characteristics, and functionality and software will be created. Will be made outline project documentation set, including drawings of solar radiation simulator frame structures, electrical schemes of simulator power supply and control, the electrical schemes of the device for the automated measurement of current-voltage characteristics of solar cells, block — diagrams of software algorithms which control the automated complex and carries out current-voltage characteristics automated processing, the code listings.

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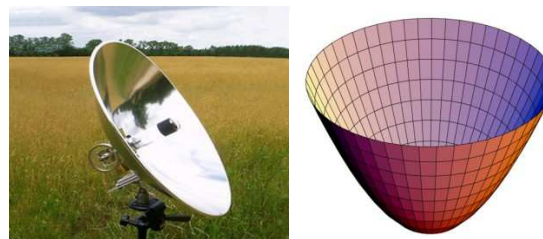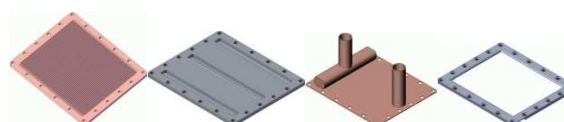

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APPLIED PHYSICS (RENEWABLE ENERGY)
Automated complex certification solar cells based on LED simulator with improved spectral characteristics and functionalities

Description
The development of cost-effective automated measuring complex, consisting of solar simulator based on light-emitting diodes, microcontroller control system, associated software, which allows certification of solar cells express on their current-voltage characteristics — is relevant. The Project will use modular design of the radiating element simulator whereby powerful super bright LEDs are included in the light-emitting cells, which are symmetrically arranged on the surface of the radiating element, which allows easy addition of additional cells to increase as the radiation power and the area in which implements the required irradiation modes. The device is supposed to perform as a prefix to the personal computer (PC). The device will provide conversion coming from the computer control of a digital signal to analog form and its subsequent submission to the actuators to create the desired physical measurement conditions. Device will be implemented at the hardware level optimal principles for physical parameters measuring of the test sample — current and voltage, and their subsequent conversion into digital form for transmission to a PC. Exchange of digital information with installed on your computer program control and data management, is expected to produce a standard interface for USB. The project is assumed to develop a computer program to determine the parameters of the equivalent circuit of diode structures, as well as the output characteristics of solar cells The basic idea, which is supposed to lay in the program, based on the approximation of the experimental light and dark current-voltage characteristics of solar cells using a known theoretical expressions for these current-voltage characteristics (CVC). As an optimization function is used functional obtained for the least squares method on the basis of the theoretical expressions for the CVC and the experimental data on the measurement of current-voltage characteristic.

Innovative Aspect and Main Advantages
The principal difference of the project ideas from the analogues is the use of previously proven authors modularity radiating element simulation, according to which the powerful (not less than 15 W power consumption) over bright LEDs included in the light-emitting cells, which are symmetrically arranged on the surface of the radiating element allowing easy addition of additional cells to increase as the radiation power and the area on which implement the required irradiation regimes. Each cell contains a light emitting from 4 to 6 LEDs with wide $450 \leq \lambda \leq 1000$ nm emission spectrum and is equipped with active cooling of the LED. To control the operation of the simulator and implementation of the automated measurement of current-voltage characteristics of solar cells will be used microcontrollers with ARM architecture. This will allow, using the programming language C+, implement an automatic power control and the LEDs mode in the composition of the simulator (from permanent to pulse). Program will also be implemented at the hardware level current and voltage measurements on the investigated SC. Combined with innovative software for treatment of the solar cells current-voltage characteristics based on the application of the Nildera – Mead algorithm and the method of least squares this complex will automatically determine the output parameters, efficiency, light diode characteristics of solar cells, as well as the minority carrier lifetime charge in their base crystals. Use in the complex a relatively small number of powerful super-bright LEDs (200 pieces), microcontrollers with ARM architecture, as well as other standard parts and components in combination with energy-saving over bright LEDs allow several times to reduce the cost of automated complex and the cost of its operation. Impact of the received results on the development of science and technology will be expressed in circuit solutions receiving of the automated complex and work algorithms of control software and also work program algorithms for analytical processing of light-current-voltage characteristics of solar cells that can be used in the development of design and technological solutions to contemporary optoelectronics devices.

Expected results: An automated complex experimental sample of certification of solar cells based on LED simulator with improved spectral characteristics, and functionality and software will be created. Will be made outline project documentation set, including drawings of solar radiation simulator frame structures, electrical schemes of simulator power supply and control, the electrical schemes of the device for the automated measurement of current-voltage characteristics of solar cells, block — diagrams of software algorithms which control the automated complex and carries out current-voltage characteristics automated processing, the code listings.

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