Institute of Optics

2020 scientific-research works

Report

Tbilisi

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Contents

Priority 2.

1. Laser target-target pointer

In modern armed conflicts and high-risk police tactical operations, laser target pointers are increasingly used (there is such a standard tool in the US Armed Forces). The world market is mainly represented by infrared lighting (used in conjunction with night vision target), visible lighting (mainly green or red) as well as combined infrared and visible lighting target indicators. It can be attached to any firearm that has a picatinny holder (bracket).

Laser target-pointers can be used effectively to control demonstrations and riots. During demonstrations or riots, law enforcement officers will be able to mark an individual to appease or detain him or her. In addition to law enforcement and law enforcement agencies, laser target pointers can be used by hunters, hunters, eco-tourists, and more. At present, the Georgian Armed Forces and law enforcement agencies, except for elite units, do not own the existing equipment.

The project aims to produce several experimental models of laser target-target pointers with infrared, visible and combined infrared and visible lights. The device will be equipped with target markers. The device will have a lower price compared to its Western counterparts. Equipping the Georgian Armed Forces and law enforcement agencies with these tools is an urgent task.

The following works were carried out in 2020:

Study of the target target laser on the world market. Consultation with the personnel of the Georgian Armed Forces to consider their requirements. Laser target-target pointer calculation, mathematical modeling;

Establish, order, purchase a list of materials, tools and equipment required for the work.

2. Replacement of polymer details with glass details in optical systems

One of the priorities of the Institute is the development, testing and preparation for production of various types of optical devices (mainly optical sights and surveillance devices). The Institute has been carrying out relevant work in this direction for years.

Organic materials were used for optical details when we created the optical night vision device, which makes it relevant to supplement such devices with organic materials. Due to the availability of such materials, cheapness, lightness, simplicity of technology. However, to achieve such a high quality device, we are considering replacing some (units) of optical details with optical glass.

The aim of the project is to determine the requirements for the NWM-34 night vision monocular processed at the LEPL Institute "Optics" and to bring the manufactured sample in line with these requirements, to process it to the level of serial production, which requires further refinement of existing sample details or their optical (any) With glass detail.

The following works were carried out in 2020:

Identify the needs for night vision monocular and create an appropriate laboratory area;

Modernization and re-equipment of the software management toolkit for the production of glass optical details - lenses.

3. Development of methodology for making aspherical polymer lenses

In modern optical systems, in addition to classic spherical lenses, the world's leading optical firms widely use aspherical lenses. Aspherical switches were designed and manufactured by us. This project envisages the continuation of this work, in the direction that using higher level technologies, it will be possible to create aspherical lenses that will be used in optical systems.

The following works were carried out in 2020:

Creating technological code;

Establish, order, purchase a list of materials, tools and equipment required for the work.

4. Development of innovative technology for the formation of protective and multilayer dielectric layers of radiation for optical details made at the Institute of Optics

The main goal of the project is to develop and plan the design of innovative planar magnetic emission device and submersible devices. Production of experimental samples according to the design documentation created within the project; Modernization of VU-1A type vacuum unit, which involves the installation of magnetrons (at least two) and sub-device designed and manufactured within the project. As a result of the modernization, the laboratory vacuum coating equipment for the formation of protective and multilayer dielectric layers on the optical details made at the Institute of Optics will be created. The mentioned equipment will be tested, its technical and technological data will be studied and analyzed; Using the laboratory vacuum coating equipment created within the project, studies related to the development of technological regimes for the formation of protective and radiation multi-layer dielectric layers will be carried out. Innovative planar magnetron emission device will be based on the technology of formation of protective and radiation multilayer dielectric layers and a fundamentally new type of laboratory coating equipment.

Innovative magnetron emission device and related technology are being developed at the institute in order to form protective and multi-layered dielectric layers on optical details and to obtain nanomaterials. As part of the work, the 3D model of the magnetron was refined and refined in 2020, drawings were prepared for articles to be published in international journals and for international conferences, the details of the magnetron block were selected and ordered.

5. Development of technology for calculating and manufacturing Fresnel lenses and prisms

The use of Fresnel lenses and prisms in optical systems, as well as in power plants and in various types of technical and household appliances, in many cases significantly simplifies the design of the relevant equipment, reduces their cost, facilitates their operation and organization of serial production. Fresnel lenses and prisms are characterized by a great variety of optical materials, dimensions and shapes used. However, with obvious advantages, Fresnel lenses, compared to other optical elements (e.g., conventional lenses), are characterized by certain disadvantages, two of which are the most important: low energy efficiency and a small range of change in optical parameters. It is therefore an important technical task to develop technologies for calculating and manufacturing Fresnel lenses and prisms that will reduce these shortcomings.

The aim of the presented project is to create the technology of calculation, manufacture and control of Fresnel lenses and prisms with different purposes and technical parameters on the basis of the existing experience at the Institute "Optics" and to make it practical.

The following works were carried out in 2020:

To study the possibilities and perspectives of using traditional and new optical materials for making Fresnel lenses;

Develop software to calculate Fresnel lenses and optimize their integration into various optical systems.

6. Monitoring fluid flow modes through fractal analysis of the fluctuations of the laser beam intensity in it

The aim of the project is to determine the moments of change of fluid flow regimes as well as the formation of critical thermal loads on the surface of the shutters by analyzing the fluctuations of the intensity of the laser beam leaving the liquid. These methods can be useful for creating various emergency and control systems.

Within the framework of the project, in 2020, construction and installation works of mechanical and electronic parts of the experimental equipment were carried out. A block of experimental data collection, processing and analysis was created on the basis of Arduino technology. Work has begun on developing its own software based on MathCAD. A scheme for conducting experiments and analyzing the results is being developed.

7. Development of a new, innovative innovation-based magnetron ion-plasma ablation device for the production of nanometer-sized materials in a vacuum and studies of materials obtained by this method

The aim of the project is to create a new, innovation-based magnetron ion-plasma ablation device on the basis of a VU-1A vacuum unit operating in a vacuum deposition laboratory, which will allow us to develop a nanometer-sized metallurgical mass with qualitatively new characteristics.

The novelty of the work lies in the development of a new modification system of magnetron ion-plasma ablation in vacuum, which is manifested in the realization of rigid and controlled modes of magnetron emission. As a result, it will be possible to develop effective processes of cascading decomposition of microprocessors in the high-intensity plasma zone of ablation and magnetron scattering on the target surface.

In the planar magnetron emission device (PMGM) previously constructed and manufactured by us, microparticles injected from the erosion zone of the metal target (only, in cases of special modes) are charged as a result of electron zenification in the high-intensity plasma zone and move to the so-called. In the unstable condition of Relevski. From this state begins the cascading decomposition of charged microdroplets, and the final product of decomposition is nanometer-sized particles of metal target material.

According to the recently developed Georgian patent (GE P 2015013835 B 2015-05-28) and international patent application (WIPO | PCT, WO 2016/189337 A1, Date of publication № WO 2016/189337 01.12.2016), PMMM magnetic block By adjusting the distances between the poles of the magnetic matrices (which is unique, unlike similar magnetron devices available to date), it became possible to change the magnetic field tension configuration on the target surface. This change allows, first in the narrow band of erosion of the metal target and then (as a result of the rotation of the magnetic system), the distribution of the density distribution of the discharge currents over its entire surface. This, in turn, together with the regulation of the rotational speed of the magnetic system, leads to the realization of rigid and controlled modes of the planar magnetic emission device with the rotating magnetic field. It is possible to effectively manage the processes of cascading decomposition of microprocessors by ablation on the surface of the metal target and then in the zone of intense plasma.

The main goal of the project is to create an innovation-based magnetron ion-plasma ablation equipment in a vacuum, which includes:

Creation of PMGM construction protected by Georgian patent and international patent application in 3D format and processing of working design documentation;

Making an experimental sample of the device and testing it;

Installation of the developed device under the cover of VU-1A type vacuum machine and testing of the equipment;

Obtaining test samples of nanometer-sized materials on the created equipment and researching and analyzing the obtained materials.

In 2020, the creation of design drawings and documentation for magnetrons was completed. The production site was modernized, a lathe was turned into a machine for processing massive stainless steel products. According to the design drawings, two bodies of innovative magnetron, designed by us, are made of massive stainless steel on a lathe. Painting and installation works are currently underway to bring the magnetrons into working condition.

Due to the quarantine regime related to Covid-19, not all planned works related to the project could be completed.

The above projects implemented in 2020 have been heard and discussed at the Scientific Council.

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