Технічні науки

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INTEGRATIVE MODULES FOR ELECTRONIC SYSTEMS, INCLUDING LASER DIODES

Integrative Modules for Electronic Systems, Including Laser Diodes, with an Intensive Cooling System Based on Diamond-Copper Composite Materials

Summary. *The laws and practices of the integrated development of technical systems and over-systems in the context of the use of quantum computers and their simplified modifications, combined with embedded elements of artificial intelligence and artificial neural networks.*

The influence of digital technologies with elements of artificial intelligence and artificial neural networks on the industrial design process, as well as on the appearance and nature of modern technical systems of varying complexity.

Today, when computer-aided design methods, particularly those from the SolidWorks software family, which can be rightfully identified with artificial intelligence, have deeply penetrated the process of making technical and technological decisions, the number of facts and characteristics of a technical solution and its development, up to the technical supersystem, becomes so significant that it requires local alignment with definitions, provisions, and methods for identifying the entire hierarchy of technical decisions—from local technical solutions with uncontrolled technical and technological links to subsystems, and to the most complex conglomerate of local technical solutions, the supersystem.

As the tasks faced by the processes of development, modernization, and optimization of technology and technique become more complex, local isolated

solutions no longer satisfy clients, who seek ways to achieve the ideal final result. The reality forces them, in order to solve complex problems, to look for compositional, integrative, and comprehensive software solutions, in accordance with the terminology and definitions optimized by the author of this book in his previous relevant publications.

Since the issues of identifying all types and levels of technical solutions primarily affect the possibilities of system protection for the created and developing intellectual property, both at the level of active and effective subsystems, as well as at the level of active accumulators of properties and characteristics of subsystems—technical supersystems.

Keywords: *Diamond-Copper Composite, Integrative Module, Module for Electronic Systems, Quantum Computers and Their Simplified Modifications, Embedded Elements of Artificial Intelligence and Artificial Neural Networks, Integrative Software Solutions, Complex Software Solutions, Identification of Technical Solutions, Technical Over-Systems, Efficient Energy.*

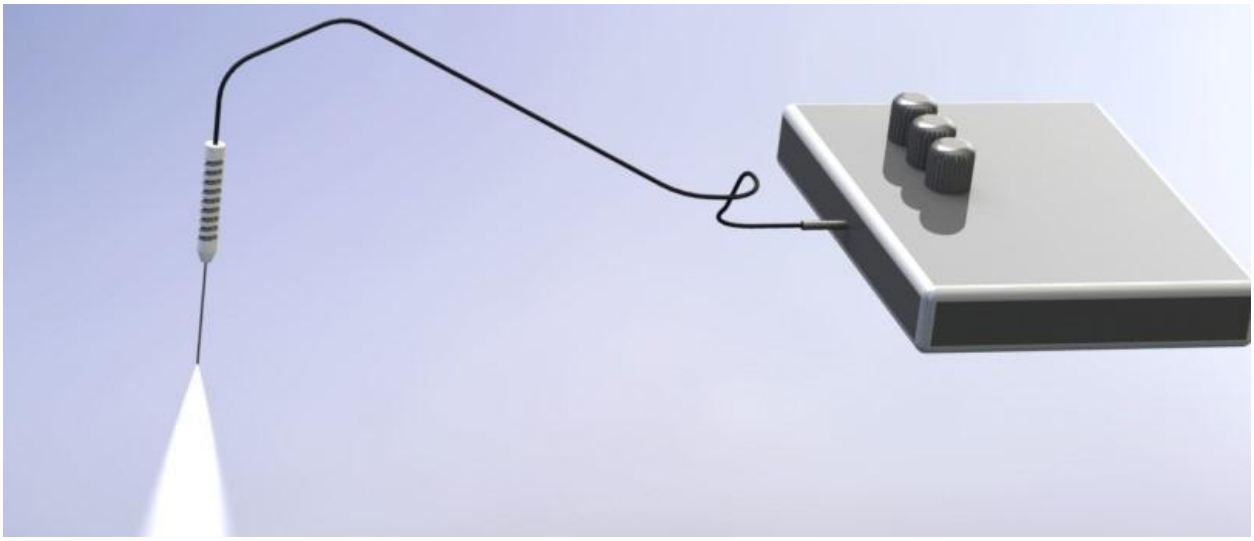
Integrative Modules for Electronic Systems, Including Laser Diodes, with an Intensive Cooling System Based on Diamond-Copper Composite Materials

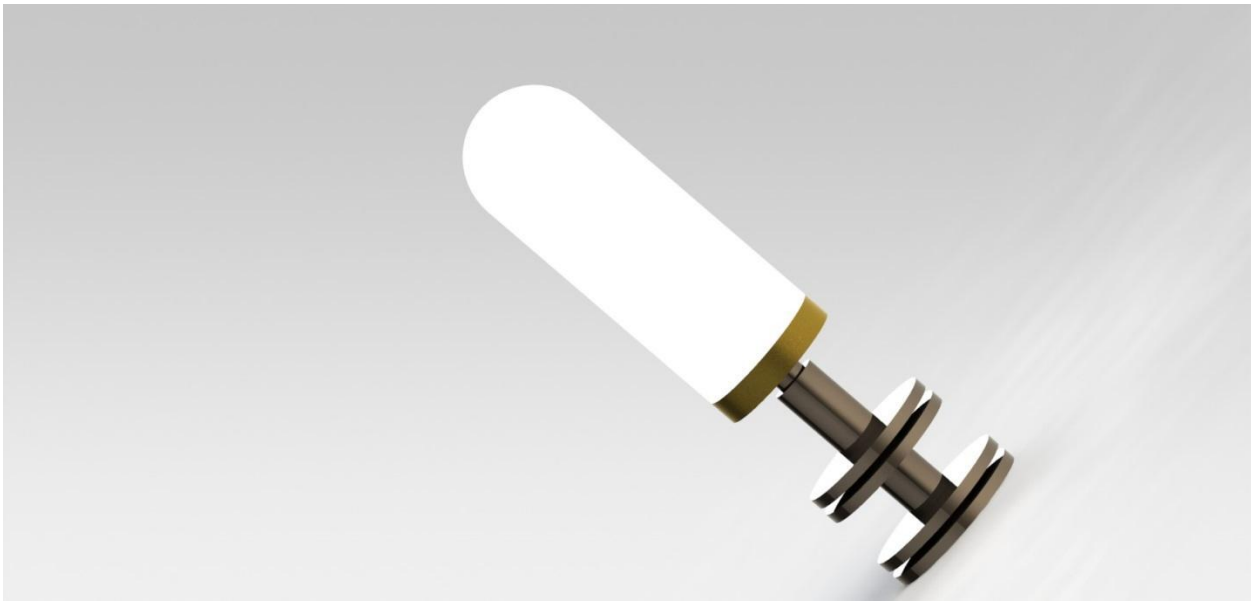
As practice in recent years has shown, one of the main issues and challenges of complex electronic devices, especially those including laser diodes, is the problem of reliable and efficient cooling.

In order to eliminate energy losses and increase the output of effective energy, especially in various lighting systems, there is an active search for integrative technical solutions that allow for efficient cooling without the need for additional structural elements or extra energy costs.

At the same time, there is ongoing research and development of technical solutions that allow for increasing the output light power of lighting devices with

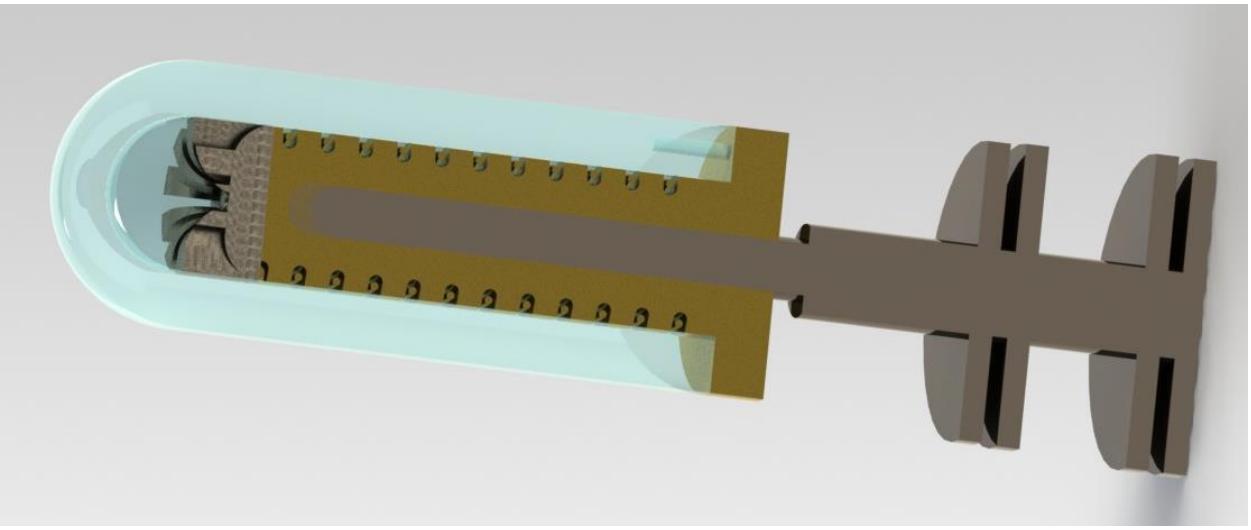
relatively low power and, accordingly, low energy consumption, while maintaining a highly concise and simple design.





The photo shows one of the innovative developments for converting laser radiation into light radiation of conventional and standard light spectra.

The next photo shows the axial section of such a device, which is more convenient for examination and analysis.



As seen in the design of the innovative lamp, the functions of several essential structural elements are combined.

The lamp holder features a vortex radiator, with its axis and discs made from a diamond-copper composite, which is a key component of the lamp's cooling system.

Each part of this system is multifunctional, meaning that in addition to their heat transfer and heat storage functions, the structure of these parts, made from numerous microglobules of the composite material, also performs a crucial role in dissipating thermal flows. This is achieved through the pseudo-porous structure of the composite.

Let's focus on the innovative structure of the diamond-copper composite.

The original process of manufacturing the composite globules begins with the formation of diamond spheres from synthetic diamond, with a diameter of 5 to 7 microns (this size can vary depending on the profile, dimensions of the part, and operating conditions).

After that, on special equipment, these spheres are coated with copper using original innovative technology.

The thickness of the coating is chosen so that, when forming the lamp component in the mold, there is enough ductile material on the diamond spheres to facilitate the liquid metal flow process and simultaneously fill the cavities between the artificial diamond spheres.

As a result, a pseudo-porous structure is formed, in which diamond spheres are evenly distributed. These spheres serve as the best heat-conducting material while having no electrical conductivity.

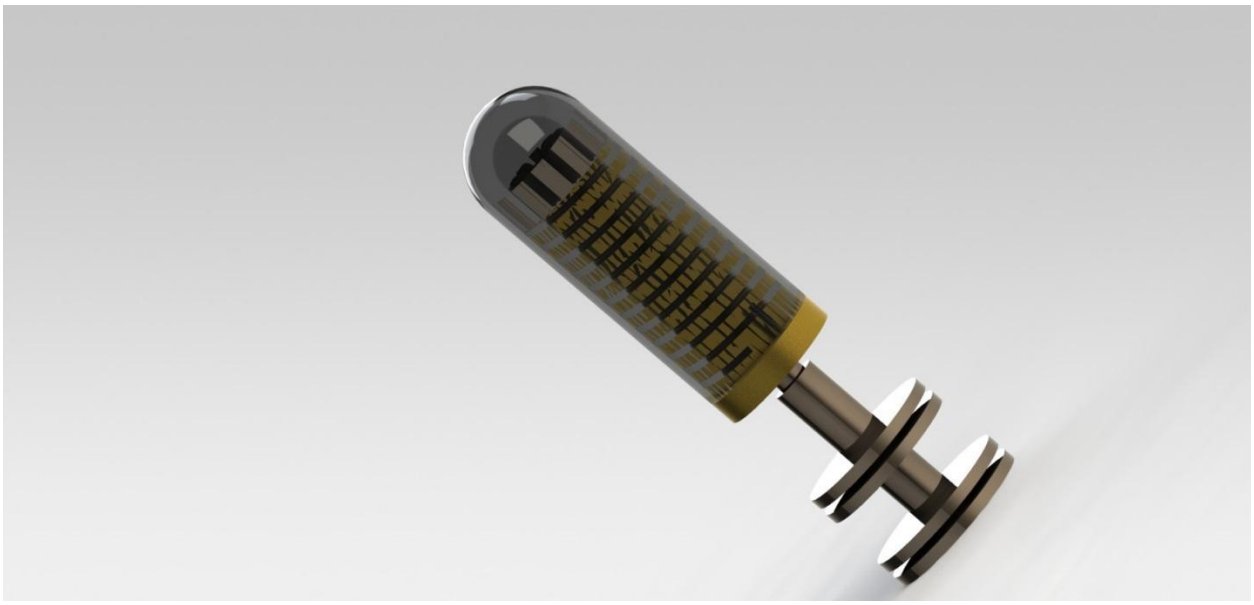
This structure allows for the instant dissipation of heat and its even distribution across the cross-sectional area of the radiator discs.

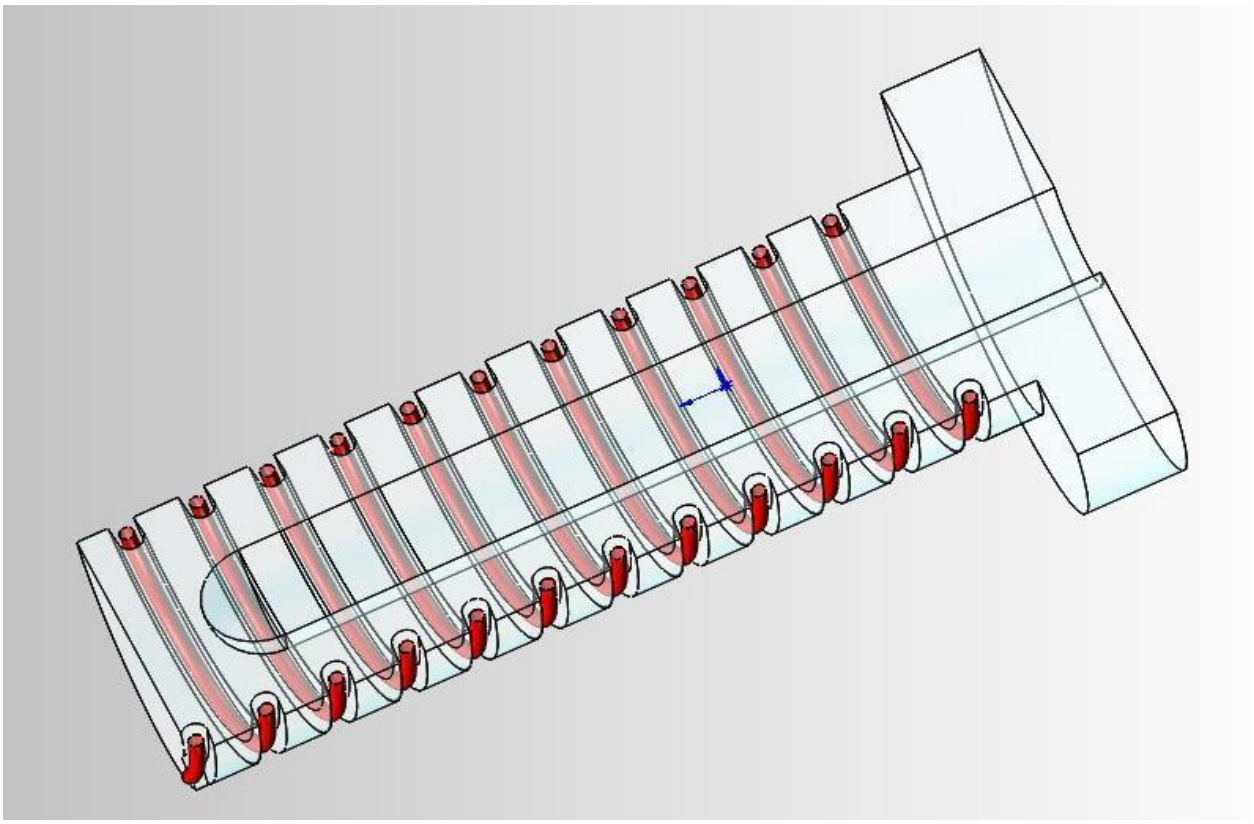
In the spiral grooves of the lamp's housing, an optical cable is placed, through which a laser beam is transmitted from the laser module.

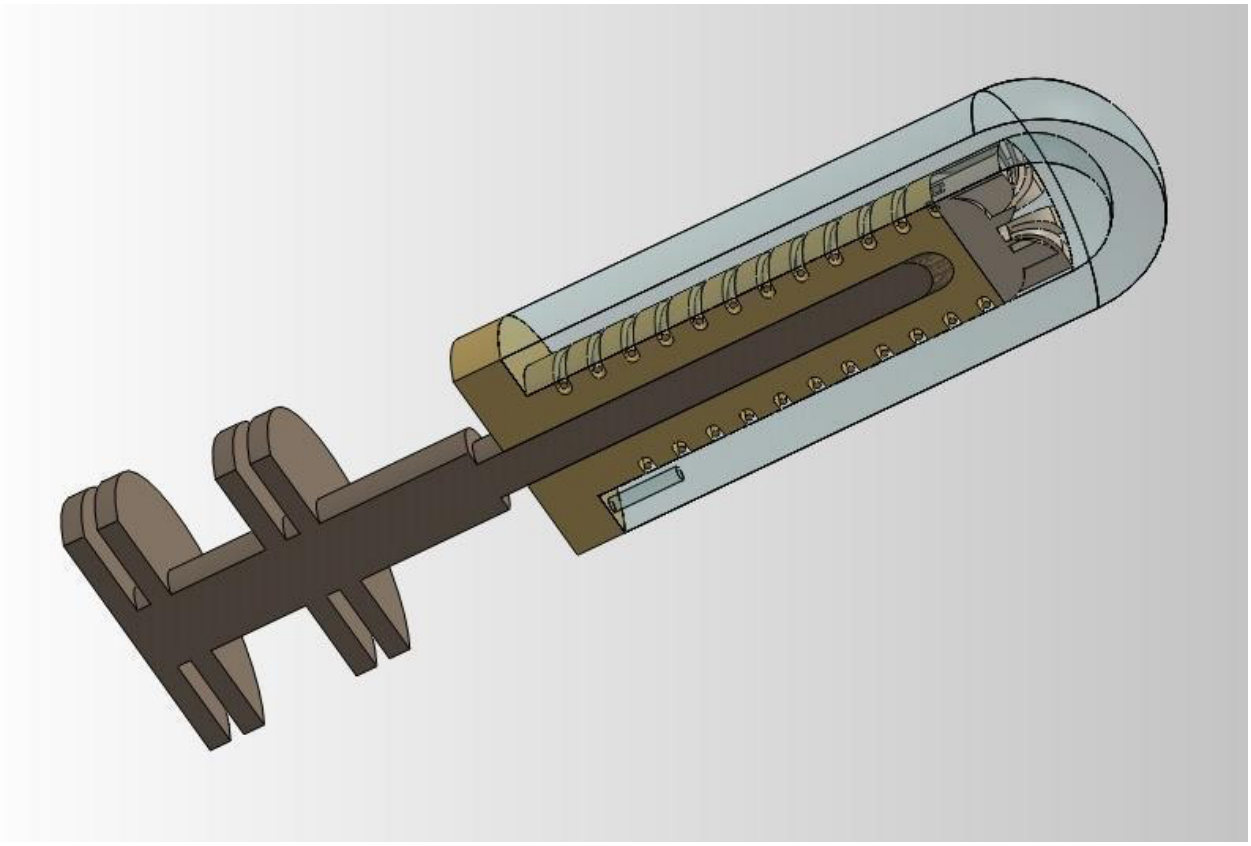
The optical cable is coiled into a spiral and placed in the grooves of the housing at a diameter that causes the cable to emit light along its entire cylindrical surface, which is significantly more efficient than light emission transmitted through the cable's end.

To separate the laser radiation from the lamp's output radiation, a layer of phosphor is applied to the optical cable, designed for a specific emission spectrum.

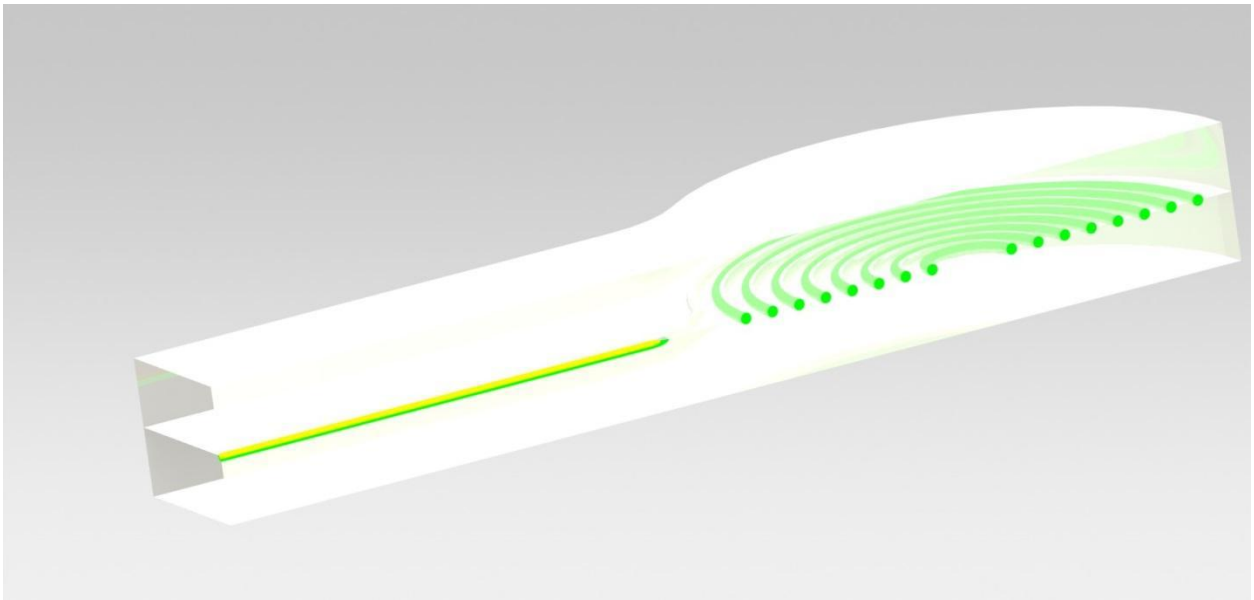
Thus, the final radiation of the lamp is completely non-toxic and, due to an emission area thousands of times larger than that of the optical cable's end, the output equivalent of the lamp corresponds to 60–75 watts, even with a laser diode power of just 1–2 watts.



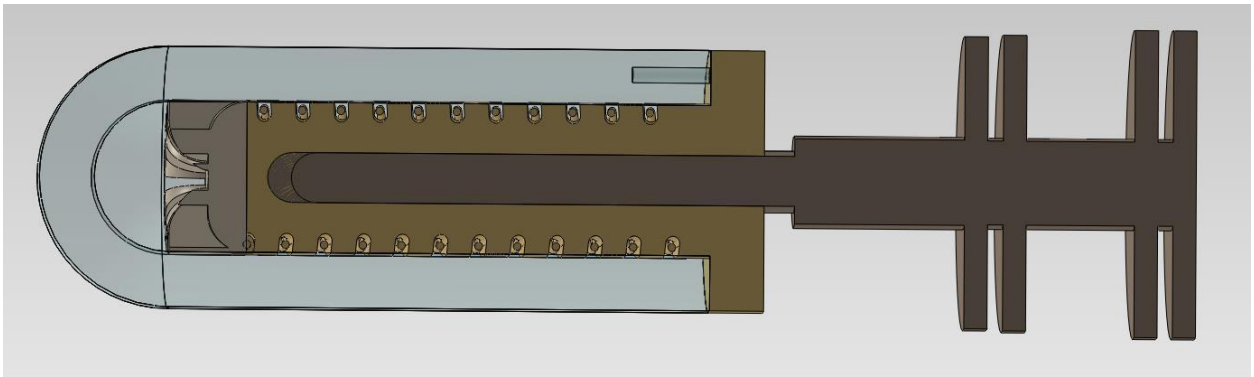




The formation of radiation from the glow of an optical cable bent at a specific radius has many alternatives. For example, as shown in the next photo, a cross-sectional view of an emitter demonstrates how the cylindrical surface of the optical cable begins to emit light at a certain bending radius.



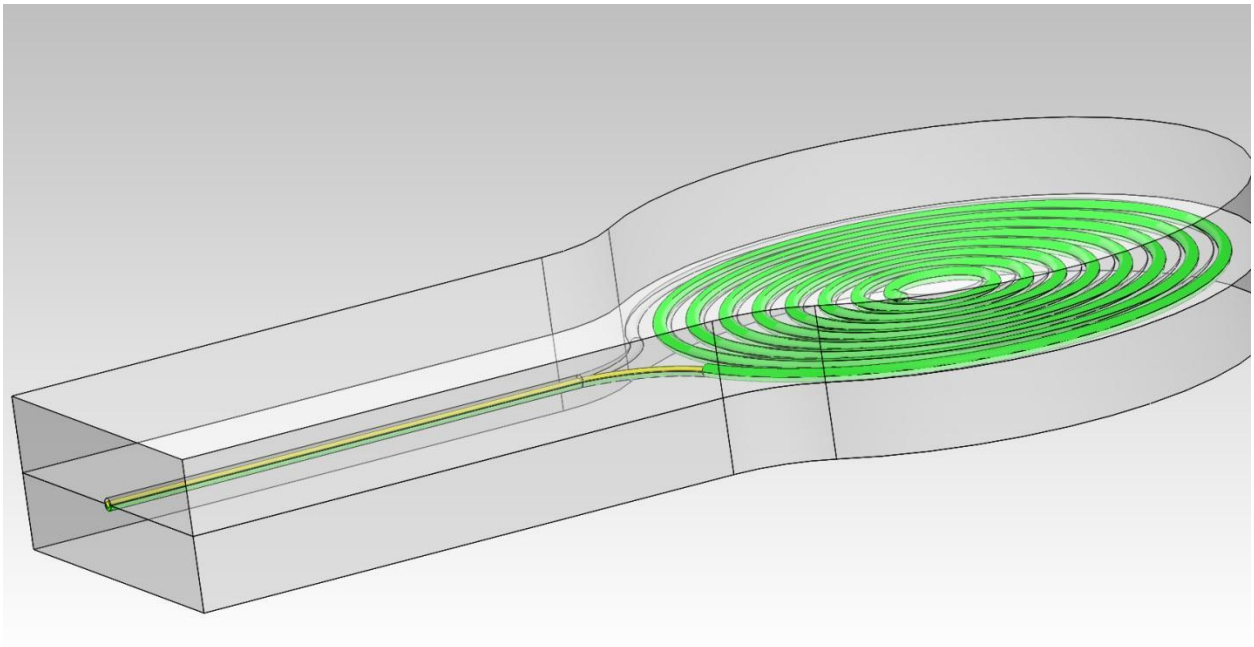
The next photo shows the structural diagram of the lamp in a transverse longitudinal section, where individual technical details are clearly visible. Each of these details carries a specific functional and technical purpose, fulfilling certain technological and conceptual roles.



The proposed design incorporates many innovative elements and, most importantly, is fully ready for serial and mass production. Moreover, the configuration of the lamp, the combination of technological principles, and the structural materials used allow for the future integration of new technical solutions that may emerge during the ongoing development of laser technologies, composite material engineering, and new energy-efficient control and cooling systems.

The next photo shows a mini-lamp in which a mixture of phosphors is applied to the end of an optical fiber according to a specific geometry in a three-dimensional coordinate system, ensuring illumination (emission) in the white spectrum range.

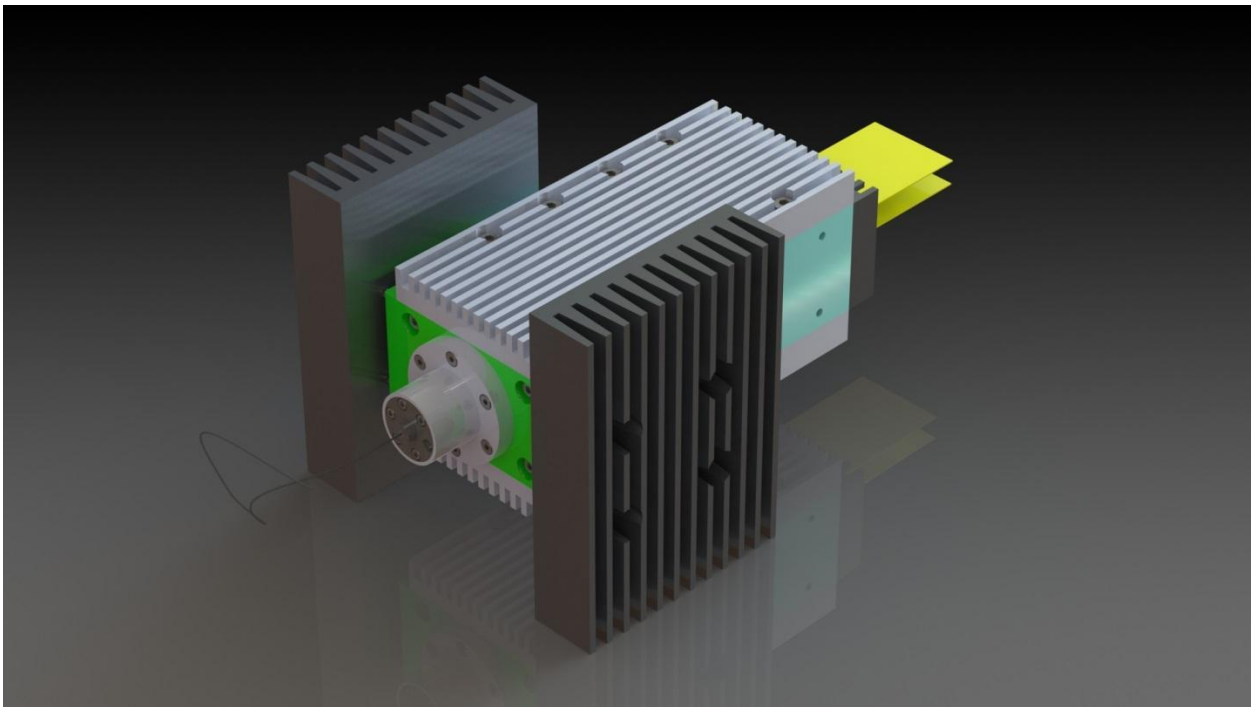
The diameter of the optical fiber is only 120 microns, allowing for the creation of micro-miniature light sources for use in the most compact optical-electronic systems.



The next photo shows a lamp with a flat emitter connected to a single optical fiber.

This system, in addition to its overall cost-effectiveness, allows achieving the required level of illumination in the desired area with minimal costs and maximum simplicity.

This system also allows applying almost any combination or mixture of phosphors to the spiral (flat spiral) part of the optical cable's end, achieving the desired light emission parameters.



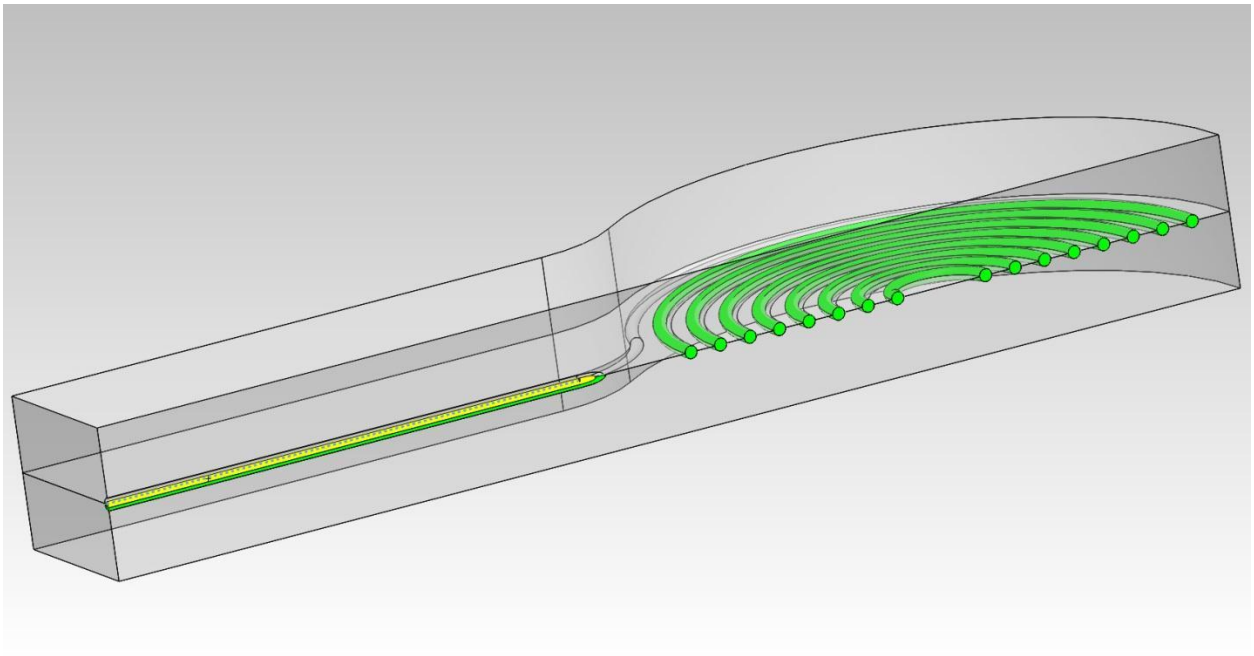
The next photo shows a laser diode module, built on the principles of active cooling through the dissipative effect in parts made of pseudo-porous diamond-copper composite.

One of the innovative integrative features of the presented design is the use of thermoelectric coolers in combination with heat-conducting and heat-dissipating elements in the housing structures of the module.

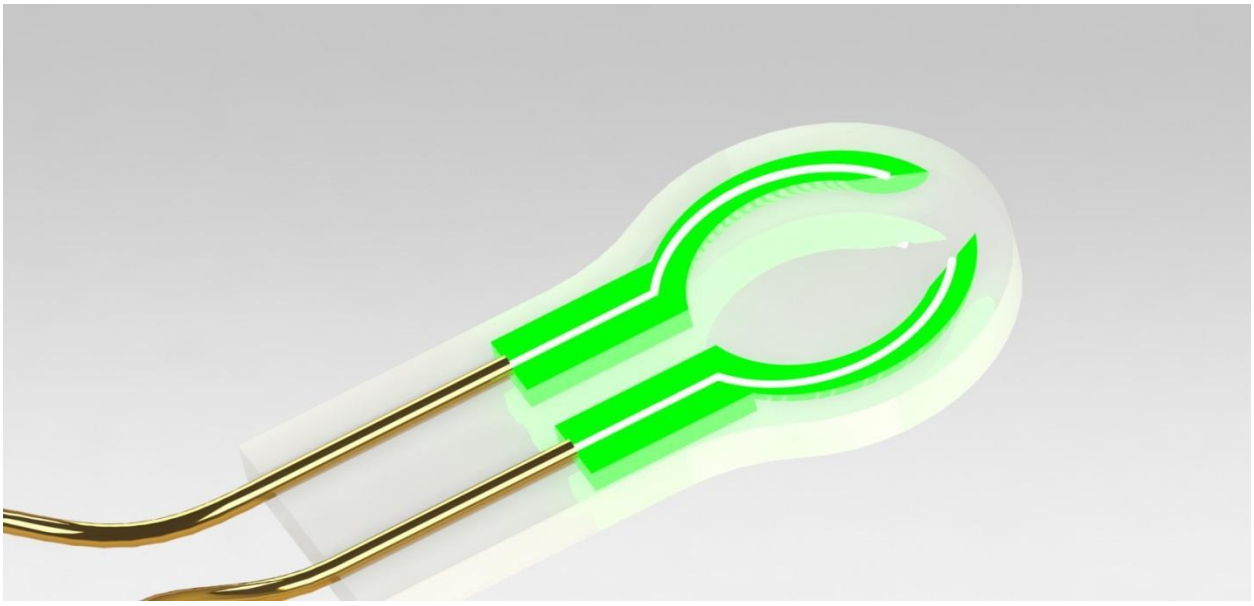
Thermoelectric coolers are positioned between the external radiators and the module housing, with heat-conducting elements in the design directing thermal fluxes from the printed circuit board to the walls of the housing, where the thermoelectric coolers are attached. In turn, the base planes of the radiators are pressed against the thermoelectric coolers, and additional module components that require constant cooling can be mounted on these radiators if necessary.

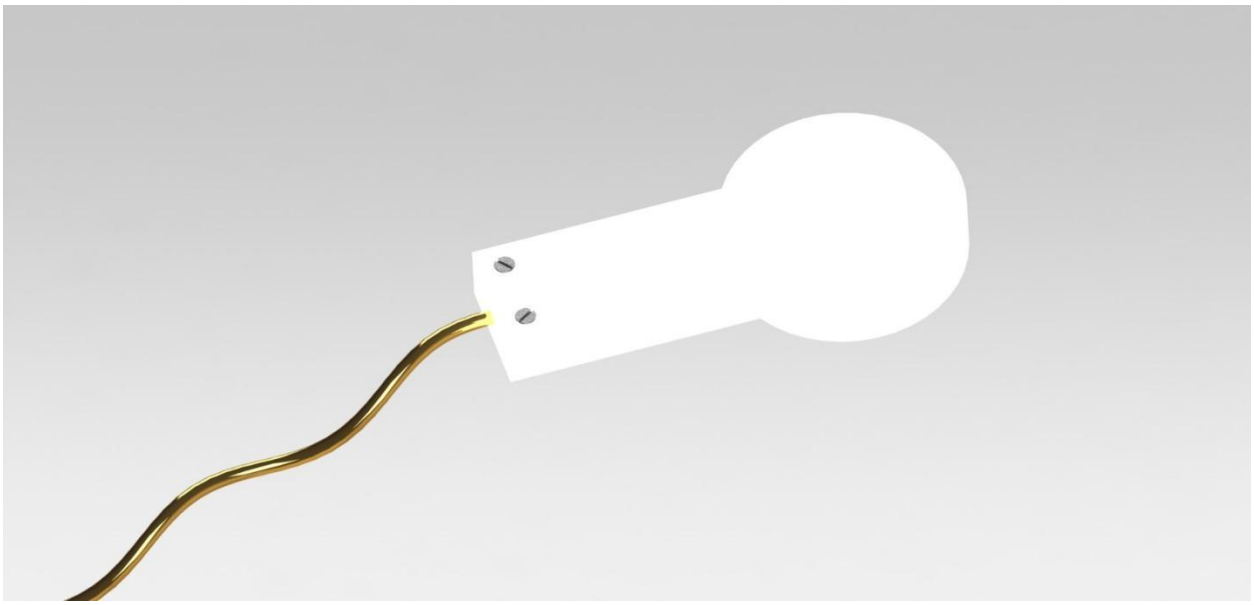
As practice has shown, reliable cooling allows for the maximum stabilization of the output parameters of the laser radiation, which, in turn, significantly expands the range of output systems of the module. If necessary, it also enables the division

of laser radiation between several optical fibers, each of which powers one lighting device.



The photo shows models of such devices.





The most important remains the initial heat extraction directly from the laser diode.

The presented 3D models show the heat-conducting and simultaneously base components for mounting the laser diode in the module housing.

As can be seen from the models, despite its simplicity and technological efficiency, the supporting disc of the laser diode (highlighted in red in the models) completely protects the laser diode from overheating, based on many factors. As mentioned earlier, this significantly improves the stability of the module's operation and reduces energy consumption for lighting.

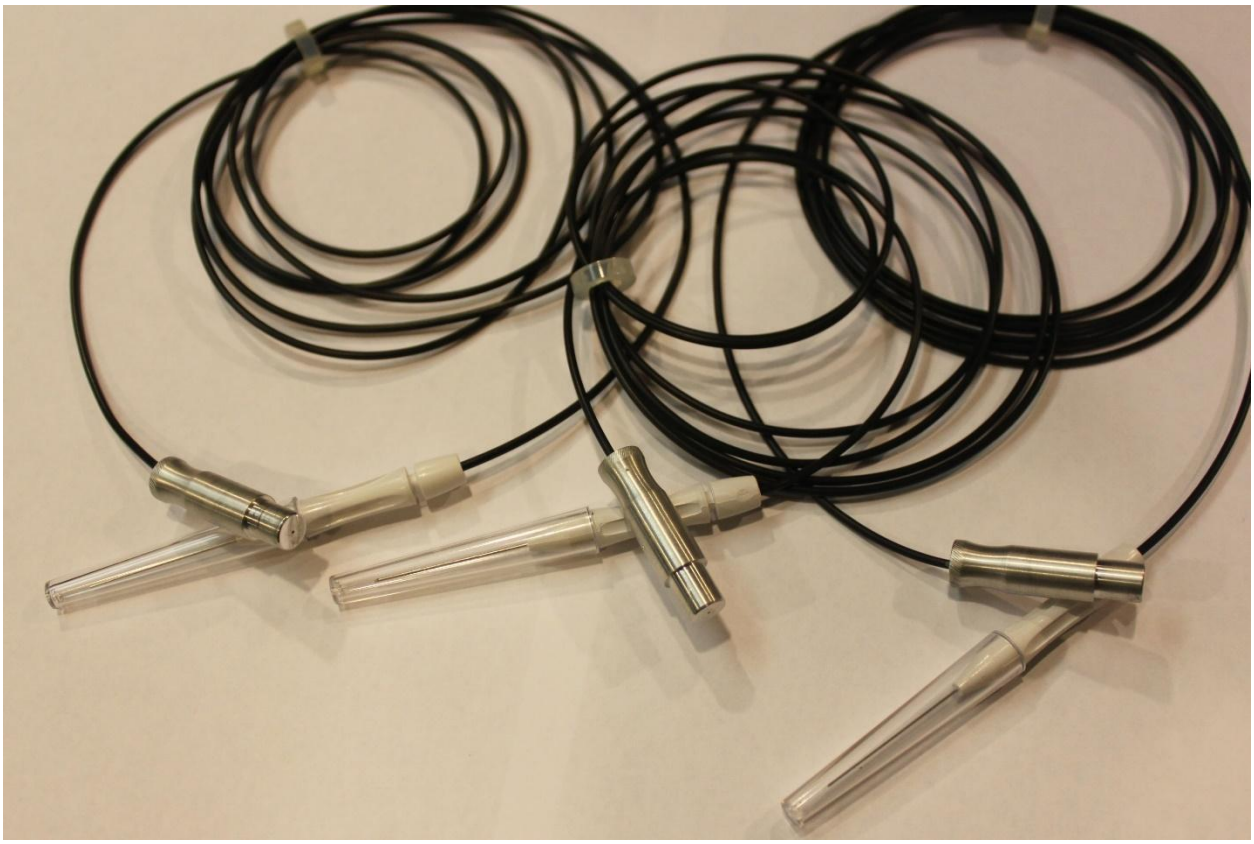
The models also display a coding and decoding system, which allows the identification of optical cables connected to the module with lighting devices.

Such a system allows, in addition to its primary functions, to provide a space for the introduction and control of various computer models for energy management and distribution.

These functions entirely depend on the purpose and operating conditions of the module. The significance for further development of the topic lies in the

possibility of embedding the software component of the system precisely in the most critical area.

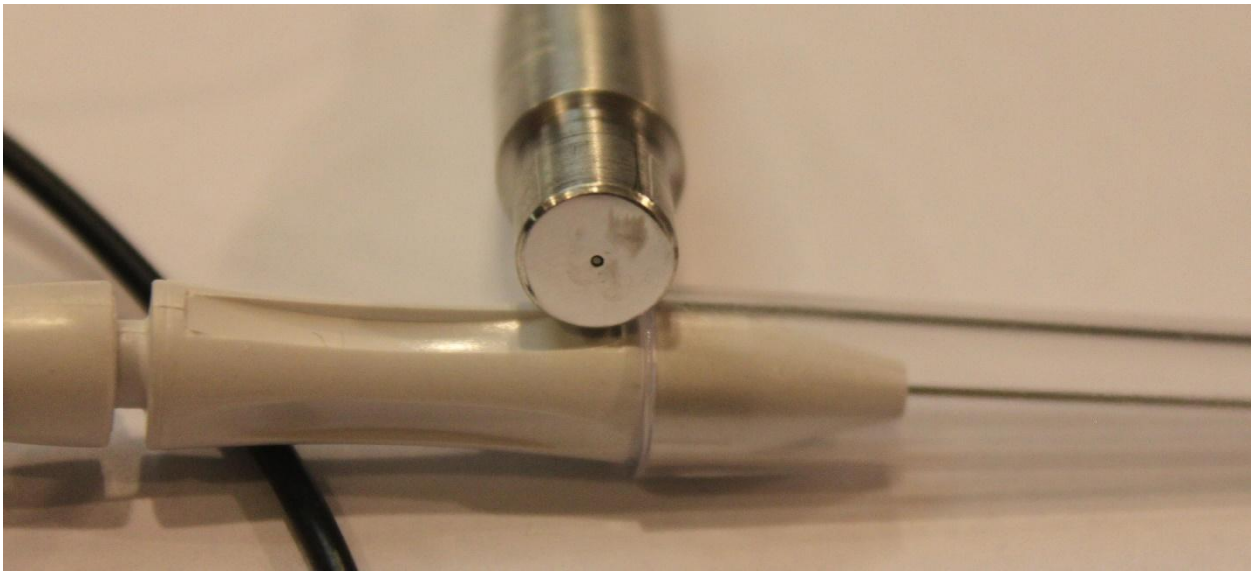
1. Variants of using disks with protective coding in household radio electronics systems



1.1 Discs with protective coding can be used in Blu-Ray and HD DVD systems. In addition, the protective coding system can be applied in new developments and technologies of optical digital memory, including discs with exceptionally high recording density, multi-layered discs, and monolithic optical discs with memory volumes of 1 terabit or more.

1.2 When manufacturing discs, the necessary indication for servo-marking can be introduced during the pressing process; the servo drive of the disc drive begins to orient the laser focus point only when the encoding signal from the encoding and decoding system, formed by a system of three micro-sensors,

coincides. These sensors, using magnetic resonance methods, compare the thickness of the coating with a standard, and when the signal parameters match the standard from at least two sensors, the obtained signal is added to the system of symbols and marking points for servo-marking. Upon reading these, the servo drive of the disc drive starts stabilizing the laser focus on the required track on the disc's recording surface.



2. Variants of using discs with protective coatings in personal computers

2.1 The technology for manufacturing discs for personal computers (PC) is similar to the technology used for making such discs for other types of optical memory.

2.2 The methodology for using discs with protective encoding is developed based on several factors, including the type of computer, its level of sophistication and power, processing speed, and other related parameters.

2.3 It becomes especially important the possibility of using protective encoding techniques and technology in hybrid discs being created, combining a hard disk with an optical disk.

LIST OF USED LITERATURE, PATENT, AND LICENSE INFORMATION

APPENDIX 1-1

United States Patent Application	**202202098 68**
Kind Code	**A1**
Frankel; Michael Y. ; et al.	**June 30, 2022**

Software programmable flexible and dynamic optical transceivers

Abstract

An optical transceiver includes an electro***-optic*** front end; a digital-to-analog converter (DAC) and an analog-to-digital converter (ADC) connected to the electro***-optic*** front end; and one or more Field Programmable Gate Arrays (FPGAs) connected to the DAC and the ADC, wherein the one or more FPGAs are connected to one or more of a local memory and a remote storage for loading FPGA bit files, and wherein the one or more FPGAs are loaded with a forward error correction (FEC) encoding app and a FEC decoding app. The FEC encoding app and the FEC decoding app can be selected based on any of an optical application and a standard compliance requirement.

APPENDIX 1-2

United States Patent Application	**202202006 99**
Kind Code	**A1**
Heath; Jeffrey Abramson ; et al.	**June 23, 2022**

METHOD AND APPARATUS FOR THE DETECTION OF DISTORTION OR CORRUPTION OF CELLULAR COMMUNICATION SIGNALS

Abstract

A system for troubleshooting signals in a cellular communications network, and in particular, for determining the cause of distortion or corruption of such signals, includes a robotic or other type of switch. The robotic switch can tap into selected uplink fiber***-optic*** lines and selected downlink fiber***-optic*** lines between radio equipment and radio equipment controllers in a wireless (e.g., cellular) network to extract therefrom the I and Q data. The selected I and Q data, in an optical form, is provided to an optical-to-electrical converter forming part of the system. The system includes an FPGA (Field Programmable Gate Array) or the like, and an analytic computer unit, or web server, and SSD (Solid State Drive) and magnetic ***disk*** storage, among other components of the system. The system analyzes the I and Q data provided to it, and determines the cause, or at least narrows the field of possible causes, of impairment to transmitted signals. The system includes a display which provides the troubleshooting information thereon for a user of the system to review, or other form of a report, and may communicate the analytical findings to a remote location over a public or private internet protocol network.

APPENDIX 1-3

United States Patent Application	**202201873 57**
Kind Code	**A1**
Sinsheimer; Roger A. ; et al.	**June 16, 2022**

AUTOMATIC TEST EQUIPEMENT HAVING FIBER OPTIC CONNECTIONS TO REMOTE SERVERS

Abstract

An example test system includes a test head, and a device interface board (DIB) configured to connect to the test head. The DIB is for holding devices under test (DUTs). The DIB includes electrical conductors for transmitting electrical signals between the DUTs and the test head. Servers are programmed to function as test instruments. The servers are external to, and remote from, the test head and are configured to communicate signals over fiber ***optic*** cables with the test head. The signals include serial signals.

APPENDIX 1-4

United States Patent Application	**202201339 10**
Kind Code	**A1**
Hu; Yang	**May 5, 2022**

NEUROPROTECTION OF NEURONAL SOMA AND AXON BY MODULATING ER STRESS/UPR MOLECULES

Abstract

Compositions and methods for treating a mammalian subject for an ***optic*** nerve (ON) neuropathy and/or reducing or ameliorating degeneration of axons and/or soma of RGCs are provided. Aspects of the composition include a mammalian viral vector, comprising a murine g-synuclein promoter, or functional fragment thereof, that promotes expression of a transgene specifically in retinal ganglion cells (RGCs), said promoter in operable linkage with an expression cassette encoding the transgene, wherein the expressed transgene inhibits activity of an

expression product of an endogenous pro-neurodegenerative gene involved in an ER stress and/or UPR pathway that leads to axon or soma degeneration in the RGCs. Aspects of the methods include intravitreally administering the composition to treat the subject for the ON neuropathy. A variety of ON neuropathies may be treated by practicing the methods, including retinal ganglion cell degeneration, glaucoma, ***optic*** neuritis, ON traumatic injury and other ON-related diseases.

APPENDIX 1-5

United States Patent Application	**20220034810**
Kind Code	**A1**
Park; David Jaehyun	**February 3, 2022**

DEVICE AND METHOD FOR AN INTRAOPERATIVE CANCER DETECTOR

Abstract

A device for intraoperative cancer detection includes an excitation fiber ***optic*** configured to excite a biological sample as a function of an intrinsic excitation wavelength, an emission fiber ***optic*** configured to detect an intrinsic emission of the biological sample, a tissue scanner module including a display window configured to visualize the intrinsic emission of the biological sample, wherein visualizing further comprises receiving a signal from a tissue scanner representing an intrinsic emission of the biological sample, and relaying a visual recording as a function of the signal to the display window, and a vacuum-line tip configured to remove a portion of the biological sample as a function of the visualized intrinsic emission of the biological sample and a haptic feedback controller.

APPENDIX 1-6

United States Patent Application	**20210165300**
Kind Code	**A1**
Cushing; Scott K. ; et al.	**June 3, 2021**

ENTANGLED PHOTON SOURCE THAT CAN REPLACE A PULSED LASER IN NON-ABLATIVE MULTIPHOTON AND NONLINEAR PROCESSES

Abstract

A coherent, entangled photon source which uses a continuous wave laser to replace pulsed photon excitation sources in multiphoton nonlinear processes. In various embodiments, the device comprises a continuous wave photon laser creating electromagnetic radiation at a specific frequency and narrow linewidth. The emitted beam may be conditioned by an optical fiber to allow for efficient interaction with a nonlinear crystal. The nonlinear material is designed and fabricated in a specific manner, enabling the quantum mechanical process of a single photon with well-defined energy being converted into two or more photons which display quantum correlations. The nonlinear material and subsequent fiber-***optic*** or free space components control the temporal, spatial, and polarization-related quantum correlations such that the entangled photons can create a signal in multiphoton nonlinear processes that is the same or exceeds that of a pulsed photon source but at the average and peak powers of a continuous wave laser.

APPENDIX 1-7

United States Patent Application	**20210401925**
Kind Code	**A1**

Wilson; D. Travis	**December 30, 2021**

METHODS AND COMPOSITIONS FOR PREVENTING OR TREATING DOMINANT OPTIC ATROPHY

Abstract

The disclosure generally describes methods of preventing or treating dominant ***optic*** atrophy. The methods comprise administering an effective amount of an aromatic-cationic peptide to subjects in need thereof. The present technology relates generally to the treatment or prevention of Leber's hereditary ***optic*** neuropathy (LHON) or dominant ***optic*** atrophy (DOA) in mammals through administration of therapeutically effective amounts of aromatic-cationic peptides to subjects in need thereof. In one aspect, the present disclosure provides a method of treating or preventing dominant ***optic*** atrophy in a mammalian subject in need thereof, the method comprising administering to the subject a therapeutically effective amount of a peptide.

APPENDIX 1-8

United States Patent Application	**201301830 40**
Kind Code	**A1**
Elahmadi; Salam	**July 18, 2013**

SYSTEM, METHOD AND FIBER-OPTIC TRANSCEIVER MODULE FOR BANDWIDTH EFFICIENT DISTORTION-TOLERANT TRANSMISSIONS FOR HIGH-BIT RATE FIBER OPTIC COMMUNICATIONS

Abstract

According to one embodiment of the invention, fiber ***optic*** communications method is described. The method comprises a first operation of dynamically identifying frequencies at which spectral nulls occur in a signal received via an optical fiber, and thereafter, segregating communications over the optical fiber into a set of inter-null bands defined by the spectral nulls.

APPENDIX 1-9

United States Patent Application	**20180302162**
Kind Code	**A1**
Gerszberg; Irwin ; et al.	**October 18, 2018**

METHOD AND APPARATUS FOR USE WITH A RADIO DISTRIBUTED ANTENNA HAVING A FIBER OPTIC LINK

Abstract

Aspects of the subject disclosure may include, for example, a transceiver that converts first modulated channel signals in a first spectral segment to the first modulated channel signals in a second spectral segment based on signal processing of the first modulated channel signals and without modifying the signaling protocol of the first modulated channel signals. The transceiver transmits, via a fiber ***optic*** cable, a transmission signal including a first reference signal with the first modulated channel signals in the second spectral segment to a network element of a plurality of network elements of the distributed antenna system for wireless distribution of the first modulated channel signals to mobile communication devices in the first spectral segment. The first reference signal enables the distributed antenna system to reduce a phase error during processing of

the first modulated channel signals from the second spectral segment to the first spectral segment.