# 22nd International Young Scientists Conference Optics and High Technology Material Science - SPO 2021 ONLINE

# Report of Contributions

Contribution ID: **1** Type: **Poster**

# BLACK NANOSTRUCTURED SILICON IS A MODERN MATERIAL FOR PHOTONICS AND NANOELECTRONICS

*Saturday, 13 November 2021 12:20 (5 minutes)*

Black silicon is the focus of the research interest of many scientists around the world, both in terms of studying its fundamental properties and in connection with the emerging prospects for a wide range of applications. Interest in this material, which has a small (up to 1%) reflection coefficient in the visible range, is associated with the prospects of creating a new generation of efficient photovoltaic current sources on its basis. Method of stain etching of the surface of single-crystal silicon allows to obtain homogeneous nanostructured layers of black silicon with thickness to 60 nm and is a simple way to modify the photonic properties of silicon nanostructures in a wide range. The surface morphology of black nanostructured silicon was investigated using a scanning tunneling microscope. The influence of nanostructured silicon film thickness on its anti-reflective characteristics was studied. It was found that the best anti-reflective characteristics have samples of black nanostructured silicon with a thickness of 35 nm. The formation of black nanostructured silicon on a textured surface leads to a decrease in the reflective characteristics of the surface and an increase in the conversion efficiency of finished silicon solar cells. The presented method is an effective and inexpensive way to texture the surface of monocrystalline silicon to obtain black silicon layers with different morphology and distribution of chemical elements while being fully compatible with the silicon planar technology used in the production of semiconductor devices. Created mini power converters based on a black nanostructured silicon film, and their panels can be integrated into electronic circuits and ready-made chips for various purposes with low power consumption. The latter opens up the possibility of using black nanostructured silicon in photonics, photoelectric devices, biophotonics, and biosensorics.

## Topics

Session D. Biomedical optics and sensors technology

**Primary authors:** Dr MELNICHENKO, Mykola (Department of Mechanics and Mathematics, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine); Dr SVEZHENTSOVA, Kateryna (Department of Physics and Technology of low-dimensional systems V.E. Lashkarev Institute of Semiconductor Physics NAS of Ukraine Kyiv, Ukraine)

**Presenter:** Dr MELNICHENKO, Mykola (Department of Mechanics and Mathematics, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)

**Session Classification:** Poster Session

Contribution ID: **2** Type: **Oral**

# Subjective Evaluation of Influence Decreasing Primary Color Saturation of UHD-TV Displays

*Saturday, 13 November 2021 10:00 (15 minutes)*

In the medical fields and industrial fields, color reproduction, which reproduces the same colors on displays as those seen by humans, is important. The standard for imaging equipment called UHD, has features such as high resolution, wide color gamut, and high dynamic range compared with standard for HD. With the color gamut has increased from HD to UHD, the saturation of primary colors of displays has increased. However, commercially available displays do not yet satisfy the color gamut defined in the standard. For this reason, each display would have different saturation is considered. Changing in saturation would affect the color reproducibility of displays is considered.
In this study, the perception of color change was evaluated when the saturation of one of primary colors was decreased in the display. Evaluation images were created by the method explained above with using the standard images while keep the hue and color temperature unchanged. The standard images and the images with changed saturation primary colors were displayed to the 21 subjects. The subjects evaluated the difference in color perception between one of standard images and one of images with different saturation . The results of the evaluation showed that the perception of the difference in saturation was greater when the standard image containing more red and green saturated colors were displayed.

## Topics

Session D. Biomedical optics and sensors technology

**Primary authors:** TSUBOI, Ryo (Shizuoka University); Prof. SHIMODAIRA, Yoshifumi (Shizuoka University); Prof. AOKI, Toru (Shizuoka Unibersity)

**Presenter:** TSUBOI, Ryo (Shizuoka University)

**Session Classification:** Saturday Session

Contribution ID: **3** Type: **Oral**

# Consideration of annealing effects for CdTe diodes fabricated by laser doping method

*Friday, 12 November 2021 11:15 (15 minutes)*

CdTe semiconductor has been used as radiation detectors at room temperature. Impurity doping of CdTe has been considered difficult because it requires high temperature heat treatment and characteristics are degraded. However, the laser doping method that we have recently developed is overcoming this problem. When doping semiconductors, not all dopants act as donors or acceptors, and some of them become defects in the crystal. In response to the presence of such inactive dopants, for example, ion implantation undergoes an annealing process to promote the activation of the dopants. On the other hand, when CdTe is annealed above 150℃, the characteristics of diodes and detectors are degraded, such as increased reverse current and decreased hole mobility. Therefore, annealing has been considered difficult for CdTe. The I-V characteristics of CdTe pn diodes doped by laser-induced backside doping do not degrade when heat-treated above 150℃, and in fact I-V characteristics are improved. Therefore, it was assumed that annealing of CdTe might be possible because the characteristic degradation due to annealing that has been reported could not be measured. The CdTe pn diodes fabricated by the laser doping method was annealed and investigated the annealing effect. CdTe Schottky diodes (In/CdTe/Au) were also fabricated, annealed, and compared to CdTe pn diodes. Annealing process was performed in a nitrogen atmosphere up to 400℃. As a result, it was found that heating at 400℃ may have had a fatal effect on CdTe. Details will be discussed on the day.

## Topics

Session D. Biomedical optics and sensors technology

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**Presenter:** Mr OHNO, Amane (Shizuoka University)

**Session Classification:** Morning Session

Contribution ID: **4** Type: **Oral**

# Evaluation of Changes in Image Contrast Due to Different Energy Weightings of X-ray by Simplification of Imaging Systems

*Saturday, 13 November 2021 10:15 (15 minutes)*

In recent, the advent of the photon-counting detector has improved the flexibility of weighting of X-ray energy within each energy region in X-ray imaging, and this enabled to improve the quality of X-ray images and to emphasize the region of interest.
On the other hand, since the changes in the contrast of the overall image is important factor in the situation that human evaluate images visually, it is necessary to predict and evaluate the entire changes of the image contrast caused by the weighting of X-ray energy in order to apply the X-ray energy weighting techniques to such situations.
A conceivable approach to evaluate this is to simulate or formulate the imaging system. However, it is not practical to construct the geometry and simulate each time the target object changes, and the interaction between X-rays and the objects is too complex to be formulated.
In this study, we simplified the imaging system to represent the changes in the image due to the difference in the weighting of X-ray energy as tone curves which used in conventional image processing, and predicted and evaluated these changes.
Images of the same object taken using two detectors with different X-ray energy weightings were compared with those transformed using the respective tone curves obtained by simplified imaging systems, and the results showed that the tendency of image changes due to energy weightings can be predicted by tone curves.
The results of this study will contribute to the prediction of the changes in images when energy weighting techniques are applied to situations where visual evaluation is required.

## Topics

Session C. Applied optics and engineering

**Primary authors:** HOTTA, Takumi; Dr TAKAGI, Katsuyuki (Shizuoka University); GOTO, Takeru (Faculty of Informatics); Mr KOIKE, Akifumi (ANSeeN Inc.); Dr IMURA, Yukino (Shizuoka University); AOKI, Toru (Shizuoka University)

**Presenter:** HOTTA, Takumi

**Session Classification:** Saturday Session

Contribution ID: **5** Type: **Oral**

# X-ray imaging using semiconductor X-ray image detectors

*Friday, 12 November 2021 11:30 (15 minutes)*

Imaging using X-rays is currently used in a wide range of fields such as medical, industry and security.The most common type of detector in use today is the indirect conversion method.In the indirect conversion method, X-rays are converted into visible light by a material called a scintillator. In the indirect conversion method, X-rays are converted into visible light by a substance called a scintillator. After being converted into visible light, it is converted into electrical signals. However, the indirect conversion method has inherent problems such as the diffusion of light in the scintillator. Semiconductor X-ray image detectors, on the other hand, are direct-conversion detectors, which means that when X-rays are detected, they do not need to be converted into visible light, but can be directly converted into electrical signals. In order to absorb X-rays efficiently at room air temperature, a material with high density, large atomic number, and large band gap is generally required. Thallium bromide (TlBr) and cadmium telluride (CdTe), both of which are compound semiconductors, are promising materials for detectors because of their high density and large atomic number. On the other hand, their attenuation and response properties in objects are different. Therefore, it is expected that the response when operating as an image detector will be different between the two. In this study, we investigated the relationship between the image evaluation and response characteristics of the transmitted image captured by two X-ray image detectors, TlBr and CdTe.

## Topics

Session C. Applied optics and engineering

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**Presenter:** Mr GOTO, Takeru (Shizuoka University)

**Session Classification:** Morning Session

Contribution ID: **6** Type: **Oral**

# Carrier transportation property of TlBr Gamma-ray detector

*Saturday, 13 November 2021 10:30 (15 minutes)*

X-ray imaging technology has been applied in medicine, non-destructive testing in industrial sites, and security inspection in airports. Nowadays, semiconductor detectors are widely used as radiation detectors. Since semiconductor detectors convert X-rays directly into electric charges, they are said to have higher spatial resolution than scintillator detectors, which convert X-rays once into visible light.
Ge detectors are widely used as semiconductor detectors in gamma-ray measurements, but their band gap is as narrow as 0.67 eV, which requires cooling with liquid nitrogen, and research on semiconductor detectors that can operate at room temperature is underway.
While detectors using CdTe are widely used as semiconductor detectors that work at room temperature, we focused on thallium bromide (TlBr), which is one of the compound semiconductors. The TlBr detector can be operated at room temperature with a band gap of 2.68 eV, high atomic number (81 for thallium and 35 for bromine), and high density (7.56 g/cm3). Therefore, it is expected to have high detection efficiency at high energy.
Therefore, in this study, as a basic experiment, we performed gamma-ray spectrum measurements using a TlBr detector and a CdTe detector, and showed the radiation detection characteristics of the TlBr detector by measuring the rise time. The TlBr detector showed higher detection efficiency than the CdTe detector at 662 keV gamma rays of 137Cs, but the rise time was longer, which poses a challenge for use at high injection rates.

## Topics

Session D. Biomedical optics and sensors technology

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**Presenter:** Mr HIDA, Kosuke (Shizuoka Univ.)

**Session Classification:** Saturday Session

Contribution ID: **7** Type: **Oral**

# Nonlinear Interaction of Bessel Gauss Laser Beams with Plasmas with Axial Temperature Ramp

*Saturday, 13 November 2021 13:20 (15 minutes)*

Theoretical investigation on nonlinear interaction of intense Bessel-Gauss laser beams with plasma with axial temperature ramp has been presented. Emphasis is put on investigation of self action effects of the laser beam like self focusing, self channelling and axial phase shift of the laser beam. Optical nonlinearity of the plasma has been modelled by the ponderomotive force acting on the plasma electrons due to the intensity gradient over the cross section of the laser beam. Using variational theory based on Lagrangian formulation nonlinear partial differential equation (P.D.E) governing the evolution of beam envelope has been reduced to a ordinary differential equations for the beam width of the laser beam along the transverse directions. The evolution equation for the axial phase of the laser beam has been obtained by the Fourier transform of the amplitude structure
of the laser beam from coordinate space to (kx; ky) space. The differential equations so obtained have been solved numerically to envision the effect of laser-plasma parameters on the propagation dynamics of the laser beam.

## Topics

Session B. Laser physics and modern optoelectronics

**Primary author:** Dr NAVEEN GUPTA, Naveen

**Presenter:** Dr NAVEEN GUPTA, Naveen

**Session Classification:** Saturday Session

Contribution ID: **8** Type: **Poster**

# Self Action Effects of Asymmetric q-Gaussian Laser Beams in Collisionless Plasmas

*Saturday, 13 November 2021 12:35 (5 minutes)*

Theoretical investigation on optical self action effects of intense q-Gaussian laser beams interaction with collisionless plasmas have been investigated in detail. Emphasis is put on investigating the dynamics of beam width and axial phase of the laser beam. Effect of the ellipticity of the cross section of the laser beam also has been incorporated. Using variational theory based on Lagrangian formulation nonlinear partial differential equation (P.D.E) governing the evolution of beam amplitude has been reduced to a set of coupled ordinary differential equations for the beam widths of the laser beam along the transverse directions. The evolution equation for the axial phase of the laser beam has been obtained by the Fourier transform of the amplitude structure of the laser beam from coordinate space to (kx; ky) space. The differential equations so obtained have been solved numerically to envision the effect of laser-plasma parameters on the propagation dynamics of the laser beam.

## Topics

**Primary authors:** Dr NAVEEN GUPTA, Naveen; Mr ALEX A K, Alex (Lovely Professional University Phagwara)

**Presenter:** Mr ALEX A K, Alex (Lovely Professional University Phagwara)

**Session Classification:** Poster Session

Contribution ID: **9** Type: **Oral**

# Talbot imaging usage for surface step control

*Friday, 12 November 2021 14:20 (15 minutes)*

The phenomenon of Talbot image formation on the stepped surface is described and demonstrated both theoretically and experimentally. It is well known that when a grating is illuminated by spatially and temporary coherent light beam, it will be self-imaged at a certain distance $Z_T$ along the direction of propagation:
\begin{eqnarray}
Z_T=2\frac{D^2}{\lambda},
\end{eqnarray}
where $D$ is a grating period, $\lambda$ is a wavelength. In the case of stepped surface reflexes on the border are formed by unequal number of grating periods and their position is changed. The analysis is done for the case of plane illumination, but theoretical basis for the spherical wavefront is given. Based on the additional calibration any wavefront shape could be used to estimate step height and intensity distribution, that have different lateral pit displacements. By measuring the self-image distortions, the information content of the step height is obtained within region from $\Delta z_{\mathrm{Min}} \approx 0.001 Z_T$ to $\Delta z_{\mathrm{Max}} \approx 0.15 Z_T$. The feasibility of the proposed approach was experimentally illustrated with gratings of different periods $D = 150$, 200, 250, 300, 350 and $500\mu$m and fill factor of $50\%$.

## Topics

Session C. Applied optics and engineering

**Primary authors:** GOLOBORODKO, Andrey; Prof. POPERENKO, Leonid (Taras Shevchenko National University of Kyiv, Faculty of Physics, Chair of Optics)

**Presenter:** GOLOBORODKO, Andrey

**Session Classification:** Afternoon Session

Contribution ID: **10** Type: **Oral**

# Power splitter based on photonic crystal fibers

*Saturday, 13 November 2021 13:35 (15 minutes)*

Optical fiber has become the most widely used transmission medium for high speed applications. However, the standard fiber has several limitations such as chromatic dispersion …
In order to overcome these limitations, air / silica microstructured fibers (FMAS) appear with original propagation properties. These FMAS consist of a periodic arrangement of air channels parallel to the direction of propagation in a matrix of pure silica with the elimination of a channel in the center of the structure thus forming the heart of the fiber. This new optical fiber, which gives it new properties, all these properties have made it possible to integrate these fibers in several fields such as telecommunications, sensors, etc.

## Topics

Session C. Applied optics and engineering

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**Presenter:** Dr OUADAH, Mohammed Chamse Eddine (Mouloud MAMMERI University Tizi-Ouzou, Algeria )

**Session Classification:** Saturday Session

Contribution ID: **11** Type: **Oral**

# Study of the sensitivity of sensors based on photonic crystal fibers

*Saturday, 13 November 2021 13:50 (15 minutes)*

**Abstract** —Sensors have known a global growth in the market regarding the different technologies. Depending on the nature of the phenomenon to be detected, there are biological, chemical and physical sensors. The optical sensors are an important example that defines the physical sensors. The sensors in integrated optics present an excellent alternative for the detection of a physical variable such as: temperature, pressure…
In this context, we determine the optical sensors and their different techniques of detection which are based on the variation of an information characterizing the light wave based on the Microstructured Fiber Sensors which are at the base of the realization of a vast range of sensors, sweeping almost all the measurable physical magnitudes thanks to a better sensitivity for a shorter time of detection with a simpler handiness and lower costs of cost by measurement.

**Keywords:** Sensor, Sensitivity, Integrated Optic, Optic Sensor, Microstructured Fiber Sensor

**References:**

[1] Shafkat et al. Design and analysis of a single elliptical channel photonic crystal fiber sensor for potential malaria detection. J Sol-Gel Sci Technol 98, 202–211 (2021).
[2] NATESAN, Ayyanar, GOVINDASAMY, Kuppusamy Peramandai, GOPAL, Thavasi Raja, et al. Tricore photonic crystal fibre based refractive index sensor for glucose detection. IET Optoelectronics, 2019, vol. 13, no 3, p. 118-123
[3] VIGNESWARAN, D., AYYANAR, N., SHARMA, Mohit, et al. Salinity sensor using photonic crystal fiber. Sensors and Actuators A: Physical, 2018, vol. 269, p. 22-28
[4] H. Ahlem, Contibution à l'etudes et la conception des capteurs à base de cristaux photoniques.doctorat en Sciences en Electronique, Université Mohamed Boudiaf - M'sila 27/04/2017.
[5] B. Rabah, Amélioration de la Sensibilité des Capteurs par l'utilisation des Fibres à Cristaux Photoniques.doctorat en Electronique, Université Mohamed Boudiaf - M'sila 21/06/2018.

## Topics

Session D. Biomedical optics and sensors technology

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**Presenter:** MIRED, ILHEM (Engineering departement. Belhadj BOUCHAIB University Ain-Temouchent, Algeria)

**Session Classification:** Saturday Session

Contribution ID: **12** Type: **Oral**

# The properties of photonic crystal fibers

*Saturday, 13 November 2021 14:05 (15 minutes)*

Abstract—The main objective of this search is, to study the photonic crystal fibers; we were interested in the characterization of optical photonic crystal fiber's properties by studying the impact of geometric distortions on chromatic dispersion and attenuation.
It will first be a question of giving a definition of these fibers which present a new category of waveguide and have advantages and unique characteristics, then we will discuss their different types which are hight index core fibers and photonic Bandgap fibers; then, in a second step, we will approach the properties of these fibers which are: Endlessly single-mode photonic crystal fiber which allows us to obtain a broadband single-mode fiber, the chromatic dispersion, the effect of losses (by absorption, by curvature, by diffusion), the effective area and the birefringence which results in the difference among the effective index of the two orthogonal polarizations of an optical wave.
In this context, we carried out a purely theoretical work based on the study of the different properties of photonic fibers. this work allowed us to see the effect of each parameter on the propagation of optical signals which exceeds the limitations of standard fibers, which allows us to offer solutions based on these fibers thereafter, and we are also convinced that this work is only a primary step for more in-depth practical research.

Keywords:PCF, Chromatic dispersion, Attenuation, Effective index, Photonic Crystal Fiber

References:
[1] AMIRI, I. S., YUPAPIN, P., et RASHED, Ahmed NabihZaki. Mathematical model analysis of dispersion and loss in photonic crystal fibers. Journal of Optical Communications, 2019.
[2] SHARMA, Mohit, DIXIT, Vaishali, KONAR, S., et al. Endlessly single-mode photonic crystal fiber with high birefringence for sensing applications. Modern Physics Letters B, 2020, vol. 34, no 06, p. 2050077.
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## Topics

Session C. Applied optics and engineering

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**Session Classification:** Saturday Session

Contribution ID: **13** Type: **Invited Lecturer**

# Phonons in semiconductor nanocrystals: structure probed by Raman spectroscopy

*Friday, 12 November 2021 13:55 (25 minutes)*

Raman spectroscopy is a fast, sensitive, and non-destructive technique for exploring semiconductor nanocrystals fabricated by various methods. Selective probing of electronic and vibrational spectra of different parts of heterogeneous NCs such as core-shell systems by tuning the excitation wavelength in resonant Raman scattering is considered. The analysis of phonon spectra is applied for quantitative estimation of the strain in the core and shell as well as the degree of interface intermixing and checking the surface oxidation. Recent results in the field of surface- and tip-enhanced Raman spectroscopy and surface-enhanced infrared absorption are analysed showing the perspectives of Raman spectroscopy as a tool for investigation of single-nanocrystal phonon spectra.

## Topics

Session A. Physics of condensed matter and spectroscopy

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**Session Classification:** Afternoon Session

Contribution ID: **14** Type: **Oral**

# OPTICAL FIBER SERVICES BASED ON A PASSIVE OPTICAL NETWORK WITH WAVE DIVISION MULTIPLEXING

*Saturday, 13 November 2021 14:20 (15 minutes)*

Optical fibers are widely used in data transmission systems due to their ability to transfer massive amounts of data and their dielectric nature. It is a critical component of the worldwide broadband network infrastructure.
Optical fibers offer a vast and unique transmission bandwidth with very low latency. With Multiple wavelengths per optical fiber network topologies are utilized in central, metropolitan, and broad area applications to connect thousands of users with a wide range of transmission speeds and capacities. A powerful feature of an optical communication link is sending several wavelengths through the 1300-1600 nm range of a fiber simultaneously and the ability to communicate in real time.
The main purpose of this research (and its contribution) is to predict when optical fiber communications networks will be implemented in the future. This means that large amounts of data may be transported using the most basic and low-cost devices with little power consumption.

## Topics

Session C. Applied optics and engineering

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**Presenter:** Mr BENHAMMOU, Samir (Engineering departement. Belhadj BOUCHAIB University)

**Session Classification:** Saturday Session

Contribution ID: **15** Type: **Oral**

# Applied Mathematics for Understanding Photon Counting Computed Tomography（PCCT）

*Saturday, 13 November 2021 11:15 (15 minutes)*

The noise analysis and its decreasing technology for CT-imaging is very important problem. Especially this basic studies should be applied by using Mathematical analysis, ①the stochastic Process and ②the Logistic Pure Chaos. In this presentation I wish to explain only about ② .
"Logistic Pure Chaos" represents the new fundamental constructed concept that occurs in the dynamical systems of microscopic phenomenon and noise analysis in nature. So this chaos can transfers the relationship between the deterministic and the stochastic variables using the nature analysis.
The nonlinear sequential equation for the Logistic Pure Chaos and those values are the random numbers according to Beta distribution（1/2,1/2). Its mathematical proof can show by using some simple harmonic oscillational model. For Monte Calro Simulation ,it is necessary to generate the white noise that transfers this random numbers. On the other hand, the electronic circuit under the CdTe semiconductor usually generate a lot of noise. This mathematical model may be useful to understand this phenomenon.

## Topics

Session D. Biomedical optics and sensors technology

**Primary author:** SUZUKI, Takaharu (Shizuoka University)

**Co-author:** AOKI, Toru (Shizuoka University)

**Presenter:** SUZUKI, Takaharu (Shizuoka University)

**Session Classification:** Saturday Session

Contribution ID: **16** Type: **Oral**

# Angular dependence of back scatter spectrum

*Saturday, 13 November 2021 11:30 (15 minutes)*

Today, X-ray imaging is applied in the medical, industrial, and security fields.
In the transmission image of X-ray imaging, a detector must be placed on the opposite side of the X-ray source across the subject, which limits the size of the subject that can be captured due to the distance between the X-ray source and the detector. In backscatter X-ray imaging, on the other hand, the X-ray source and detector are placed on the same side to detect scattered X-rays. This method is considered able to detect objects regardless of their size.
The angular dependence of the scattered X-ray spectrum is expected to change depending on the shape of the object. In addition, it is necessary to verify whether the angular dependence of the scattered X-ray spectrum changes depending on the material of the object. Therefore, the purpose of this study is to discriminate the angular dependence of the scattered X-ray spectrum and to identify the material and shape of a material from the reflection angle and spectrum of scattered X-rays.
In this report, we performed Monte Carlo simulations to evaluate the fraction of X-ray photons scattered for each angle of scattering from 0° to 180° when a pencil beam is applied to an object.

## Topics

Session D. Biomedical optics and sensors technology

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**Presenter:** SAITO, Wataru (Shizuoka University)

**Session Classification:** Saturday Session

Contribution ID: **17** Type: **Oral**

# Study of GaN X-ray detector

*Saturday, 13 November 2021 11:00 (15 minutes)*

Ge detectors are widely used as X/γ detectors, but they need to be cooled by liquid nitrogen, so semiconductor detectors that can operate at room temperature are being studied as an alternative. Typical materials are CdTe and TlBr, which have the advantages of room temperature operation and higher stopping power than Ge. However, compared to Ge, which has been used in practical applications for a long time, the fabrication processes such as crystal growth, shaping, and electrode formation are still under development, which hinders mass production. In this paper, we propose the use of GaN as a new semiconductor detector material.

GaN has a wide band gap and can be operated at room temperature, and has a stopping power equivalent to that of Ge. GaN has been developed and put to practical use in optical and power devices, and it is expected that the availability of high-quality crystals and the establishment of processing processes for radiation detectors will become easier in the future. On the other hand, there is a lack of sufficient experimental data on GaN as a radiation detector.

In this study, in order to demonstrate the X-ray detectability of GaN, we fabricated a prototype GaN detector with a pn diode structure and conducted X-ray irradiation experiments, in which X-rays were generated by an X-ray tube system and irradiated onto a GaN diode, and the response current according to the X-ray intensity was observed.

## Topics

Session D. Biomedical optics and sensors technology

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**Presenter:** MAEDA, Yusuke (Shizuoka University)

**Session Classification:** Saturday Session

Contribution ID: **18** Type: **Oral**

# Development of small neutron source generated by DD fusion reaction using Dc plasma

*Saturday, 13 November 2021 10:45 (15 minutes)*

Non-destructive testing is routinely performed in factories. This is essential for quality assurance of products and prevention of serious accidents. Among the various non-destructive testing methods that exist, radiographic transmission testing is suitable for inspecting scratches and structures inside objects. Neutrons, a type of radiation, have a higher penetration power into metals than X-rays, and therefore are expected to be used in the inspection of metal products such as heavy metals. However, since the neutron generator is large, the inspection equipment is too huge to install in factories. Therefore, if neutron generator become smaller, the inspection device can be made smaller, and it will be easier to install neutron inspection. In order to reduce the size of the neutron inspection device, this work tried to reduce the size of the neutron generator. Conventional neutron generators are large because they use nuclear reactors or accelerators. In order to reduce the size of the neutron generator, we used the DD reaction as the principle of neutron generation. Neutrons were generated using the DD reaction. After filling the chamber with deuterium, the pressure was reduced using a vacuum pump. A high-voltage electric current was flowed into the chamber to generate plasma and induce the DD reaction. The chamber was shielded using blocks containing Boric acid, and the moderated neutrons were measured using two detectors with different characteristics, the LiCaAlF6 detector and Neutron counter. The change in the ratio of thermal-neutrons was observed from the difference in the measurement results between the detectors.

## Topics

Session D. Biomedical optics and sensors technology

**Primary author:** IKEDA, Takehiro (Shizuoka University)

**Co-authors:** Dr NISHIZAWA, Junichi (Shizuoka Univ.); TABATA, Kento; TAKAGI, Katsuyuki (Shizuoka University); Mr TOYODA, Kohei; AOKI, Toru (Shizuoka University)

**Presenter:** IKEDA, Takehiro (Shizuoka University)

**Session Classification:** Saturday Session

Contribution ID: **19** Type: **Oral**

# Optical Design of Bifurcated Light Coronagraph and Ultrafast Raman Spectrometer

*Friday, 12 November 2021 16:35 (15 minutes)*

Optical design tools are challenging but a cornerstone for optimal and high-quality constructions of optical systems. This work presents a design of a Bifurcated Light Optical Coronograph for interferometry applications in a large-scale telescope and the design and construction of an Ultrafast Raman spectrometer. The novel telescope was designed to detect exoplanets both, indirectly (with radial velocity and astrometry techniques) and directly with advanced spectroscopy, using a HOE as a primary objective, with a bandpass function. The Coronograph is the major part of the exoplanet telescope designed by using ZEMAX software, where two optical paths are directed from the slit located between the primary and secondary dispersers. By two configurations, a half-wave path difference is established at the host star position and diameter causing phase cancellation at a unique spectral band. The spectral interferometer can be fiber-fed from the near field and far-field due to the implementation of spherical mirrors. Additionally, a reconstruction of a high-resolution double-grating Raman spectrometer was made. In order to capture the Raman spectrum, a CCD camera was implemented and configured using a program built based on C# programming language. It allows recording the intensity of radiation in every pixel of the array and converting this mapping into a spectrum. The spectrometer was designed for ultrafast Raman spectroscopy applications to measure phonons dynamics of iron-based superconductors and vanadium oxides.

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary author:** GUTIERREZ, Diego

**Co-authors:** BARTENEV, Alexander; DITTO, Thomas; Dr LYSENKO, Sergiy

**Presenter:** GUTIERREZ, Diego

**Session Classification:** Evening Session

Contribution ID: **20** Type: **Poster**

# Analysis of the state of carbon nanotubes solution based on dynamic speckles

*Saturday, 13 November 2021 12:40 (5 minutes)*

Nanofluid is a colloidal solution of particles with a size of (0.1-100) nm in a liquid solvent. Due to their unique physicochemical properties, nanofluids are considered promising materials for electronics, energy, pharmaceuticals, etc. The great value of the surface energy of nanoparticles contributes to their tendency to aggregation. Therefore, nanofluids are very unstable. Their properties are easily changed and are highly dependent on external influences. The development of technologies for obtaining stable nanofluids requires special control methods.
In this work, we consider the possibility of using dynamic speckle analysis to control the state of an aqueous solution of carbon nanotubes. We used an optical scheme and a signal processing algorithm to analyze dynamic speckles in the scattering of laser radiation in a weakly inhomogeneous medium, which were previously used for pure liquids.
Aqueous suspensions of nanotubes were prepared in various concentrations (C < 1%) using ultrasonic treatment. A high-speed USB camera was used to record dynamic speckles from the scattering of radiation from a He-Ne laser by nanoparticles. We calculated the autocorrelation function of dynamic speckle every 2 s and investigated the dynamics of the behavior of the decay rate of the ACF over a long time (~1 h). The increase in the decay rate over time reflects the coarsening of the nanoparticles due to aggregation.
We have recorded different types of behavior of carbon nanotubes suspension of depending on concentration, ultrasonic treatment time and storage duration. We also found that some substances are able to stabilize the suspension.

## Topics

Session C. Applied optics and engineering

**Primary authors:** Ms KASIANCHUK, Maria; Mr ANDRIY , Yakunov

**Presenter:** Ms KASIANCHUK, Maria

**Session Classification:** Poster Session

Contribution ID: **21** Type: **Poster**

# The feature of resonant stimulated Raman scattering of dyes in a random media

*Saturday, 13 November 2021 12:55 (5 minutes)*

The work is devoted to the exploration of convenient conditions for Raman spectroscopy of laser dyes. Having strong luminescence prevents dye Raman spectroscopy from the resonant condition use while excitation wavelength is within a dye absorption band.
Otherwise the use of excitation wavelength out of the absorption band is not informative owing to matrix Raman lines appearance and being more intensive in this case. Thus to use a convenient Raman Spectroscopy for dye Raman spectra investigation the proper conditions should be chosen.
We investigated Raman spectra of lasing dyes embedded into different polymeric matrixes and dye crystal powder. The conventional Raman spectra technique was carried out under different excitation wavelengths. The results were compared with the vibration spectra obtained by SERRS method.
The Raman spectra observed by conventional technique under nom-resonance excitation revealed two sets of spectral lines against a constant background. These are matrix molecules and dye molecules Raman spectra. The dye Raman lines are essentially weaker and unlike the matrix spectrum the dye Raman lines significantly grow under the excitation closing to the dye absorption band. The excitation shift to the resonant condition causes luminescence to grow as well. Based on luminescence and Raman lines intensity relation the most appropriate conditions for dye Raman spectra conventional technique observation were proposed.
The spectra comparison with the spectra obtained by SERRS method showed that SERRS method is more informative for dye vibration spectra investigation as neither luminescence nor matrix emission are revealed in this method.

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary authors:** Dr YASHCHUK, Vasil (Kyiv national Taras Shevchenko university); BABICH, Danylo (Taras Shevchenko National University of Kyiv); SMALIUK, Andrii; PRYHODIUK, Olha

**Presenter:** PRYHODIUK, Olha

**Session Classification:** Poster Session

Contribution ID: **22** Type: **Invited Lecturer**

# Development of scintillator type X-ray imager with pixel optical separator

*Friday, 12 November 2021 10:50 (25 minutes)*

X-ray image detectors have been developed for medical and non-destructive testing applications. This study shows the improvement of the resolution of the scintillator, which is an indirect conversion type X-ray image detector. The emission of the scintillator is diffused and the spatial resolution of detector is reduced. Therefore, the scintillator was optically separated using silicon that hardly transmits visible light in order to suppress the diffusion of the scintillation light. A silicon wafer was used as a collimator in the form of pixels, and each of its holes was filled with scintillator material. The improvement in spatial resolution of this pixel separation scintillator was measured, and the image characteristics for practical use of this pixel-separator were evaluated. From these results, it was expected that the pixel separation scintillator would be put into practical use. CsI doped Thallium was used for the scintillator and was encapsulated in pixel-type silicon by the melting method. The evaluation for image characterization were spatial resolution, graininess, and quantum detection efficiency, which were obtained by calculating Modulation Transfer Function, Noise Power Spectrum, and Detective Quantum Efficiency.

## Topics

Session D. Biomedical optics and sensors technology

**Primary author:** Dr TABATA, Kento (Shizuoka University)

**Co-authors:** Dr NISHIZAWA, Junichi (Shizuoka University); Dr TAKAGI, Katsuyuki (Shizuoka University); Prof. AOKI, Toru (Shizuoka University)

**Presenter:** Dr TABATA, Kento (Shizuoka University)

**Session Classification:** Morning Session

Contribution ID: **23** Type: **Oral**

# Effects of cation substitution in the vibrational spectra of colloidal ternary and quaternary chalcogenide nanocrystals

*Friday, 12 November 2021 14:35 (15 minutes)*

Compounds of ternary (I-III-VI) and quaternary (I-II-IV-VI) metal chalcogenide nanocrystals (NC) are promising materials for photodetectors and absorber layers of thin-film solar cells of the new (third) generation, fluorophores and low-toxic fluorescent labels for biomedical applications, photocatalytic devices, supercapacitors, and other energy conversion and storage devices. The advantages of these compounds are the cheap and non-toxic components, as well as the possibility of partial substitution of any of the elements, which allows the properties of the material to be modified in a wide range. These materials are characterized by a combination of several important physical parameters, such as high optical absorption coefficient (10<sup>4</sup>-10<sup>5</sup> cm<sup>-1</sup>), the spectral position of the absorption edge in the range of solar radiation (~1.5eV for bulk material), good electrical and thermal conductivity, advantageous position of the band edges in terms of charge transfer to other components.
The phonon spectra of I-III-VI and I-II-IV-VI NCs were little studied, because the crystal structure and component composition of these compounds significantly depend on the technological conditions of production. Even among the available data, there were inconsistencies in interpretation.
Here are presented phonon Raman spectra of ternary NC Me-In-S (Me = Cu, Ag, Hg) and quaternary Me-Zn-Sn-S (Me = Cu, Ag) and all potential secondary phases, depending on their component composition.

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary authors:** MAZUR, Nazar (V.E. Lashkaryov Institute of Semiconductor Physics NAS of Ukraine, Kyiv, Ukraine); DZHAGAN, Volodymyr (V. Lashkaryov Institute of Semiconductors Physics, National Academy of Sciences of Ukraine, 03038 Kyiv, Ukraine); Dr YUKHYMCHUK, Volodymyr (V.E. Lashkaryov Institute of Semiconductor Physics NAS of Ukraine, Kyiv, Ukraine); Dr VALAKH, Mykhailo (V.E. Lashkaryov Institute of Semiconductor Physics NAS of Ukraine, Kyiv, Ukraine); Dr ZAHN, Dietrich RT (Chemnitz University of Technology, Chemnitz, Germany)

**Presenter:** MAZUR, Nazar (V.E. Lashkaryov Institute of Semiconductor Physics NAS of Ukraine, Kyiv, Ukraine)

**Session Classification:** Afternoon Session

Contribution ID: **24** Type: **Oral**

# Sb-doped ZnO films for the fabrication of all ZnO rod/film homojunction structure applied as UV detection device

*Friday, 12 November 2021 12:10 (15 minutes)*

In this work, ZnO rod/film homojunction structure was fabricated on Sb-doped ZnO film. The Sb-doped ZnO films were prepared by sol-gel spin coating technique onto the ITO substrate then annealed in nitrogen, air and argon followed by low-temperature hydrothermal process to obtain ZnO rod structure. The morphology of Sb-doped ZnO film exhibit the ZnO nanoparticle with smaller and increasing density when compared with undoped ZnO. The deterioration in the crystal structure of Sb-doped ZnO film suggest that the substitution of Sb atom in ZnO lattice without other impurity phases. While ZnO rod sample shows (002) plane dominance of wurtzite hexagonal with pyramid-like structure. The photoluminescence spectra exhibit the near-band-edge of all samples while the red emission appears in ZnO rod structure due to the imperfection in the ZnO crystal structure. The reflectance of ZnO rod structure in the visible region with the absorption edge of 375 nm. The electrical measurement of Sb-doped on undoped ZnO film suggests the diode characteristic then becomes photocurrent under UV irradiation.

## Topics

Session B. Laser physics and modern optoelectronics

**Primary author:** Mr SINORNATE, Wuttichai (College of Materials Innovation and Technology, King Mongkut's Institute of Technology Ladkrabang)

**Co-authors:** Prof. MIMURA, Hidenori (Research Institute of Electronics, Shizuoka University); Prof. PECHARAPA, Wisanu (College of Materials Innovation and Technology, King Mongkut's Institute of Technology Ladkrabang)

**Presenter:** Mr SINORNATE, Wuttichai (College of Materials Innovation and Technology, King Mongkut's Institute of Technology Ladkrabang)

**Session Classification:** Morning Session

Contribution ID: **25** Type: **Oral**

# OPTICAL POLARIZATION PROPERTIES OF P(VDF-TrFE) COPOLYMER

*Friday, 12 November 2021 14:50 (15 minutes)*

P(VDF-TrFE) copolymers actually have a variety of potential applications, e.g. volatile memory, flexible electronics, artificial skin. Anisotropy of their ferroelectric phases make them interesting for optics, from the reasons of polarimetrical phase containment control and potential optoelectronic applications.
Two samples were been fabricated. They are polymer films enclosed between two silver electrodesю Polymer was deposited by spincoating P(VDF-TrFE) 75:25 15% and 17% solutions in DMA, silver – by thermal evaporation.
Then the samples were annealed at 140 ℃ during 4 hours to achieve alpha-phase.
Angular polarimetry of the samples was carried out at wavelength λ = 625 nm. The Stokes vector components of the reflected light were measured with and without DC voltage applied to the electrodes. From the components of the vector one can find the polarization degree of the reflected light, as well as ellipsometric parameters ψ and Δ of the samples.
Application of 10 V caused changes in both of ψ and Δ parameters up to 1 °. As for the sample of 17%, with the voltage applied we have qualitative changes in the angular dependence ψ - it forms a gap of about 3 ° in depth, the position of which differs for different voltage values. This may be due to interference effects in the piezoelectric three-layer structure (remember that the 17% polymer film turned out to be more perfect), but the final clarification of this issue requires further research.
No regular changes in the graph Δ are noticeable for the samples.

## Topics

**Primary authors:** YAMPOLSKIY, Andriy; Dr MAKARENKO, Olexii (Taras Shevchenko National University of Kyiv, Faculty of Physics, Chair of Optics, 64/13 Volodymyrska str., 01601 Kyiv, Ukraine.)

**Presenter:** YAMPOLSKIY, Andriy

**Session Classification:** Afternoon Session

Contribution ID: **26** Type: **Oral**

# Identifying different contributions to the ultrafast spin-to-charge conversion from the experiment

*Friday, 12 November 2021 17:05 (15 minutes)*

Spintronics is the thriving field of research with the aim to control the electron spin degree of freedom for potential applications in computing, storage and memory, and fundamental science. Spintronic devices are promising in terms of lower power consumption, higher information density, and non-volatility compared to conventional electronics. However, in order to utilize the electron spin to its fullest potential, the question about efficient generation, detection, transport, and inter-conversion of the electron's intrinsic angular momentum should be answered.
Over the last three decades, the scientific community has mastered spin control in the static regime(DC)[1]. The breakthrough in transient and ultrafast spintronics can be attributed to the detection of the terahertz (THz) radiation, emitted as a consequence of an ultrafast demagnetization [2], and ultrashort spin-current burst injection from a ferromagnet into a metallic layer[3]. In such Ferromagnet/Metal heterostructure, the THz emission is mediated via the Inverse Spin-Hall effect (ISHE). Recently, it has been demonstrated that the time-varying charge current can be generated via spin injection at the Rashba-split inteface[4], [5], or via hot-carrier gradient established in the magnetic heterostructure[6].
In this work, we use 165 femtosecond, 805 nm laser pulses to generate the ultrafast spin-current burst in 5 and 20 nm thick ferromagnet CoFeB. This net spin current then can be converted into the transient charge current within ferromagnet itself (AHE), at the Rashba states established at the CoFeB/MgO interface (IREE) or inside the 3 nm thick Pt layer (ISHE) deposited onto the CoFeB. With comparative analysis of experiments conducted for different geometrical sample orientations and at the different pump wavelengths, we try to estimate ISHE, IREE, and AHE contributions to the overall THz radiation, emitted as a result of ultrafast spin-to-charge conversion.

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[5] M. B. Jungfleisch et al., "Control of Terahertz Emission by Ultrafast Spin-Charge Current Conversion at Rashba Interfaces," Physical Review Letters, vol. 120, no. 20, p. 207207, 2018, doi: 10.1103/PhysRevLett.120.207207.
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## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary author:** LEVCHUK, Artem (Le Mans University)

**Co-authors:** Prof. RUELLO, Pascal (Le Mans University); Dr JUVÉ, Vincent (Le Mans University); OTOMALO, Tadele (Le Mans University); Mr EL HAMDI, Anas (CEA Saclay); Dr GWENAËLE, Vaudel (Le Mans University); Dr MICHEL, Viret (CEA Saclay); Dr CHAULEAU, Jean-Yves (CEA Saclay)

**Presenter:** LEVCHUK, Artem (Le Mans University)

**Session Classification:** Evening Session

Contribution ID: **27** Type: **Oral**

# The detection of breast's microcalcifications using the image processing technique

*Saturday, 13 November 2021 14:35 (15 minutes)*

Due to the increase in the number of mammograms performed in recent years it's still difficult for expert radiologists to provide accurate and consistent analyses. Over the past 20 years, diagnostic support tools have taken a remarkable place in the medical and research sector. Several research studies have been developed either to automatically detect deseases (micro-calcifications or masses) or to provide a second opinion about the lesion detected through computer-assisted diagnostic systems.
micro calcifications clusters in mammograms can be considered by early signs of breast cancer. However, their detection is conciderated as a very difficult task due to various factors such as :
- wide variety of breast composition
- breast anatomy with hight texture
-impalpable size of micro calcifications in some cases
- low contrast in mammography.
In this paper, we work on the detection of breast's micros calcifications by using an image processing technique. We obtained satisfactory results, the proposed method was tested on the basis of MIAS breast cancer data.
key-words: breast cancer , image processing, microcalcifications, detection, medical image

## Topics

Session D. Biomedical optics and sensors technology

**Primary author:** ADDOU, Sara (Laboratoire systèmes et signaux,Université de mostaganem, Algérie)

**Presenter:** ADDOU, Sara (Laboratoire systèmes et signaux,Université de mostaganem, Algérie)

**Session Classification:** Saturday Session

Contribution ID: **28** Type: **Invited Lecturer**

# Nanomaterials with surface plasmon resonance property for optical applications

*Friday, 12 November 2021 11:45 (25 minutes)*

This presentation focuses on functional nanomaterials with good surface plasmon resonance properties including Ag and conductive F/Sb doped SnO2 nanoparticles synthesized via facile chemical routes. Ag nanoparticles (NPs) with the size less than 10 nm were fabricated in TiO2-SiO2 photosensitve composite film showing prominent SPR absorption spectra at around 350-500 nm with its peak at 410 nm. This hybrid film with strong SPR absorption of Ag NPs can be applied as diffraction optical element fabricated by holographic lithography. Ag NPs was also prepared in the composite form with SiO2 particles to be utilized as light scattering particles in light guided plate application. Next, F/Sb co-doped SnO2 conductive nanoparticles with the size less than 10 nm were synthesized by one-step sonochemical process. They exhibited good size distribution and SPR spectra in near infrared region. This feature makes the possibility for IR-shielding application in solar cell panel that can considerably improve the cell efficiency.

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary author:** Prof. PECHARAPA, Wisanu (College of Materials Innovation and Technology, King Mongkut's Institute of Technology Ladkrabang)

**Presenter:** Prof. PECHARAPA, Wisanu (College of Materials Innovation and Technology, King Mongkut's Institute of Technology Ladkrabang)

**Session Classification:** Morning Session

Contribution ID: **29** Type: **Oral**

# Local structure study of BiVO4 incorporated with Fe and Mn investigated by X-ray absorption spectroscopy

*Friday, 12 November 2021 12:25 (15 minutes)*

Mn and Fe-incorporated BiVO4 nanoparticles with different doping contents were synthesized via one-step sonochemical method. XRD results show the essential structure of monoclinic BiVO4 structure and secondary phases were clearly found in form of metal-based oxide as MnO, Mn3O4, Mn2O3 and Fe2O3 compounds suggesting the incorporation of Mn and Fe ions. In addition, the effect of higher Fe loading content into BiVO4 nanoparticles distinctly displays the gradually lower intensity of main peak affected by disorder of major phase structure of BiVO4 due to the amorphous phase of BiFeO3. UV-Vis DRS results show the absorption edge in visible range of all samples when loading Mn and Fe contents into pure BiVO4 exhibit obviously the red-shift in visible range suggesting the lower optical band gap of pure BiVO4. XAS results show that oxidation states of all elements correspond to Bi3+, V5+, Fe3+ and Mn2+/Mn3+ ions. Mn K-edge XANES spectra of all samples indicate that local atomic sites of Mn atoms would not replace in local site of either Bi or V site in BiVO4 crystal, confirmed by the simulated Mn K-edge XANES spectra using FEFF9 code. Fe K-edge XANES spectra of all samples suggest that local site of Bi and V site in BiVO4 crystal were not replaced by Fe atoms verified by the simulated Fe K-edge XANES spectra. EXAFS results evidently display that local atomic site of Fe atoms of all samples was formed to BiFeO3 in form of the amorphous phase verified by simulated and experimental XANES and EXAFS spectra.

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary authors:** Mr WECHPRASIT, Tirapat (King Mongkut's Institute of Technology Ladkrabang); PECHARAPA, Wisanu (College of Materials Innovation and Technology, King Mongkut's Institute of Technology Ladkrabang); Dr BOOTCHANONT, Atipong (RMUTT)

**Presenter:** Mr WECHPRASIT, Tirapat (King Mongkut's Institute of Technology Ladkrabang)

**Session Classification:** Morning Session

Contribution ID: **30** Type: **Poster**

# Improving RL performance by random media size adjustment

*Saturday, 13 November 2021 12:50 (5 minutes)*

Strongly scattered amplifying media are sources of stimulated emission and consequently random lasing (RL). These environments are very convenient, but effects at their boundaries can lead to different behaviors of the emission. Competing processes that depend on the boundaries properties can both catastrophically weak or significantly enhance the emission making RL impossible or highly intensified [1].

The highly scattering sample is pumped to create an active area. The size of the area depends on the pump's beam diameter, the sample's dimensions, its absorption value and the bulk scattering rate. Transmission and scattering of the photons were simulated by a Monte Carlo method.

If the concentration of scattering centers in the sample is low, the RL is evenly distributed over the sample. A change of boundaries' reflection rate does not affect the distribution of RL photons.

However the RL photons are distributed unevenly in the sample's volume in case of high scattering. A maximum of the RL can form inside the sample. Therefore the strong bulk scattering and the high boundaries reflection rate under the same pump intensity lead to the RL energy increasing. Experiments confirm this.

The RL energy maximum and its dependence on the sample size and the boundaries reflection rate are simulated by computer modeling. Shown that it is possible to vary the sample's sizes to lead the RL energy maximization for the current pump and the boundaries reflection rate.

## Topics

Session B. Laser physics and modern optoelectronics

**Primary authors:** YASHCHUK, Vasil (Kyiv national Taras Shevchenko university); ZHURAVSKY, Michael (Taras Shevchenko National University of Kyiv, Faculty of Physics, Laser and Optoelectronic Technics); PRYHODIUK, Olha

**Presenter:** ZHURAVSKY, Michael (Taras Shevchenko National University of Kyiv, Faculty of Physics, Laser and Optoelectronic Technics)

**Session Classification:** Poster Session

Contribution ID: **31** Type: **Oral**

# A Study on stereoscopic representation of 3D X-ray CT data using motion capture

*Saturday, 13 November 2021 11:45 (15 minutes)*

3D X-ray CT is currently used in various situations to obtain information of the internal structure of objects that are invisible to the human eye. The internal structure of obtained from 3D X-ray CT is grasped by observer sterically, such as its size in length, width, and depth. Although, methods for expressing information are not progressed as 2D images of cross sections despite the progress in research on the representation of 3D images. A system that uses a spatial reproduction display for represent data captured by 3D X-ray CT, and mount a motion capture to enable rotation and display at any cross-sectional angle is proposed. When it combined with motion capture, it allows the observer to observe the internal structure of an object from any perspective, as if they were grabbing and moving the object itself.

## Topics

Session C. Applied optics and engineering

**Primary author:** KASE, Hiroki

**Co-authors:** TAKAGI, Katsuyuki (Shizuoka University); AOKI, Toru (Shizuoka University)

**Presenter:** KASE, Hiroki

**Session Classification:** Saturday Session

Contribution ID: **32** Type: **Invited Lecturer**

# Using phase-change materials for ultimate functional reconfiguration at far- and mid-infrared

*Friday, 12 November 2021 15:05 (20 minutes)*

Materials with metal-to-insulator phase transition occurring under the external biasing have an unprecedented potential in control of electromagnetic radiation in a wide frequency range from microwaves to the visible. The focus of this talk is numerical demonstration of how the space of material parameters is connected with the space of functionality at far- and mid-infrared frequencies. The preferable scenarios are those with ultimate functional reconfiguration achieved at small and moderate variations of the biasing parameter. Four classes of the structures are studied, which include three ones with thermally tunable (InSb, VO2) and one with electrically tunable (graphene) materials. First, the transmissive diffraction gratings fully or partially made of InSb are presented, in which switching between the dominant zero-order and first-negative-order transmission is achieved at far-infrared by varying temperature, T, just by 20-30 K. Second, we present the results of the study of scattering on core-shell microcylinders comprising InSb shells. Thermally tunable invisibility is demonstrated, at which various mechanisms of scattering cancellation can exist for different frequencies in the same structure, and switching between diverse scattering and invisibility regimes is possible by a T-variation of 20 to 40 K. Third, a-few-layer metasurfaces with VO2 meta-atoms and grids that are capable in polarization manipulation and related asymmetric transmission at far- and mid-infrared have been introduced. Fourth, heterostructures comprising graphene-hBN metamaterials and dielectric gratings are examined for the capability in the diffraction inspired asymmetric transmission and asymmetric absorption at far- and mid-infrared frequencies. The obtained results indicate a route to feasible multifunctional devices.

## Topics

**Primary author:** SEREBRYANNIKOV, ANDRIY (Adam Mickiewicz University)

**Presenter:** SEREBRYANNIKOV, ANDRIY (Adam Mickiewicz University)

**Session Classification:** Afternoon Session

Contribution ID: **33** Type: **Invited Lecturer**

# Erasing of lasing effect from singly ionized Nitrogen molecules

*Friday, 12 November 2021 16:10 (25 minutes)*

Filamentation of femtosecond laser pulses leads to a variety of spectacular nonlinear phenomena like broadband THz generation, pulse self-compression, guiding of electric discharges and lasing effects. In particular, a coherent emission at 391.4 nm is observed from plasma filaments corresponding to a transition between levels B and X of the singly ionized Nitrogen molecule. To explain the optical gain at 391.4 nm we have developed a model of laser without population inversion in a V-arrangement. This quantum effect may appear when two electronic levels in atoms or molecules are simultaneously coupled by two coherent light fields to the third common level, so the corresponding amplitudes of transition probabilities can interfere. In the case of singly ionized Nitrogen molecule this coupling can take place between B, X and intermediate state A. It was experimentally confirmed that long-lived coherent polarizations A-X and B-X are established, as required by the V-scheme. We show that the temporal shape of the lasing emission and its dependence with gas pressure can be well restituted theoretically. To confirm further this model experimentally, we present the measurements using consecutive twin femtosecond 800 nm pump pulses. A reduction of the global lasing signal at 391.4. nm by a factor ~ 1000 is observed when the gas is pumped with the delayed twin pulses. This erasing effect is observed over the delay range of several ps and can be interpreted and reproduced theoretically in the frame of the V-scheme of laser without inversion.

## Topics

Session B. Laser physics and modern optoelectronics

**Primary authors:** Dr DANYLO, Rostyslav (Laboratoire d'Optique Appliquée); Dr LAMBERT, Guillaume (Laboratoire d'Optique Appliquée); Prof. TIKHONCHUK, Vladimir (Université de Bordeaux); Prof. LIU, Yi (University of Shanghai for Science and Technology); Dr HOUARD, Aurélien (Laboratoire d'Optique Appliquée); Prof. MYSYROWICZ, André (Laboratoire d'Optique Appliquée)

**Presenter:** Dr DANYLO, Rostyslav (Laboratoire d'Optique Appliquée)

**Session Classification:** Evening Session

Contribution ID: **34** Type: **Oral**

# Application of laser-induced thermal emission for surface relief imaging

*Friday, 12 November 2021 17:20 (15 minutes)*

Laser-induced thermal emission (LITE), generated by light-absorbing objects heated up to incandescent temperatures with nanosecond laser pulses of moderate power, is observed in the visible range of optical radiation spectrum. LITE is a kind of secondary emission which is sensitive to the structure of the irradiated surface layer. The techniques based on thermal emission observation are promising for diagnostics of surface roughness and temperature under laser processing, visualization of microinclusions in the subsurface region and porosity of porous carbons, as well as can be used to distinguish variations of such environment parameter as air pressure.
A Q-switched YAG:Nd laser (pulse duration $\tau$ = 20 ns, wavelength $\lambda$ = 1064 nm) was used to excite LITE. The images of laser-irradiated surfaces were observed through a microscope with LOMO-8-0.20 object lens and K15x eyepiece lens. The snapshots with LITE were made in a single-shot laser regime.
The greyscale maps of time-integrated radiant exitance were calculated for different combinations of material parameters and for various peak and hole sizes. It was revealed that LITE local exitance and its kinetics depend on a shape and size of the elements forming surface roughness relief. Besides, the LITE characteristics are also sensitive to the variations of local thermal and optical parameters of the material of a surface layer at a depth of the order of the laser penetration depth and the temperature diffusion depth.

## Topics

Session C. Applied optics and engineering

**Primary authors:** ZELENSKA, Kateryna (Shizuoka University); Ms TKACH, Olga (Taras Shevchenko National University of Kyiv); Prof. ZELENSKY, Serge (Taras Shevchenko National University of Kyiv); KOLESNIK, Olexandr (Taras Shevchenko National University of Kyiv); AOKI, Toru (Shizuoka University)

**Presenter:** ZELENSKA, Kateryna (Shizuoka University)

**Session Classification:** Evening Session

Contribution ID: **35** Type: **Oral**

# Ultrafast Optical Nonlinearity of V4O7

*Friday, 12 November 2021 16:50 (15 minutes)*

The V4O7 material is one of the correlated vanadium oxides with non-trivial metal-insulator transition (MIT) behavior. This oxide belongs to Magneli phases (VnO2n-1, n=3,4,…,9) and shows reversible MIT at temperature Tc~237K. Similar to other vanadium oxides, V4O7 shows exotic electronic, magnetic, and optical properties due to strong electron-electron correlations. Here we report on photoinduced optical dynamics of V4O7 within a broad range of sample temperatures. Thin stoichiometric V4O7 films were synthesized by direct current sputtering technique. The observed optical dynamics of V4O7 show complex transient nonlinearity, and suggest a significant contribution of polaronic effects. Owing to strong electron-electron correlations in Low-T V4O7, its insulating phase can be understood in terms of Wigner crystallization of small polarons. Photoinduced screening of electronic correlations results in melting of polaronic order into non-correlated polaronic states accompanied by increased conductivity. The characteristic photoinduced dynamics of V4O7 in High-T and Low-T phases reveal multistage evolution of electronic and phonon subsystems with specific threshold behavior for the Low-T phase associated with insulator-to-metal phase transition.

This work is sponsored by the National Science Foundation, Award No. 2033328; and from U.S. Army Research Laboratory and the U.S. Army Research Office under Contracts No. W911NF-15-1-0448, and W911NF-19-1-0480.

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary author:** BARTENEV, Alexander (University of Puerto Rico, Mayaguez)

**Co-authors:** Prof. RUA, Armando (University of Puerto Rico, Mayaguez); VERBEL, Camilo (University of Puerto Rico, Mayaguez); KOLODKA, Roman (University of Puerto Rico, Mayaguez); Prof. FERNANDEZ, Felix (University of Puerto Rico, Mayaguez); Prof. LYSENKO, Sergiy (University of Puerto Rico, Mayaguez)

**Presenter:** BARTENEV, Alexander (University of Puerto Rico, Mayaguez)

**Session Classification:** Evening Session

Contribution ID: **36** Type: **Poster**

# Optical properties of Au- and Cu- based layered structures

*Saturday, 13 November 2021 12:45 (5 minutes)*

The significant potentialcattributed to multilayer films consisting of alternating layers of ferromagnetic 3d-transition metal and a noble metal exists because of, such used as sensitive sensors. Besides the sarouses interest in elucidating the nature of changes in optical properties of such systems during their transformations from some island structure to a continuous one while their thickness increase is still actual attractive.
A Semilab SE-2000 spectroscopic ellipsometer, was used to find the optical settings in the $Au-$ and $Cu-$samples. As a result, we obtained, the phase shift Δ(λ) between the p-and s-components of the polarization vector and the azimuth ψ(λ) of the restored linear polarization for these samples at constant value of the light incidence angle of 70°.
The refractive index (n),absorption index (k),optical conductivity(σ), real ($_1$), and imaginary ($_2$) parts of the dielectric function, and reflection coefficient (R) were determined due to spectroellipsometric data and solution of principal ellipsometrшc equation.
It was found theat the interband absorption in photon energy range from 2.5 to 4.5 eV decreases by at least 40% in the $Cr_{1.5nm}Au_{45nm}Glass$ layer system relative to one for the bulk gold sample. For $Cr_{1.5nm}Cu_{43nm}Glass$ heterostructure appropriate of such value due to optical conductivity of a bulk copper sample isequel to 15% These differences between the values of the optical characteristics of layer structures investigated and bulk samples may be explained by the disordering of the crystal structure inherent for bulk samples of gold and copper.

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary author:** Mrs ROSHCHANSKAYA, Alexandra (Taras Shevchenko National University of Kyiv, Faculty of Physics, Chair of Optics)

**Co-authors:** Mr KOVANZHI, Petro (Taras Shevchenko National University of Kyiv, Faculty of Physics, Chair of Optics); Prof. POPERENKO, Leonid (Taras Shevchenko National University of Kyiv, Faculty of Physics, Chair of Optics); Mr KRAVETS, Vasyl (Taras Shevchenko National University of Kyiv); Ms KONDRATENKO, Olga (V.E. Lashkaryov Institute of Semiconductor Physics, )

**Presenter:** Mrs ROSHCHANSKAYA, Alexandra (Taras Shevchenko National University of Kyiv, Faculty of Physics, Chair of Optics)

**Session Classification:** Poster Session

Contribution ID: **37** Type: **Poster**

# Effect of calcium impurities on optical band gap values of lanthanum and samarium vanadate nanoparticles

*Saturday, 13 November 2021 12:25 (5 minutes)*

The rare-earth (RE) orthovanadate nanoparticles with compositions characterized by increased ability to absorb and transform light from the near-ultraviolet range of the spectrum are promising for wide range of practical applications as luminescent light converting materials. Heterovalent substitutions of the RE ions with double charged cations are used to increase absorption of such compounds in the 350 – 450 nm spectral range. In this paper, we report the results of the effects of calcium impurities on the optical band gap width of vanadate nanoparticles. This work uses calculations based on the measured experimentally diffuse reflection spectra of the La1- yCayVO4, La1-ySmyVO4, La1-x-ySmxCayVO4 nanoparticles synthesized by sol-gel method. The measured spectra consist of broad band in around 300 - 350 nm, which corresponds to the internal transitions in the vanadate anion. It was found that the edge of the reflection spectra is shifted to the long-wavelength region with increasing calcium impurity concentration. Using the Kubelka-Munch transformation of the measured reflection spectra by the formula F = (1-R)^2/2R, where R is the diffuse reflection spectrum, the band gaps of the investigated samples were determined. We suppose that the red shift is occurred due to the formation of additional Ca-induced defect states near the absorption edge. The structure of these defects in the doped vanadate nanoparticles is discussed.

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary author:** DOROFIEIEVA, Anna

**Co-authors:** CHUKOVA, Oksana; NEDILKO, S.A.; NEDILKO, Serhii (Taras Shevchenko National University of Kyiv); PAPADOPOULOS, A.; STRATAKIS, E.; Dr VOITENKO, Tetiana (Taras Shevchenko Kyiv National University)

**Presenter:** DOROFIEIEVA, Anna

**Session Classification:** Poster Session

Contribution ID: **38** Type: **Invited Lecturer**

# Chalcogenide glasses: properties and applications

*Friday, 12 November 2021 13:30 (25 minutes)*

**In present report the recent results on studies of structural properties of chalcogenides glasses (CG), and their application in holographic recording are reviewed. The changes of optical, thermal and other properties of chalcogenide glasses and functional materials structures on their base are connected with changing of the structure. XRD, EXAFS, AFM, SEM techniques and Raman spectroscopy were used as tools in studying the structural peculiarities of CG's. As2S3-As2Se3, As2S3-Sb2S3, Ge-As-(S)Se, and Ge-S-Ag, Ag–As–S chalcogenide glasses. Pair distribution functions were obtained using XRD data. Evolution of first coordination sphere position with glass composition was analyzed. Bonds lengh's and patrial coordination numbers were estimated. Raman data show presence of different nanohases whose concentration changes along the chosen compositional cross-section. Surface relief holographic diffraction gratings were directly recorded using composite nano-multilayered structures using some studied chalcogenide glasses. Diffraction efficiency values of the recorded gratings in transmission were ~22%. AFM measurements have shown high quality of the recorded gratings relief's. Direct surface patterning of 2D structures using As-S-Se layers by e-beam was performed. Digital holograms were directly recorded composite nano-multilayered structures. Reviewed investigation results concerning chalcogenide glasses show that chalcogenide glasses are perspective for various applications in photonics.**

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary author:** STRONSKI, Alexander (V.Lashkaryov Institute of Semiconductor Physics NAS kraine)

**Presenter:** STRONSKI, Alexander (V.Lashkaryov Institute of Semiconductor Physics NAS kraine)

**Session Classification:** Afternoon Session

Contribution ID: **39** Type: **not specified**

# Opening

*Friday, 12 November 2021 10:00 (25 minutes)*

## Topics

**Presenters:** Prof. POPERENKO, Leonid (Taras Shevchenko National University of Kyiv, Faculty of Physics, Chair of Optics); Prof. ILCHENKO, Volodymyr (Taras Shevchenko National University of Kyiv); Prof. BULAVIN, Leonid (Taras Shevchenko National University of Kyiv); Prof. MAKARETS, Mykola (Taras Shevchenko National University of Kyiv)

**Session Classification:** Morning Session

Contribution ID: **40** Type: **Poster**

# Photoluminescent characterization of nanostructured ZnO obtained by electrolysis

*Saturday, 13 November 2021 12:30 (5 minutes)*

The rapid development of the optoelectronic industry is stimulating the search for new materials and the development of highly efficient emission structures based on them, including nanoscale objects, in particular nanocrystals or nanoparticles. Particular attention is paid to expanding the spectral range of luminescent materials, as well as improving their manufacturability, efficiency, stability.
This work is devoted to the study of the luminescent properties of ZnO nanoparticles depending on different conditions of electrolytic synthesis developed by domestic technologists, and, accordingly, the optimization of synthesis regimes.
Nanosized zinc oxide particles were obtained by electrolysis of Zn in aqueous sodium chloride solution without or with the surfactant. The addition of surfactants to the electrolyte solution leads to much smaller particles and reduces their polydispersity. The samples under study were obtained using different durations of synthesis.
Investigations of the light-emitting properties of the obtained samples were done using two modern facilities. Measurements of photoluminescence at high-power monochromatic excitation (using lasers and laser LEDs) was performed using the MDR-23 spectrometer based set-up on. More detailed studies of luminescence and luminescence excitation was performed using the SHIMADZU RF-1501 spectrofluorimeter, which allows to measure spectra when excited by light in a wider range of wavelengths. The correlation has been found between the presence of blue photoluminescence band and technological parameters of synthesis.

## Topics

**Primary author:** MUDRAK, Vladyslav

**Presenter:** MUDRAK, Vladyslav

**Session Classification:** Poster Session

Contribution ID: **41** Type: **Invited Lecturer**

# How short the silicon and 2D MoS2 MOSFET conduction channel can be?

*Friday, 12 November 2021 10:25 (25 minutes)*

The scaling of the traditional silicon MOSFETs, which are the basic devices of modern electronics, had resulted already in the channel length of 5 nm order. However, its further miniaturization faces the obstacles of fundamental nature: electrons in the ultra-short channels are tunneling freely through the barrier, and the current in the source-drain circuit is no longer governed by the gate voltage, making a transistor to lose its functionality .
The work estimates the minimum channel length of the silicon MOSFET transistor. Taking into account the real shape of potential barrier in the channel shows that the electron tunnels through a region significantly shorter than the physical length of the channel L in the presence of drain voltage, and so the available estimate of the minimum quantum constraint channel length in silicon MOSFET, Lmin ~ 1.2 nm, is significantly underestimated. The fact makes it clear why after reaching 5 nm working lengths of the channel it was impossible to reach the long-declared values of 3 nm under maintaining the proper level of functionality of the transistor. The estimates made in this work confirm that the fundamental scaling limits of silicon MOSFETs have almost been reached.
Therefore the new possibilities for MOSFETs miniaturization are studied intensively now, including the use of the novel 2D transition metal dichalcogenides for conduction channel materials. We propose in [3] a theoretical model for describing the operation of a transistor with a MoS2 monolayer channel, which allows to obtain an analytical approximation of the potential in the channel, that depends on the drain and gate voltages. On this basis we make estimates for the minimum channel lengths due to the fundamental restriction of quantum tunneling through the barrier. It is shown that the relatively large effective mass of electrons in the MoS2 monolayer allows to predict the creation of devices with channels of a significantly shorter (2.5 - 3 nm) length than in traditional silicon MOSFETs. The ultra-short channel and high enough (of the order of silicon one) mobility of electrons in MoS2 monolayer on the hafnium oxide substrate, makes this transistor promising for the ultra-fast electronics of new generation, and, in particular potentially suitable for 5G devices.

## Topics

**Primary author:** Prof. STRIKHA, Maksym (Taras Shevchenko National University of Kyiv)

**Presenter:** Prof. STRIKHA, Maksym (Taras Shevchenko National University of Kyiv)

**Session Classification:** Morning Session

Contribution ID: **42** Type: **Oral**

# Choice of The Analyzing Wavelet in The Phonocardiogram Signal Analysis Using the Continuous Wavelet Transform Based on The Fast Fourier Transform

*Saturday, 13 November 2021 14:50 (15 minutes)*

The conventional continuous wavelet transform (CWT) requires considerable power and time when analyzing long signals. In order to increase the speed of computation we used CWT analysis based on Fast Fourier Transform (CWTFT), this method provides results for long recordings of phonocardiogram signals (PCG) in a short time. The analysis of the CWT depends on the mother wavelet function, in this paper we apply a different analyzing wavelet (Morlet, Dog, Paul and Bump wavelets) and each time the value of the mean difference (in absolute value) between the original signal and the synthesis signal obtained by the Fast Fourier Transform (FFT) is measured. In this study, we indicate the possibility of parametric analysis of PCG signals using the CWTFT which is the new solution, and we evaluate her performance. The results obtained show the clinical utility of our extraction methods for the recognition of heart sounds, and also for the estimation of pulmonary arterial hypertension.

## Topics

Session D. Biomedical optics and sensors technology

**Primary authors:** Mrs BENMESSAOUD, Nadia (Abou bekr belkaid tlemcen-Algeria); HAMZA CHERIF, Lotfi (abou bekr belkaid-tlemcen-ALGERIA)

**Presenter:** Mrs BENMESSAOUD, Nadia (Abou bekr belkaid tlemcen-Algeria)

**Session Classification:** Saturday Session

Contribution ID: **44** Type: **Poster**

# Metallic binary alloyed superconductors as a new class of photocatalytic materials for photogeneration of hydrogen through water splitting

*Saturday, 13 November 2021 13:00 (4 minutes)*

We present a direct experimental evidence for photogeneration of the electric current from dissociated water molecules using a new class of catalytic materials - binary layered metals (BLM) with layered graphite-like structures [1-3]. BLM consists of alternative layers of metals (Al, Mg, Cr, etc.) and metalloids (B) where the ionic (covalent) exchange between layers results in alternating charges (electrons and holes) sitting on alternating layers. We have shown, for the first time, a series of metallic binary alloyed superconductors (MgB2, AlB2, NbB2, and NbSe2) that can be used as photoanodes and cathodes in a photocatalyst composite for both hydrogen production and water oxidation reactions. Interestingly, it was found that the highly active ion binary metal-based photocatalyst can be used as a low-cost alternative to Pt for water photolysis. For example, a MgB2 layer was formed with the help of inexpensive spraying technique from a suspension produced by liquid-phase exfoliation of MgB2 powder (Sigma Aldrich) in ethanol solution by sonication with a homogenizer. The resulting MgB2 flakes were mostly single polycrystals with lateral dimensions of 1-2 □m, as characterized by optical microscopy. The exfoliated suspension of MgB2 was sprayed onto a clean glass substrates covered by either Au(50nm), or Ag (50nm), or Cu standard foil (100□m) at 120oC using a spray gun. The produced H2 bubbles (clearly seen by eyes) gathered on the cathode surface of MgB2 (or Pt) electrode, while O2 bubbles were gathered on the MgB2 photoanode. The conversion efficiency has been calculated using bubble microscopy (and following gas chromatography). These measurements confirmed 0.95% Faraday efficiency (every 2 electrons generated ~0.95 molecules H2). The hydrogen production was directly related to the photocurrent through the reaction 2H++2e-=H2. The BLMs exhibit high activity toward both the oxygen and hydrogen evolution reactions in pure distilled and seawater. The combination of the two such photoanodes and cathodes yields water splitting photocurrent density of around 1 mA/cm2, corresponding to a solar-to-photocurrent efficiency of 34% [1,2]. A strong correlation between the values of superconductive temperature and photocatalytic water splitting efficiency for investigated diborides has also been revealed.

The photogeneration of current in MgB2-based solar cell is unexpectedly efficient, suggesting that a new model may be needed to describe water splitting mechanism in such systems. We suggest that unusual surface states of electrons in ionic binary metals are responsible for creation of electron-hole pairs that creates ions of H+ and OH- in this simple single particle picture. In reality, the situation is more complicated. Indeed, metals interact with light through collective oscillations of electron plasma which yield quantized collective plasmon states. In BLM, plasmons are characterized by plasmon bands which can strongly interact with surface states and affect creation of surface electron-hole pairs [4]. The relation between BLM plasmons and surface states is an open question that requires further investigation. It is well known that the electron plasma provides negative values of metal permittivity in visible range and hence the light absorption in metals happens in thin (skin) layer where the catalytic reaction takes place. This makes metal catalysts to be more effective than semiconductor ones as the light absorbed in the bulk of a semiconductor catalyst is effectively lost for the reaction.

## Topics

**Presenter:** Mr KRAVETS, Vasyl (School of Physics and Astronomy, University of Manchester, Manchester, M13 9PL, UK )

**Session Classification:** Poster Session

Contribution ID: **45** Type: **Poster**

# Features of anelastic and elastic, adsorption characteristics of nanocomposites of multiwalled carbon nanotubes and polyamide, polyethylene, polyvinyl chloride, porous polystyrene

*Saturday, 13 November 2021 13:04 (4 minutes)*

Acoustic emission (AE) allow to receive the additional information about the process of microcracks. Poisson coefficient μ is equal to ratio of relative transversal compression ε⊠ to relative longitudinal lengthening ε⊠.
Complex elastic module of polyamide (NH(CH2)5CO)n, polyethylene (C2H4)n, polyvinyl chloride (C2H3Cl)n, porous polystyrene C8H8 nanocomposite E* is equal to the sum of dynamical elastic module E' = ρV2⊠ and loss module E" = E'δ [1,2].
The increase of the nano composite crystalline degree at growth of multiwalled carbon nanotubes concentration filling with the nanotubes of matrix results in the decline of content of well-organized phase.
As the result of the mechanical study the presence of the strong effect between low-density polyethylene (C2H4)n, polyvinyl chloride (C2H3Cl)n and multiwalled carbon nanotubes was confirmed.

This work has been supported by Ministry of Education and Science of Ukraine: Grant of the Ministry of Education and Science of Ukraine for perspective development of a scientific direction "Mathematical sciences and natural sciences" at Taras Shevchenko National University of Kyiv.

## Topics

**Primary author:** Ms DENIS, Lada (Taras Shevchenko National University of Kyiv)

**Co-authors:** Dr ONANKO, Anatoliy (Taras Shevchenko National University of Kyiv); Dr CHARNIY, Dmitro (Taras Shevchenko National University of Kyiv); Prof. KULISH, Mykola (Taras Shevchenko National University of Kyiv); Prof. DMYTRENKO, Oksana (Taras Shevchenko National University of Kyiv); Dr PAVLENKO, Olena (Taras Shevchenko National University of Kyiv); Prof. PINCHUK-RUGAL, Tatiana (Taras Shevchenko National University of Kyiv); Mr ONANKO, Yuriy (Taras Shevchenko National University of Kyiv)

**Presenter:** Ms DENIS, Lada (Taras Shevchenko National University of Kyiv)

**Session Classification:** Poster Session

Contribution ID: **46** Type: **Poster**

# Investigation of the spread of a diffracted Gaussian beam in the Fresnel diffraction region

*Saturday, 13 November 2021 13:08 (5 minutes)*

An experimental study of the spatial distribution of the light intensity of the diffraction pattern was performed by two methods: the method of photography and the method of a moving photodetector. Using the Wolfram Mathematica software package, the spatial intensity distribution of the diffracted Gaussian beam diffracted on the slit and the round hole due to Fresnel diffraction was calculated, and the intensity distribution was modeled. An analysis and comparison of theoretically calculated and experimentally measured diffraction patterns were performed.
Spatial distribution of the diffraction picture obtained by using a digital camera and software written in Python language compared with theoretically calculated and with the distribution obtained by the photomultiplier tube. The accuracy and feasibility of using this method is determined.

## Topics

Session B. Laser physics and modern optoelectronics

**Primary author:** VEREMEICHYK, Taras (Taras Shevchenko National University of Kyiv)

**Co-author:** PROKOPETS, Vadym

**Presenter:** VEREMEICHYK, Taras (Taras Shevchenko National University of Kyiv)

**Session Classification:** Poster Session

Contribution ID: **47** Type: **Poster**

# Features of dye lasing in organic-nonorganic thin films

*Saturday, 13 November 2021 13:10 (5 minutes)*

For the necessities of the integrated optoelectronics it is extremely necessary creation of light sources of submicron sizes that would be made on the same layer with other optical elements. This possibility is provided by sol-gel technology which allows making hybrid organic-inorganic films with optical parameters that vary depending on their composition and manufacturing technology. These films are an inorganic matrix (of 200 - 300 nm thickness) made from silicon or titanium oxides containing the nanosized pores (about 12 nm diameter) filled by an organic compound with dissolved lasing dye. Due to the pore diameter much less then wavelength thew light propagates in such films without scattering. In combination with possibility to make their refractive index by varying of inorganic component these films are perspective for their application as active media of waveguide lasers.

The studying is shown that both films reveal lasing on quasi waveguide modes, which have radiative losses into the substrate and correspond to radiative mode of substrate. Corresponding radiation, emerging from the end of the film, diverges strongly through diffraction. This emission is accompanied by the emergence of the less diverged lateral beam from the end of substrate which corresponds to radiative mode of substrate. Threshold intensity of the lasing in the more refractive matrix TiO2 appeared one order lower than in SiO2 one. These results demonstrate perspective of studied film a light sources for integrated optoelectronics.

## Topics

Session B. Laser physics and modern optoelectronics

**Primary authors:** YASHCHUK, Vasil (Kyiv T. Shevchenko National University); PODSHEBIAKIN, Artem (Kyiv T. Shevchenko National University); TELBIZ, G. (L.V. Pisarzhevsky Institute of the Physical Chemistry NAS of Ukraine, ); LEONENKO, E. (L.V. Pisarzhevsky Institute of the Physical Chemistry NAS of Ukraine, )

**Presenter:** PODSHEBIAKIN, Artem (Kyiv T. Shevchenko National University)

**Session Classification:** Poster Session

Contribution ID: **48** Type: **not specified**

# DFT computational studies of cellulose molecules adsorption on carbon nanostructures

*Saturday, 13 November 2021 13:10 (5 minutes)*

Cellulose is one of the most common biopolymers. It has high strength, flexible, and has the transparency in the optical range. Also, cellulose is very ecology and refers to renewable resources. Carbons nanostructure is low-size structures that carbon in the basic. They can be used to create high-strength conductive wires or to create nano sorbents that filter water and air. They are also used to create a thin and transparent conductive surface.
The work presents results of the computational studies of cellulose molecules adsorption on the surfaces of carbon nanostructures as part of the ab-initio method. Geometry-optimized calculations of the electronic structure of carbon nanostructures (graphene sheets and fragments of nanotubes) with adsorbed molecules (clusters) based on DFT were performed using the Gaussian 09 software package [1].
Relaxed geometries, binding energies, cellulose molecules in adsorbed and free states were calculated and analyzed, in this work. The results of the calculation were used for comparison with experimental data. Obtained results are discussed in view of potential use of cellulose-carbon composite materials in various optical and optoelectronic applications.

## Topics

**Primary author:** Mr ISOKOV, Timur (Taras Shechenko University of Kyiv )

**Co-authors:** Dr GOMENYUK , Olga; Prof. NEDILKO, Sergey; Dr SCHELUDKO , Vadym; Dr BORISYUK, Viktor; Prof. ZHYDACHEVSKYY , Yaroslav; Dr HIZHNYI , Yuriy

**Presenter:** Mr ISOKOV, Timur (Taras Shechenko University of Kyiv )

**Session Classification:** Poster Session

Contribution ID: **49** Type: **Poster**

# Optical properties of hybrid MoS2 and CdTe films

*Saturday, 13 November 2021 13:00 (5 minutes)*

Molybdenum disulfide is due to electrical and optical properties, MoS2 can replace silicon and even graphene in the next generation nanoelectronics devices and represents new opportunities for flexible electronics. Quantum dots cadmium telluride CdTe is the most consistent for research together with MoS2 due to its high photo stability and long photoluminescence decay time.
In this work, we performed luminescence of two mixtures with different concentrations of MoS2 and CdTe quantum dots by excitation with a diode laser at room temperature. The wavelength of the laser is 405 nm, and its power is 200 mV. The first solution was a dilution of MoS2 and CdTe in a ratio of 1: 1, the second - MoS2 and CdTe in a ratio of 1: 2. Two peaks were be observed in the obtained luminescence spectra. From the analysis of the spectra, we that the first maximum is observed ~ 1.8 eV due to radiation transitions in MoS2. the high-energy band with a maximum of about 2.1 eV is due to electronic transitions in CdTe. It turned out that the shape of the spectral dependence of photoluminescence is determined by the component composition of the mixture. Namely, as the MoS2 content increases, the photoluminescence bands shift toward lower quantum energies due to the coupling of two-dimensional MoS2 states and the CdTe quantum dot.

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary authors:** Ms IVAKHNO-TSEHELNYK, Oleksandra (Taras Shevchenko National University of Kyiv); Dr DATSENKO, Oleksandr (Taras Shevchenko National University of Kyiv); Dr BABICH, Danylo (Taras Shevchenko National University of Kyiv); Prof. KONDRATENKO, Serhii (Taras Shevchenko National University of Kyiv)

**Presenter:** Ms IVAKHNO-TSEHELNYK, Oleksandra (Taras Shevchenko National University of Kyiv)

**Session Classification:** Poster Session

Contribution ID: **50** Type: **Poster**

# Evolution of crystal structure of KFeO2 nanoparticles at aging

*Saturday, 13 November 2021 13:00 (5 minutes)*

KFeO2 magnetic nanoparticles, which are biocompatible and have a relatively high saturation magnetization are considered as promising heat mediators for magnetic hyperthermia applications. In this work, we study aging effects in KFeO2 nanoparticles and show that they change their structural characteristics over time. As-produced KFeO2 nanoparticles synthesized by sol-gel technique have been aged in the ambient atmosphere for 10,000 h. Aging effect was studied by X-ray diffraction methods. Crystal structure of nanoparticles undergoes essential changes, including an increase of lattice parameter and average coherent block size, and decrease of the microdeformation of crystal lattice. The diffraction pattern of aged KFeO2 sample generally reproduces the Fe3O4 diffraction spectrum and is indexed well in a cubic crystal lattice with a = 0.8337(2) nm. Parameters of real structure have also estimated.
A modeling the possible placement of potassium atoms in the lattice of the oxide studied has revealed that non-equivalent iron atoms in the Fe2.5K0.3O4 and Fe3O4 structures have octahedral FeO6 environment of oxygen atoms, while the potassium atom, which is located at certain positions of the iron atoms in magnetite structure, inherits its setting of oxygen atoms, namely, KO6 with K–O interatomic distances equal to 0.2101 nm.

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary author:** Mr SAVISKO, Artemii (LLC “Mainstream School”)

**Co-authors:** NAKONECHNA, Olesya (Taras Shevchenko National university of Kyiv); Mr ZAMORSKYI, Vlad (Institute of Magnetism of the NAS of Ukraine and MES of Ukraine); Prof. TOVSTOLYTKIN, Olexandr (Institute of Magnetism of the NAS of Ukraine and MES of Ukraine)

**Presenter:** Mr SAVISKO, Artemii (LLC “Mainstream School”)

**Session Classification:** Poster Session

Contribution ID: **51** Type: **Poster**

# Temperature dependence of 2D MoS2 photoconductivity.

*Saturday, 13 November 2021 13:00 (5 minutes)*

Photoelectric properties of a two monolayer thick (indirect-gap) MoS2 flake with lateral Ag contacts on a SiO2/Si substrate were studied. Photocurrent spectra were obtained with AC technique using a lock-amplifier at temperatures from 10 to 290 K. Apart from a band due to Si substrate, a contribution of MoS2 reveals in the spectra as a broad background of band-to-band transitions and sharp peaks of A and B excitons originating from a spin-orbital split of the valence band. An increase of the exciton contribution with temperature is observed, being followed by a decrease above 110 K. Above 200 K, the exciton peaks transfer to valleys on the background originated from band-to-band transitions. The temperature increase of integral A and B exciton photoresponse with temperature is analyzed in terms of thermal dissociation of the excitons. The exciton binding energy of 680 meV was estimated from the exponential part of temperature dependency.

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary authors:** Mr REDKIN, Mykyta (Taras Shevchenko National University of Kyiv); Dr BABICH, Danylo (Taras Shevchenko National University of Kyiv); Dr DATSENKO, Oleksandr (Taras Shevchenko National University of Kyiv); Prof. KONDRATENKO, Serhii (Taras Shevchenko National University of Kyiv)

**Presenter:** Mr REDKIN, Mykyta (Taras Shevchenko National University of Kyiv)

**Session Classification:** Poster Session

Contribution ID: **52** Type: **Poster**

# Photoelectric properties of Ge electron-hole junction with GeSn thin films.

The mechanisms of the photoelectric response of Ge electron-hole junction with GeSn thin films are investigated. The shape of current-voltage characteristics of the p-Ge/i-GeSn/n-Ge heterojunctions, measured in the temperature range 10–200 K, was analyzed using a two-diode model, which involves the influence of diffusion and recombination currents. The analysis of the temperature dependence of the diffusion current allowed us to determine the height of the potential barrier about 514 meV. It was shown that the conductivity of electron-hole transitions at low temperatures is determined by the dominance of the recombination current with the participation of the energy levels of the valence band of the GeSn film. At the same time, the photovoltage spectra of p-Ge/i-GeSn/n-Ge heterojunctions have been analyzed to determine a bandgap of the GeSn film. It is shown that direct band-band transitions in GeSn determine the photosensitivity of diodes in the spectral range of 0.5-0.7 eV.

## Topics

Session A. Physics of condensed matter and spectroscopy

**Primary authors:** Ms KOSAR, Anna (Taras Shevchenko National University of Kyiv); Mr DERENKO, Serhii (Taras Shevchenko National University of Kyiv); Dr BABICH, Danylo (Taras Shevchenko National University of Kyiv); Dr DATSENKO, Oleksandr (Taras Shevchenko National University of Kyiv); Prof. KONDRATENKO, Serhiy (Taras Shevchenko National University of Kyiv)

**Presenters:** Ms KOSAR, Anna (Taras Shevchenko National University of Kyiv); Mr DERENKO, Serhii (Taras Shevchenko National University of Kyiv)