5th International Symposium on Lasers in Medicine and Biophotonics. Section P. Plenary

1035
TuSMP-01 09:00-09:30 Plenary
High power Tm fiber laser – new laser platform for endoscopic surgery and lithotripsy
G. Altshuler 1, A. Mashkin 2, D. Myasnikov 3, V. Syrin 3, S .Larin 3, V. Vinichenko 3, V. Minaev 3, N. Evtichiev 3, V. Gapontsev 4; 1 - IPG Medical Corp., USA; 2 - IPG Laser GmbH, Germany; 3 - NTO IRE-Polus, Russia; 4 - IPG Photonics, USA
New high power Tm fiber laser with 1940 nm wavelength, average power up to 200 W, and peak power up to 1000 W has been developed. Preclinical evaluation of the new laser for soft tissue surgery and human stone ablation was carried out and performance compared to that of Ho;YAG laser. It was shown that Tm fiber laser provides better ablation efficiency for soft tissue and human stones with significantly lower retropulsion when treating stone and better coagulation when treating soft tissue. First clinical experience with the new laser confirmed advantages of Tm fiber laser in urological applications such as prostate enucleation, bladder and kidney tumor ablation, and kidney resection, and lithotripsy.

989
TuSMP-02 09:30-10:00 Plenary
Present and futures of laser in oncology
A.D. Kaprin, E.V. Filonenko; National Medical Research Radiological Center, Russia
In oncology lasers are used as: high-intensity laser (CO2, Nd:YAG, argon) for evaporation, excision and coagulation of tissue; photodynamic therapy (PDT) and diagnosis for tumors; low-intensity laser (LIL) for rehabilitation. PDT for treatment malignant primary, recurrence or metastatic tumors has been developed and used since 1992. Methods for prevention and treatment of complications of cancer therapy with LIL are used.

811
TuSMP-03 10:00-10:30 Plenary
Highly sensitive optical methods for life-science applications
P.I. Nikitin; Prokhorov General Physics Inst. RAS, Russia
Several original optical methods, e.g., the phase surface plasmon resonance (SPR), spectral-phase and spectralcorrelation interferometry, combined SPR and SERS chemical sensing on optoelectronic Au-Si grating microstructures, etc. have been introduced and tested as powerful tools for a wide range of life science applications. These include real-time monitoring of molecular interactions, label-free and nanoparticle-based biosensing for nanorobotic developments, rapid medical in vitro diagnostics, food control, environmental monitoring and detection of biological weapons.

980
TuSMP-04 10:30-11:00 Plenary
Usage of lasers for remote diagnosis of diseases
Z. Zalevsky; Bar-Ilan Univ., Israel
A novel concept of remote photonic sensing providing the capability to sense nano-vibrations is applied to perform bio-medical diseases diagnosis and monitoring of breast cancer, skin lesions and melanoma as well as glaucoma.

1042
TuSMP-05 11:00-11:30 Plenary
Biophotonics in neurosurgery
A.A. Potapov 1, S.A. Goryajnov 1, D. M. Chelushkin 1, K.A. Chernishov 1, T.A. Savelieva 3,4, V.B. Loschenov 3,4, V.A. Okhlopkov 1, A.N. Konovalov 1, P.V. Zelenkov 1, Sh.Sh. Eliava 1, O.D. Shehtman 1, D.Yu. Usachev 1, V.A. Lukshin 1; 1 - Burdenko National Medical Research Center of Neurosurgery; 2 - First Moscow State Medical Univ., 3 - Prokhorov General Physics Inst. RAS, 4 - National Research Nuclear Univ. MEPhI, Russia
Recently, 5-aminolevulinic acid (5-ALA) has been utilized as an adjuvant to the surgical resection of primary brain tumors and metastases and indocyanine green is widely used in vascular neurosurgery. We perform our series of 784 cases, in which the neurosurgical operation was carried out with different types of fluorescence navigation.

5th International A.M. Prokhorov Symposium on Lasers in Medicine and Biophotonics. Section A. Advanced laser medical systems and technologies

994
TuSMA-01 12:00-12:20 Invited
Optoacoustic Diagnostic Platform: Principles, Instrumentation, and Applications
R. Esenaliev; Univ. of Texas Medical Branch, USA
Optoacoustic diagnostics is a novel imaging modality based on detection and analysis of optoacoustic waves induced in tissues. We proposed and tested in animal and clinical studies a number of important optoacoustic diagnostic applications such as diagnostics of cerebral hypoxia, circulatory shock, anemia, thermotherapy monitoring, as well as breast cancer and hematoma detection. Our initial studies were performed with OPO-based systems. Recently, we developed and built FDA-compliant, multi-wavelength, fiber-coupled, highly-compact laser diode optoacoustic systems for imaging, monitoring, and sensing. To provide optoacoustic detection with high SNR, we developed ultra-sensitive optoacoustic probes that incorporate light delivery systems and wide-band acoustic sensors. This optoacoustic instrumentation allows for sensitive detection of optoacoustic signals from small tumors, native, coagulated and frozen tissues, intracranial hematomas, cerebral blood vessels such as the superior sagittal sinus, central veins such as the internal jugular vein, peripheral veins and arteries. We demonstrated also other examples of imaging, sensing, and monitoring with the optoacoustic instrumentation developed by our group including automatic, real-time, continuous measurements of blood oxygenation with high accuracy.

803
TuSMA-02 12:20-12:40 Invited
Femtosecond laser cellular and embryo microsurgery accompanied with femtosecond microscopy and spectroscopy
A.A. Osychenko, M.S. Syrchina, A.V. Aybush, A.A. Astaf'ev, A.M. Shakhov, A.D.Zalesskiy, A.S. Krivokharchenko; Semenov Inst. of Chemical Physics RAS, Russia
Changes of chemical composition and optical properties due to the femtosecond laser action on the biomaterials was characterized by multiphoton luminescence, femtosecond CARS microscopy techniques, atomic force microscopy and time of flight secondary ions mass-spectroscopy. The survival and ability to development of mammalian embryos has been studied.

984
TuSMA-03 12:40-13:00 Invited
Bismuth-doped fiber lasers – promising new wavelength and tunable lasers
E.M. Dianov; Fiber Optics Research Center, Russia
We present the generation of new laser wavelengths in the spectral region 1150-1775 nm by choosing the core glass composition in Bi-doped fibers. We demonstrate Bi-doped fiber lasers with a continuous wavelength tuning within 140 nm.

210
TuSMA-04 13:00-13:15
Precise laser contact surgery enhanced with thermal feedback: ex vivo evaluation
K.V. Shatilova 1, G.A. Aloian 2, I.V. Yaroslavsky 3, G.B. Altshuler 3; 1 - NTO IRE-Polus, 2 - Moscow Inst. of Physics and Technology, Russia; 3 - IPG Medical Corp., USA
Comparison of laser contact surgery in conventional CW and thermal feedback modes with pre-initiated developed optical fiber tip has been performed. It is shown that thermal feedback mode leads to less thermal damage in comparison with the conventional CW mode.

50
TuSMA-05 13:15-13:30
Laser-induced boiling of biological liquids and its application in medical technologies
V.M. Chudnovskii 2, V.I. Yusupov 2, V.N. Bagratashvili 2; 1 - Il'ichev Pacific Oceanological Inst., Far Eastern Branch, RAS, 2 - Federal Scientific Research Centre 'Crystallography and Photonics' RAS, Russia
We study thermal and transport processes related to the boiling of biological liquids under the action of continuous-wave laser radiation having moderate power (1 – 10 W) in the near-IR range (0.97 – 1.94 μm) . These processes are investigated in the course of a few particular clinical procedures aimed at the modification and removal of pathological tissues.

683
TuSMA-06 15:00-15:20 Invited
Aerosols in medicine - harmful and beneficial effects
A. Czitrovszky; Wigner Research Centre for Physics, Hungarian Academy of Sciences, Hungary
Aerosol deposition and penetration were studied experimentally in realistic hollow human lung models using a complex system consisting of a respirator, laser Doppler anemometer, aerosol particle counters and sizers and other optical instruments. Real time in situ measurements of aerodynamic parameters, aerosol concentration, size distribution, deposition, etc. were performed. The results were compared with calculations made using a stochastic lung model. Optimization methods for different aerosol drugs were proposed.

621
TuSMA-07 15:20-15:40 Invited
Safety of laser and terahertz femtosecond pulses effect on living bioobjects
D.S. Sitnikov 1, I.V. Ilina 1, A.A. Pronkin 1, I.M. Zurina 2,3, A.A. Gorkun 2,3, Yu. V. Khramova 4, N.V. Kosheleva 2,4; 1 - Joint Inst. for High Temperatures RAS, 2 - FSBSI Institute of General Pathology and Pathophysiology, 3 - Inst. for Regenerative Medicine, Sechenov Univ., 4 - Lomonosov Moscow State Univ., Russia
Efficiency of using femtosecond laser pulses to perform noncontact embryo biopsy and laser-assisted hatching is shown. First results on laser marking on the surface of embryo outer shell for individual embryo tagging are presented. Experimental study of high-power THz pulses effect on living MSC cell culture is presented. No short-term damage effects are observed during first hours post cell irradiation.

600
TuSMA-08 15:40-16:00 Invited
Ultrasound and thermometry guidance of laser interstitial thermotherapy. Application to Baker's cyst
A.V.Lappa 1, A.V.Zhilyakov 2, A.N.Kulikovsky 3, I.A.Abushkin 4, V.A.Privalov 5; 1 - Chelyabinsk State Univ., 2 - New Technologies in Outpatient Medicine, 3 - Industrial Group "Metran", Russia; 4 - Center for Medical Laser Technologies, 5 - South Ural State Medical Univ., Russia
Temperature control of laser operations by means of ultrasonic sounding and contact thermometry is presented. New method and device for minimally invasive interstitial measurement of temperature in the presence of intensive radiation are suggested. Applications of the temperature control to laser-induced interstitial thermotherapy and intracavitary thermotherapy cysts are considered.

593

TuSMA-09 16:00-16:15

Laser microsurgery of cell spheroids: an effective tool for regeneration studying and novel test system in aesthetic medicine

N.V. Kosheleva 1,2, I.V. Ilina 3, I.M. Zurina 1,4, A.A. Gorkun 1,4, D.S. Sitnikov 3, I.N. Saburina 1; 1 - FSBSI Inst. of General Pathology and Pathophysiology, 2 - Lomonosov Moscow State Univ., 3 - Joint Inst. for High Temperatures RAS, 4 - Inst. for Regenerative Medicine, Sechenov Univ., Russia

Technique of laser microsurgery of cell spheroids with nanosecond laser pulses was used to develop a new simple reproducible model for studying regeneration in vitro. Wound restoration accompanying the reparative processes occurred gradually over seven days due to rearrangement of surviving non-proliferating cells. Skin anti-ageing drugs can be tested on the developed model of cell spheroid's regeneration.

896
TuSMA-10 16:15-16:30

Thulium fiber laser enucleation of the prostate in management if giant BPH (>200 cc)

L.M. Rapoport, D.V. Enikeev, M.S. Taratkin; Sechenov First Moscow State Medical Univ., Russia

Holmium laser enucleation of the prostate is currently a viable alternative to open prostatectomy in patients with BHP over 80 cm3. However, information of Tm fiber laser enucleation efficiency for treatment of large-sized glands are lacking. The aim of our study was to demonstrate that thulium fiber laser enucleation (ThuFLEP) is a highly effective treatment modality for BPH exceeding 200 cm3.

946
TuSMA-11 16:30-16:45

Reducing retropulsion effect in Tm fiber laser lithotripsy through pulse-train modulation

V.A. Vinnichenko 1, A.A. Kovalenko 1, I.V. Yaroslavsky 2, G.B. Altshuler 2; 1 - NTO IRE-Polus, Russia; 2 - IPG Medical Corp., USA

We investigated impact of temporal structure of Tm fiber laser output on retropuslion effect in laser lithotripsy. Single-pulse and pulse-train modulation regimes were tested and the laser parameters were optimized to maximize reduction of retropulsion.

3
TuSMA-12 16:45-17:00

Numerical modeling of thermal homeostasis of the vessel heating exposed to laser exposure in various modes

A.E. Pushkareva 1, I.V. Ponomarev 2, A.A. Isaev 2, S.V. Klyuchareva 3; 1 - ITMO Univ., 2 - Lebedev Physics Inst. RAS, 3 - Mechnikov North-West State Medical Univ., Russia

Numerical modeling has been used for the choice of most effective and safe methods of laser treatment of VCM used in modern dermatology. The application of the multipulse CVL laser radiation with the wavelength most absorbed by the blood chromophore allows achieve the maximum clinical efficacy due to coagulation of dysplastic vessels of venous capillary malformations.

367
TuSMA-13 17:00-17:15

New laser radiation hydrodynamic effect in endoscopic urological surgery

V.P. Minaev 1, A.Z. Vinarov 2, A.M. Dymov 2, 1N.I. Sorokin 2, V.YU. Lekarev 2; 1 - NTO "IRE-Polus", 2 - Sechenov Univ., Russia

Authors describe new effect of laser radiation in endoscopic urological: two-phase jet - a result of superintensive boiling in the area of laser radiation absorption and consisting of steam-gas microbubbles and hot water. Cutting soft tissue, the jet coagulates section walls due to heat generated at steam condensation.

941
WeSMA-14 09:00-09:20 Invited

Advanced laser technologies for regenerative medicine

P.S. Timashev 1,2, N.V. Minaev 1, V.N. Bagratashvili 1; 1 - Inst. of Photon Technologies FSRC "Crystallography and Photonics" RAS, 2 - Inst. for Regenerative Medicine, Sechenov Univ., Russia

This presentation will discusses recent studies on two photon polymerization process and examples of its application in TE.

527
WeSMA-15 09:20-09:40 Invited

Laser engineering of microbial systems

N.V. Minaev 1, V.I. Yusupov 1, V.S. Zhigarkov 1, E.S. Churbanova 1, M.V. Gorlenko 2, V.N. Bagratashvili 1; 1 - Federal Research Centre "Crystallography and Photonics" RAS, 2 - Lomonosov Moscow State Univ., Russia

The report presents the Laser Engineering Microbial System (LEMS) technology for direct isolation of pure microbial cultures and microbial consortia from soil by laser 3d printing technology. We study thermal and transport processes involved in the transfer of gel microdroplets under the conditions of microprinting by LIFT method. The specific features of the interaction of pulsed laser radiation (l = 1.064 mm, pulse duration 4 – 200 ns, energy 2 mJ – 1 mJ) with the absorbing gold film deposited on the glass donor substrate are determined.

743
WeSMA-16 09:40-10:00 Invited

Optical techniques for advancement of photodynamic therapy: from model experiments to clinical studies

M.Yu. Kirillin 1, M.A. Shakhova 1,2, A.V. Khilov 1, D.A. Loginova 1, E.A. Sergeeva 1, A.E. Meller 1,2, D.A. Sapunov 1,2, V.V. Perekatova 1, I.V. Turchin 1, N.Yu. Orlinskaya 1,2, A.V. Shakhov 1,2; 1 - Inst. of Applied Physics RAS, 2 - Nizhny Novgorod State Medical Academy, Russia

Progress in photodynamic therapy (PDT) requires development of novel protocols. We report on performance of PDT employing chlorine-based photosensitizers and irradiation at wavelengths of 405 and 660 nm with monitoring by fluorescence imaging (FI) and optical coherence tomography (OCT). The study includes numerical simulations, model and animal experiments, as well as clinical monitoring.

441
WeSMA-17 10:00-10:15

In vivo diffuse reflectance for bone boundary detection in orthopedic surgery

K. Komolibus 1, C. Fisher 2, K. Grygoryev 1, R. Burke 1, B. C. Wilson 2, S. Andersson-Engels 1; 1 - Tyndall National Inst., Ireland; 2 - Univ. of Toronto, Canada

Real-time detection of tissue boundaries in orthopedic surgery could help prevent trauma, severe postoperative complications and reduce the risk of revisions. Diffuse reflectance spectroscopy is a potential candidate technique to enable tissue and boundary identification with a sufficient look ahead distance to anticipate breach. The aim of this study is to differentiate between four different types of tissue based on results from in vivo measurements.

299
WeSMA-18 10:15-10:30

Non-ablative fractional laser treatment for soft oral tissue regeneration

K.V. Shatilova 1, G.A. Aloian 2, M.M. Karabut 3, V.M. Ryabova 3, S.V. Tarasenko 4, I.V. Lyspak 4, I.V. Yaroslavsky 5, G.B. Altshuler 5; 1 - NTO IRE-

Polus, 2 - Moscow Inst. of Physics and Technology, 3 - Nizhny Novgorod State Medical Academy, 4 - Sechenov First Moscow State Medical Univ., Russia; 5 - IPG Medical Corp., USA
In this work, we present the first histological ex vivo (porcine gum) and in vivo (human) study of effects of fractional Er fiber laser (wavelength 1550 nm, peak power 25 W) on keratinized gum and alveolar mucosa in oral cavity.

459
WeSMA-19 10:30-10:45
The prospects of interventional coronary angiography with Thomson laser-electron X-ray source
I.A. Artyukov 1, E.G. Bessonov 1, N.V. Dyachkov 1,2, R.M. Feshchenko 1, M.V. Gorbunkov 1, B.S. Ishkhanov 3, Y.Y. Maslova 1, A.V. Polunina 4, N.L. Popov 1, V.I. Shvedunov 1,3, A.V. Vinogradov 1; 1 - Lebedev Physical Inst. RAS, 2 - Moscow Inst. of Physics and Technology, 3 - Lomonosov Moscow State Univ., Skobeltsyn Inst. of Nuclear Physics, 4 - City Clinical Hospital #17, Moscow, Russia.
To reduce patient radiation dose and improve image quality in interventional coronary angiography the replacement of X-ray tube by Thomson laser-electron X-ray source in angiography imaging systems is suggested. This is achieved due to matching of source spectra with that of iodine dye. Other angiography technologies including catheterization, multi-projections, cine and fluoro modes, image recording and processing will be preserved.

182
WeSMA-20 10:45-11:00
Comparison of a blue diode laser with Ho:YAG,Tm fiber and KTP lasers for soft tissue ablation
V.A. Vinnichenko 1, A.A. Kovalenko 1, V.A. Arkhipova 1, I.V. Yaroslavsky 2, G.B. Altshuler 2; 1 - IRE Polus, Russia; 2 - IPG Medical, USA
We compared three lasers: Ho: YAG, Tm fiber and blue diode laser in terms of their vaporization and coagulation efficiency on soft tissue in water. We compared our results with published data on performance of KTP laser. We showed, that the combination of Tm fiber and blue diode laser can provide a practical alternative to Ho: YAG and KTP lasers for surgical applications.

442
WeSMA-21 11:30-11:50 Invited
The method of excision the superficial microcystic form of lymphatic or lymphovenous malformation of the tongue in children
D.Yu. Komelyagin 1,2, A.V. Petukhov 1, S.V. Iamatina 1, V.P. Minaev 3, S.A. Dubin 1, F.I. Vladimirov 1, A.V. Dergachenko 1, E.N. Staroverova 1, E.V. Striga 1, T.N. Gromova 1; 1 - SBIH "Children's Municipal Clinical Hospital of St. Vladimir", 2 - SRI of Children's Surgery of Pirogov Russian National Research Medical Univ., 3 - NTO "IRE-Polus", Russia
Lymphatic malformation is representing approximately 6-18 percent of all benign (harmless) tumors in children. This paper describes the method of excision (removal) the superficial microcystic form of lymphatic and lymphovenous malformations of the tongue in children with the use of continuous or pulse-periodic laser radiation. For the pathology denotation the classification of the ISSVA is used (edition 2014).

547
WeSMA-22 11:50-12:10 Invited
Laser thermotherapy of vascular tumors in children under ultrasound control
I.A. Abushkin 1, A.G. Denis 2, I.S. Vasiliev 3, A.V. Lappa 4, V.A. Privalov 3, O.A. Gavrilova 2, V.O. Lapin 1, O.A. Romanova 1, M.Y. Galiulin 1; 1 - Center for Medical Laser Technologies, 2 - Tver State Medical Univ., 3 - South Ural State Medical Univ., 4 - Chelyabinsk State Univ., Russia
The results of treatment of vascular tumors (subcuta-neous and combined hemangiomas, kaposiform hemangioendo-thelioma) using interstitial thermotherapy with laser radiation of 0.97 and 1.56 μm are presented. The great value of ultrasonic mon-itoring of tumor coagulation is shown. It allowed us to reduce the number of repeated sessions of laser interstitial thermotherapy and to accelerate the recovery of children.

205
WeSMA-23 12:10-12:25
Laser mass spectrometry for biological tissue analysis and pathology identification
A.Bukharina 1, A.Pento 1,S.Nikiforov 1, S.Alimpiev 1, Ya.Simanovsky 1, A.Grechnikov 2; 1 - Prokhorov General Physics Inst. RAS, 2 - Vernadsky Inst. of Geochemistry and Analytical Chemistry RAS, Russia
A novel technique for real time mass spectrometric analysis of bioorganic samples at atmospheric pressure without any pretreatment based on laser ablation of the sample and ionization of the vapor plume by laser plasma radiation was developed. The potential of the method was showcased in drug screening, mass spectrometric imaging of biological tissues, tissue type and oncologic decease presence identification.

194
WeSMA-24 12:25-12:40
Effects of continuous wave, conventional pulse and super-pulse Tm fiber laser on tissue: a comparison study
V.A. Vinnichenko 1, A.A. Kovalenko 1, I.V. Yaroslavsky 2, G.B. Altshuler 2; 1 - NTO IRE-Polus, Russia; 2 - IPG Medical Corp., USA
In this study we are presented the comparison of the vaporization and coagulation efficiency for blood-rich soft tissues, ex vivo, (porcine kidney) of Tm fiber laser operating in three different modes (continuous wave, conventional pulse, super-pulse).

181
WeSMA-25 12:40-12:55
Soft tissue ablation by a novel Mid-IR laser
V. A. Arkhipova 1, A. A. Kovalenko 1, V. A. Vinnichenko 1, V. A. Tyrtyshniy 1, I. V. Yaroslavsky 2; 1 - IRE Polus, Russia; 2 - IPG Medical, USA
We present a novel laser emitting at wavelength 3050 nm. We analyzed its effect on soft tissue in terms of ablation and coagulation. Our preliminary data demonstrated that this system is attractive for further development of efficient device for tissue surgery.

682
WeSMA-26 12:55-13:10
Clinical testing of HILT for pain therapy
N.M. Chudesnikov 1, V.A. Arhipova 1, I.V. Yaroslavsky 2, G.B. Altshuler 2; 1 - NTO IRE-Polus, Russia; 2 - IPG Medical Corp., USA
We conducted clinical testing of a double-wavelength, high power laser system for pain therapy. Group of osteoarthritis patients was tretaed. We compared therapeutic effects of high intensity laser therapy and standard-of-care therapeutic methods.

436
TuSMA-p01 15:00-19:00
Use of laser radiation for spinal degenerative diseases treatment
A.N. Zabrodskiy 1, V.N. Karp 1, S.V. Vovnenko 1, V.P. Minaev 2, D.A. Ushakov 1; 1 - 1st Branch of the 3rd Central Military Clinical Hospital, 2 - NTO "IRE-Polus", Russia
The results of laser radiation treatment of patients with intervertebral disk hernias and facet syndrome are presented in the article. The applied techniques are based on low-invasive punction surgery, i.e. Percutaneous Laser Intervebral Disk Decompression (PLDD) and Percutaneous Laser Destruction of Facet Nerves (PLDFN), where laser radiation with wavelengths 1.06; 0.97 and 1.55 micrometers was applied. The exact choice of treatment techniques led to almost 97% positive results.

517
TuSMA-p02 15:00-19:00
Two-wavelength laser minimally-invasive percutaneous nephrolithotomy in the management of staghorn stones
S.A. Naryshkin 1,2, O.V. Teodorovich 1,2, G. G. Borisenko 2, D.G. Kochiev 3; 1 - Scientific Clinical Center JSC RZhD "Russian Railways", 2 - Russian Medical Academy of Postgraduate Education, 3 - Prokhorov General Physics Inst. RAS, Russia
In the report, we reflected our experience of minimally invasive percutaneous nephrolithotomy (Mini PCNL) in the treatment of staghorn kidney calculi. Our experience demonstrated that Mini PCNL by two-wavelength laser lithotripter with microsecond pulse duration and second harmonic generation is effective and safe procedure in treatment of staghorn nephrolithiasis.

509
TuSMA-p03 15:00-19:00
Thermal field analysis in the process of surface-selective laser sintering of bioresorbable polymer matrixies
S.A. Minaeva, E.N. Antonov, A.N. Konovalov, N.V. Minaev, V.K. Popov; Federal Research Centre "Crystallography and Photonics" RAS, Russia
The influence of the parameters of surface-selective laser sintering of polymer particles on the spatio-temporal temperature distribution in active zone was investigated using water as the sensitizer of heating. The temperature distribution at the surface and inside the sintered particles was estimated.

543
TuSMA-p04 15:00-19:00
Surface-selective laser sintering as a method for mechanically inductive scaffolds with a multilayer bio-interface
V.D. Grinchenko 1, E.A. Grebenik 1, S.N. Churbanov 1,2, N.V. Minaev 2, P.A. Melnikov 4, A.I. Schpichka 1, D.V. Butnaru 1, V.N. Bagratashvili 2, Yu.A. Rochev 1,3, P.S. Timashev 1,2; 1 - Inst. for Regenerative Medicine, Sechenov First Moscow State Medical Univ., 2 - Research Center "Crystallography and Photonics" RAS, Russia; 3 - National Univ. of Ireland, Ireland; 4 - Serbsky National Medical Research Center for Psychiatry and Narcology, Russia
Cells and 3D porous scaffolds are the key components of engineered tissues. The scaffolds provide transport of chemicals, structural support for cell migration, attachment, growth and subsequent ECM secretion and tissue development. Currently, there are variety of methods and biomaterials used for scaffold fabrication. However, optimization of their properties aiming to improve functional and structural restoration of damaged bone tissue is still an urgent task.

520
TuSMA-p05 15:00-19:00
Development of LEMS technology
E.S. Churbanova 1, V.I. Yusupov 1, V.S. Zhigarkov 1, V.S. Cheptsov 2, M.V. Gorlenko 2, N.V. Minaev 1, E.A. Chutko 1, V.N. Bagratashvili 1; 1 - Federal Research Center "Crystallography and Photonics" RAS, 2 - Lomonosov Moscow State Univ., Russia
In this paper, we describe the development and application of the laser engineering technology for microbial systems (LEMS), which based on the laser-induced forward transfer method.

519
TuSMA-p06 15:00-19:00
Laser perforation as a method for controlling bioresorbtion of tissue engineering scaffolds
S.N. Churbanov 1,2, A.A. Antoshin 1, N.V. Minaev 2, T.I. Gromovyih 1, P.S. Timashev 1,2, D.V. Butnaru 1; 1 - Inst. for Regenerative Medicine, Sechenov Univ., 2 - Federal State Research Center "Crystallography and Photonics" RAS, Russia
There is the effect of laser perforation on the rate of biodegradation of scaffolds was analyzed, using bacterial cellulose as a biomaterial.

549
TuSMA-p07 15:00-19:00
Applying LIFT-technology for vasculature formation in tissue and organ engineering
A.A. Antoshin 1, M.D. Fedyakov 1, S.N. Churbanov 1,2, N.V. Minaev 2, A.I. Shpichka 1, P.S. Timashev 1,2; 1 - Inst. for Regenerative Medicine, Sechenov Univ., 2 - Inst. of Photon Technologies of FSRC "Crystallography and Photonics" RAS, Russia
This study aimed to develop the approach to the vasculature formation using LIFT-technology for tissue and organ engineering.

306
TuSMA-p08 15:00-19:00
Application of 2-micron laser radiation for endovenous laser coagulation of varicose veins: in-vitro and in-vivo experiments
S.A. Khrushchalina, S.A. Artemov, A.N. Belyaev, S.V. Kostin, O.A. Kuznetsova, A.A. Lyapin, P.A. Ryabochkina; Ogarev Mordovia State Univ., Russia
Experiments on endovenous laser coagulation (EVLC) of varicose veins in-vitro and in-vivo have been performed using radiation of a solid state laser based on the crystal LiYF4: Tm, with a wavelength of 1.885 μm. As result it was shown that effect of coagulation is provided at a radiation power of 4-5 W.

609
TuSMA-p09 15:00-19:00
Pulsed transverse discharge CO2 laser removal of traumatic scars
N. Gorbatova 2,3, S. Nikiforov 1, A. Pento 1, Ya. Simanovsky 1, S. Zolotov 2, A. Brynsev 2; 1 - Prokhorov General Physics Inst. RAS, 2 - Clinical and Research Inst. of Emergency Pediatric Surgery and Trauma, 3 - Federal State Autonomous Inst. "National Medical Research Center of Children's Health", Russia
Removing children traumatic scars, resulting from various injuries and surgeries, is still actual problem. Unlike conventional laser skin resurfacing removal of sizeable amount of tissue is required for such treatment. To decrease the injury rate a special laser with the pulse duration below 20 μs was used. The data of 6 years successful method application are presented (over 250 patients).

610
TuSMA-p10 15:00-19:00
Pulsed transverse discharge CO2 laser mucosa ablation for the treatment of ENT diseases
N. Gorbatova 2,3, S. Nikiforov 1, Ya. Simanovsky 1, A. Pento 1, A. Brynsev 2, K. Baranov 2, N. Starshova 2, S. Zolotov 2; 1 - Prokhorov General Physics Inst. RAS,2 - Clinical and Research Inst. of Emergency Pediatric Surgery and Trauma, 3 - Federal State Autonomous Inst. "National Medical Research Center of Children's Health", Russia
Therapeutic effect with ENT diseases can be achieved removing the infected surface epithelial layer by laser ablation. To reduce adverse effects a CO2 laser with pulse duration below 20 μs is needed. The laser treatment significantly reduced bacteria content in the mucosa right after the procedure in 89% of 54 patients. After 6 months, 78% of patients had stable improvement.

209
TuSMA-p11 15:00-19:00
Evaluation of Tm fiber laser as a prospective energy source for fractional treatment in gynecological applications

K.V. Shatilova 1, V.A. Vinnichenko 1, A.A. Petrov 2, V.P. Veiko 2, I.V. Yaroslavsky 3; 1 - NTO IRE-Polus, 2 - ITMO Univ., Russia; 3 - IPG Medical Corp., USA
We investigated regimes of Tm fiber laser suitable for non-ablative soft tissue fractional treatment in animal model ex vivo. We have compared resulting temperature fields with those produced by Er:YAG laser and identified Tm fiber laser parameters allowing to closely match temperature effects of the two lasers. These data suggest feasibility of using Tm fiber laser as energy source for a number of applications in gynecology.

805
TuSMA-p12 15:00-19:00
Repetitively-pulsed Mid-IR laser for precise microsurgery
V.A. Serebryakov, A.S. Narivonchik, N.A. Kalintseva, D.V. Skvortsov, S.V. Doroganov; Vavilov State Optical Inst., Russia
Smoothly tunable in Mid-IR 5.75-8 μm range solid state laser device of Tm: Ho: ZGP-OPO-OPA architecture of several watt level at 100-1000 Hz pulse repetition rate intended for the experimental precise surgery research for medical laboratory was constructed.

891
TuSMA-p13 15:00-19:00
Pulsed fiber based yellow laser for ophthalmology
A.A. Surin 1,2, K.Y. Prusakov 1,2, T.E. Borisenko 1, A.A. Molkov 1,2; 1 - NTO "IRE-Polus", 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia
We introduce yellow laser for ophthalmology operating in continuous wave and pulse regime.

875
TuSMA-p14 15:00-19:00
The first experience of the use of the multiwave laser device «Livadia» in the treatment of relapse of inflammatory diseases of the epithelial pilonidal cyst in children
A.A. Sirotkin 1, G.P. Kuzmin 1, N.E. Gorbatova 2,3, A.V. Brynsev 2, M.A. Dvornikova 3, S.A. Zolotov 2, O.V.Tikhonevich 1; 1 - Prokhorov General Physics Inst. RAS, 2 - Clinical and Research Inst. of Emergency Pediatric Surgery and Trauma, 3 - Federal State Autonomous Inst. "National Medical Research Center of Children's Health", Russia
The results of application of a multiwave laser medical device "LIVADIA" for the treatment of inflammation of the epithelial pilonidal cyst in children are presented. The effectiveness of the technique due to the anti-inflammatory and antibacterial effect of multiwave radiation is shown. After five sessions of laser therapy, there is complete absence of inflammation and fistula closure.

113
TuSMA-p15 15:00-19:00
Fiber pyrometer for the control of Baker's cyst laser obliteration
A.S.Shmygalev 1, D.S. Suchkova 1, A.V.Zhilyakov 2, A.S.Korsakov 1, B.P.Zhilkin 1; 1 - Ural Federal Univ., 2 - Ural State Medical Univ., Russia
In this work, the calibration of the temperature readings obtained with the help of infrared fibers was performed. Based on the data obtained, a model of a fiber pyrometer is proposed.

413
TuSMA-p16 15:00-19:00
Sapphire shaped crystals for laser-assisted cryodestruction of biological tissues
I.A. Shikunova 1, E.N. Dubyanskaya 1, A.A. Kuznetsov 2, G.M. Katyba 1, I.N. Dolganova 2, E.E. Mukhina 2, M.A. Shchedrina 3, I.V. Reshetov 3, N.V. Chernomyrdin 2,3,4, K.I. Zaytsev 2,3,4, V.V. Tuchin 5,6,7, V.N. Kurlov 1; 1 - Inst. of Solid State Physics RAS, 2 - Bauman Moscow State Technical Univ., 3 - Sechenov First Moscow State Medical Univ., 4 - Prokhorov General Physics Inst. RAS, 5 - Saratov State Univ., 6 - Inst. of Precision Mechanics and Control RAS, 7 - Tomsk State Univ., Russia
We have developed cryoapplicators based on the sapphire shaped crystals fabricated via the edge-defined filmfed growth technique. They combine unique physical properties of sapphire - high thermal, mechanical and chemical strength, impressive thermal conductivity and optical transparency. We have applied the proposed sapphire cryoapplicators for the destruction of biotissues in vitro. The observed results highlight the prospectives of the sapphire cryoapplicators in cryosurgery.

657
TuSMA-p17 15:00-19:00
Fabrication of photopatterns upon collagen films with enhanced mechanical properties
K.N. Bardakova 1,2, S.N. Churbanov 1,2, L.P. Istranov 2, E.V. Istranova 2, N.V. Minaev 1, P.S. Timashev 1,2; 1 - Inst. of Photonic Technologies, FSRC "Crystallography and Photonics" RAS, 2 - Inst. for Regenerative Medicine, Sechenov First Moscow State Medical Univ., Russia
In this paper, we report the development of a simple method to produce collagen materials with improved mechanical characteristics using laser stereolithography.

5th International A.M. Prokhorov Symposium on Lasers in Medicine and Biophotonics. Section B. Laser interaction with cells and tissues: clinical imaging and spectroscopy

988
TuSMB-01 12:00-12:20 Invited
Optical amplification of in vivo photoacoustic flow cytometry
V.V. Tuchin 1, E.I. Galanzha 1,2, V.P. Zharov 1,2; 1 - Saratov State Univ., Russia; 2 - Univ. of Arkansas for Medical Sciences, USA
Recent results on tissue optical clearing (TOC) technology optimization in application to in vivo photoacoustic flow cytometry (PAFC) are presented and discussed accounting for features and benefits of this technique.

627
TuSMB-02 12:20-12:40 Invited
Wideband optoacoustic detectors for multi-scale characterization of the vasculature
P. Subochev, V. Perekatova, M. Kirillin, A. Orlova, E. Smolina, D. Loginova, I. Turchin; Inst. of Applied Physics RAS, Russia
The paper reviews our recent experience in multi-scale biomedical optoacoustic imaging using wideband ultrasonic detectors based on polyvinylidene fluoride films. The experimental setups for optoacoustic microscopy and tomography are presented, numerical algorithms for versatile characterization of tissue vasculature are discussed.

177
TuSMB-03 12:40-13:00 Invited
Development of optical monitoring of lung function in preterm infants
S. Andersson-Engels 1,2, A.L. Pacheco 1,2, E. Dempsey 3; 1 - Tyndall National Inst., 2 - Univ. College Cork, 3 - INFANT Center, Cork Univ. Maternity Hospital, Ireland
Gas in scattering media absorption spectroscopy (GASMAS) is a non-invasive method used to measure absolute lung oxygen volume and concentration. Its feasibility to monitor the lungs of full term babies has been demonstrated. This paper provides an overview of the work to be done to develop a clinically useful GASMAS system.

20
TuSMB-04 13:00-13:15
Monte Carlo simulations of the diffuse correlation spectroscopy signals for bounded biomodels
V. Kuzmin 1, A. Valkov 1,2, L. Zubkov 3; 1 - Peter the Great St. Petersburg Polytechnic Univ., 2 - St. Petersburg State Univ., Russia; 3 - Drexel Univ., USA
The diffuse near infrared spectroscopy (DNIRS) and diffuse correlation spectroscopy (DCS) are the contemporary non-invasive optical methods. We present results of numerical simulations of the photon diffusion and temporal correlations underlying these techniques in spatially restricted bio models. The calculations are performed for multi-layered models, in particular a finite-thick scull layer localized above the semi- infinite brain model.

294
TuSMB-05 13:15-13:30
Nonlinear microscopy as a tool of express biopsy in breast cancer diagnostics
E.A. Sergeeva 1,V.V. Dudenkova 2, S.S. Kuznetsov 2, M.Yu. Kirillin 1, M.V. Pavlov 2, A.V. Maslennikova 2, N.M. Shakhova 1; 1 - Inst. of Applied Physics RAS, 2 - Nizhny Novgorod State Medical Academy, Russia
We demonstrate nonlinear microscopy (NLM) imaging of ex vivo breast tissue samples aimed at revealing pathological changes by observation of stroma reorganization. Numerical processing of NLM images is performed to evaluate the degree of collagen disorganization as the result of different pathologies.

112
TuSMB-06 15:00-15:20 Invited
Challenges in structured illumination microscopy
H. Schneckenburger, V. Richter, M. Piper, M. Wagner; Aalen Univ., Germany
An experimental setup for super-resolution microscopy by structured illumination has been established, preliminary experiments of nanoparticles and living cells with a resolution around 100 nm are described, and further requirements for live cell imaging are discussed.

1047
TuSMB-07 15:20-15:40 Invited
New photoconvertible protein for superresolution microscopy
I.D. Solovyev 1,2, A.V Gavshina 2, A.P. Savitsky 1,2; 1 - Lomonosov Moscow State Univ., 2 - Bach Inst. of Biochemistry, Research Center of Biotechnology RAS, Russia
Physicochemical characterization of photoconvertible fluorescent protein (PCFP) SAASoti – a promising candidate for the use in different super-resolution techniques.

465
TuSMB-08 15:40-16:00 Invited
Individual sperm cell analysis and selection for In vitro fertilization using interferometric phase microscopy
N.T. Shaked 1, P. Ja. Eravuchira 1, S.K. Mirsky 1, M. Levi 2, M. Balberg 1,3, I. Barnea 1; 1,2 - Tel Aviv Univ., 3 - Holon Inst. of Technology, Israel
We review our advances in developing a platform for real-time quantitative analysis and selection of individual sperm cells without staining. Our system is based on combining interferometric phase microscopy, for stain-free sperm imaging and real-time analysis based on the sperm cell morphology and contents, with a disposable microfluidic device, for sperm selection and enrichment. We believe that the presented integrated approach has the potential to make the sperm selection process for in-vitro fertilization more objective, quantitative and automatic, hence increasing success rates.

619
TuSMB-09 16:00-16:20 Invited
In vivo laser imaging of metabolic processes connected with the microcirculatory system
E.A. Shirshin 1, B.P. Yakimov 1, Y.I. Gurfinkel 1, A.V. Priezzhev 1, N.P. Omelyanenko 2, J. Lademann 3, M.E. Darvin 3; 1 - Moscow State Univ., 2 - Central Inst. for Traumathology and Orthopedics, Russia; 3 - Charite Univ. Clinics, Germany
Here we present the results of label free multiphoton imaging of metabolic processes in the human skin papillary dermis, which are connected with transcapillary diffusion and microcirculatory system. Namely, fluid retention in the perivascular zone and cells migration from the blood vessels are addressed and investigated using the fluorescence lifetime imaging technique.

528
TuSMB-10 16:20-16:40 Invited

Study of nanoparticles interaction with biological tissues using comparative optical-spectroscopic methods

E.V. Perevedentseva 1,4, A.V. Karmenyan 1, Y.C. Lin 1, Ashek-I-Ahmed 1, N. Ali 2, M. Kinnunen 3, O. Bibikova 2,3, I. Skovorodkin 2, S. Vainio 2, C.L. Cheng 1; 1 - National Dong Hwa Univ., Taiwan; 2 - Univ. of Oulu, 3 - Faculty of Information Technology and Electrical Engineering, Univ. of Oulu, Finland; 4 - Lebedev Physics Inst. RAS, Russia

Recent development of nanoparticles bio-medical applications is determined by perspectives of their use for multimodal bio-imaging and sensing. Informative and noninvasive optical-spectroscopic methods are designed for the detection and analysis of the NP interaction with target biological systems. Presented work is focused on study of nanoparticles interaction with biological tissues combining complimentary methods to obtain versatile optical-spectroscopic information.

837
TuSMB-11 16:40-17:00 Invited

Laser-optic studies in hemorheology

A. Priezzhev 1,2, A. Lugovtsov 1, A. Semenov 1,2, K. Lee 2,3, S. Nikitin 1,2, V. Ustinov 4; 1,2 - Lomonosov Moscow State Univ., 3 - Currently with Center for Soft and Living Matter, Inst. of Basic Science, Ulsan National Inst. of Science and Technology, Republic of Korea; 4 - Lomonosov Moscow State Univ., Russia

Fundamental microrheologic properties of blood mostly related to erythrocytes deformability and reversible aggregation and strongly determining blood fluidity and microcirculation are assessed in vitro with laser-optic techniques including lasers tweezers, laser diffractometry, diffuse light scattering. This allows for better understanding the basic mechanisms of the cells interaction and behavior in blood flow in norm and pathology.

41
TuSMB-12 17:00-17:15

Wavelet-domain denoising of OCT images of human brain malignant tissues

I.N. Dolganova 1,2,3, P.V. Aleksandrova 1, S.-I.T. Beshplav 4, I.V. Reshetov 2, A.A. Potapov 4, K.I. Zaytsev 1,2,5; 1 - Bauman Moscow State Technical Univ.; 2 - Sechenov First Moscow State Medical Univ.; 3 - Inst. of Solid State Physics RAS; 4 - Burdenko Neurosurgery Inst.; 5 - Prokhorov General Physics Inst. RAS, Russia

We demonstrate a wavelet-domain denoising technique for imaging of human brain malignant tissues by optical coherence tomography. Among wide base of wavelet-domain filters we select appropriate ones by means of different criteria, i.e. tissue-class differentiation for brain glioma and micro-scale inclusions determination for brain meningioma. This selection allows for reducing scattering noise and retaining signal artifacts for each tissue type.

554
TuSMB-13 17:15-17:30

Delivery of the photodynamic agent under the nail plate using Er-laser microperforation and laser-induced hydrodynamic processes

A.V. Belikov, S.N. Smirnov, A.N. Sergeev, A.D. Tavalinskaya; ITMO Univ., Russia

The active delivery of photodynamic agent (aqueous solution of methylene blue) under a nail plate is discussed. The delivery was implemented by microperforating the nail plate using Er: YLF laser radiation and stimulating hydrodynamic processes in drug droplet on the nail surface under the action of Yb,Er: Glass laser pulses. Optimal pulse energy of Yb,Er: Glass laser radiation for effective active delivery of the photodynamic agent are determined.

570
TuSMB-14 17:30-17:45

Modified non-invasive diffuse reflective calibration-free method to determine optical parameters of biological tissues

A.V.Lappa, A.E.Anchugova, D.Iu.Shakaeva; Chelyabinsk State Univ., Russia

A modification of the non-invasive, calibration-free diffuse reflective method to determine optical parameters of turbid media proposed by us earlier [1] is presented. Crucial improvements of this modification are the using of a one-step non-analog Monte Carlo algorithm instead of a two-step algorithm, reducing the inverse problem to the variational problem of minimizing the functional instead of table interpolation.

569
WeSMB-15 09:00-09:20 Invited

Probe pressure impact on optical spectra acquired on ex vivo and in vivo human skin

G. Khairallah 1,2,3, W. Blondel 1,2, A. Delconte 2, F. Marchal 1,2,4, M. Amouroux 1,2; 1 - Univ. de Lorraine, CRAN, 2 - Centre National pour la Recherche Scientifique, CRAN, 3 - Regional Hospital Metz-Thionville, 4 - Inst. de Cancérologie de Lorraine, France

This work investigates the impact of several levels of optical probe pressure on human skin autofluorescence (AF) and diffuse reflectance (DR) spectra acquired using spatially-resolved optical spectroscopy in vivo and on ex vivo, i.e. exsanguinated, skin samples.

30
WeSMB-16 09:20-09:40 Invited

Synchronous fluorescence spectroscopy of soft tissues – tool for diagnostics of malignant lesions

E. Borisova 1,2, Ts. Genova-Hristova 1, N. Penkov 3, I. Terziev 3, P. Troyanova 3, B. Vladimirov 3, L. Avramov 1; 1 - Inst. of Electronics, Bulgarian Academy of Sciences, Bulgaria; 2 - Saratov State Univ., Russia; 3 - Univ. Hospital "Tzaritza Yoanna – ISUL", Bulgaria

Different steady-state fluorescence spectroscopy approaches are investigated to obtain the highest quality spectral information from biological objects. Synchronous fluorescence spectroscopy (SFS) leads to improved spectral resolution in detection of multi-compound and complex systems, where several fluorophores with similar excitation and emission properties have place. In this study SFS was used to detect and differentiate normal and neoplastic skin and gastrointestinal lesions.

905
WeSMB-17 09:40-10:00 Invited

Two-color fluorescence monitoring in PDT treatment

A. Khilov 1, M. Kirillin 1, D. Loginova 1, S. Gamayunov 2, I. Turchin 1; 1 - Inst. of Applied Physics RAS, 2 - Republican Clinical Oncological Dispensary Health Ministry of Chuvashia, Russia

The device based on a fluorescence imaging for localizing the tumor in the patient's body and monitoring photobleaching of the sensitizer during laser irradiation has been created. The system includes two LED sources 402 and 662 nm for excitation of chlorine-based photosensitizer. The ratio of fluorescence signals upon excitation of these peaks provides evaluation of photosensitizer penetration depth in biotissues.

950
WeSMB-18 10:00-10:15

Autofluorescence emission features of normal oral mucosa and potentially malignant

N.N. Bulgakova 1, T.I. Pozdnjakova 2; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow State Univ. of Medicine and Dentistry, Russia

The data base of autofluorescence images and laser-induced autofluorescence spectra of healthy oral mucosa and potentially malignant lesions have been collected and analyzed. It was shown that within 430÷700 nm spectral range autofluorescence emission of oral mucosa is sensitive to any abnormal changes that could be effectively used for detection of different diseases. Comparative study of laser-induced autofluorescence spectra (n=680) allowed to identify four basic spectral characteristics which significantly differ between normal and premalignant tissues.

190
WeSMB-19 10:15-10:30
Time-dependance of synchronous fluorescence signals in gastrointestinal tumours ex vivo
Ts. Genova 1, E. Borisova 1,2, N. Penkov 3, B. Vladimirov 3, Al. Zhelyazkova 1, L. Avramov 1; 1 - Inst. of Electronics, BAS, Bulgaria; 2 - Saratov State Univ., Russia; 3 - Univ. Hospital "Tsaritsa Yoanna-ISUL", Bulgaria
Our goal is to improve autofluorescence detection of gastrointestinal cancer by developing new diagnostic techniques and parameters with higher specificity. This study explores the post excision time effects over fluorescence characteristics of tissue samples through synchronous fluorescence spectroscopy. The obtained results enlighten the tissue alterations after excision and would be useful in transitioning from ex vivo to in vivo investigations.

178
WeSMB-20 11:30-10:45
Estimation of beta-carotene using calibrated reflection spectroscopy method: phantom study
S. Masoumi 1, M.A. Ansari 1, E. Mohajerani 1, E.A. Genina 2,3, V.V. Tuchin 2,3,4; 1 - Shahid Beheshti Univ., Tehran, Iran; 2 - Saratov State Univ., 3 - Tomsk State Univ., 4 - Inst. of Precision Mechanics and Control RAS, Russia
In this work, we use compression and immersion optical clearing to enhance the accuracy of reflection spectroscopy to measure the concentration of beta-carotene inside biological phantom. The estimated results are in good agreement with exact value of beta-carotene.

513
WeSMB-21 10:45-11:00
Spectral properties comparative analysis of normal and tumor brain tissues in the visible and near infrared optical ranges
A.S. Sharova 1,2, Yu.S. Maklygina 2, A.V. Ryabova 2, V.B. Loschenov 1,2; 1 - National Research Nuclear Univ. MEPhI, 2 - Prokhorov General Physics Inst. RAS, Russia
Current study presents the comparative analysis results of spectral-optical properties of rat normal and tumor brain tissues. The differentiation of normal and malignant brain tissues was carried out by photodiagnostics method using 5-aminolevulinic acid photosensitive compound. The fluorescent images, fluorescence and absorption spectra were obtained.

671
WeSMB-22 11:30-11:50 Invited
Nanodiamond–gold core shell nanoparticles for bio-imaging applications
Yu-Ch. Lin 1, E. Perevedentseva 1, Zh.-R. Lin 1, Ch.E. Nebel 2, G. Aperanza 3, A. Karmenyan 1, Ch.-L. Cheng 1; 1 - National Dong Hwa Univ., Taiwan; 2 - Fraunhofer Inst. for Applied Solid State Physics, Germany; 3 - Plasma Advanced Materials and Surface Engineering CMM–FBK, Italy
It has been a new trend to develop multifunctional nanoparticle (NP) for bio-medical applications. The methods to integrate diverse functionalities are developed. One of the promising approaches is synthesis of hybrid NP with synergetic properties. The paper discusses multifunctional applications of core-shell nanodiamond-gold (ND@Au) nanoparticles and demonstrates number of imaging modalities using them.

987
WeSMB-23 11:50-12:10 Invited
Functional optical coherence tomography for in vivo imaging of mammalian reproductive processes
I.V. Larina; Baylor College of Medicine, USA
We developed a 3D optical imaging approach, which allows for prolonged, functional, and quantitative analysis oocyte transit, the contraction of the oviduct muscle, the frequency of cilia beat, as well as sperm behavior in the ampulla, revealing never-before-seen dynamic events.

129
WeSMB-24 12:10-12:30 Invited
Functional near-infrared spectroscopy as a screening tool for prodromal Alzheimer's disease
T. Nguyen 1, M. Kim 1, J.S. Lee 3,4,5, K.H. Lee 3,4,5, K.Y. Choi 3, J.E. Park 4, B.C. Kim 4,6, J. Gwak 7, J.G. Kim 1,2; 1,2 - Gwangju Inst. of Science and Technology, 3 - Chosun Univ., 4 - National Research Center for Dementia, 5 - Chosun Univ., 6 - Chonnam National Univ., 7 - Seoul National Univ., South Korea
Prodromal Alzheimer's disease (PAD) patients express mild cognitive impairment (MCI) including memory loss and language disturbance. Although a few techniques including PET and MRI can diagnose prodromal AD, there is no convenient method to detect MCI non-invasively. This study investigates brain functional connectivity in both healthy elderly and PAD patients to identify a feature that can be used to distinguish these two groups.

632
WeSMB-25 12:30-12:50 Invited
In vitro terahertz dielectric spectroscopy of human brain tumors
K.I. Zaytsev 1,2,3, N.V. Chernomyrdin 1,2,3, K.M. Malakhov 1, Sh.-I.T. Beshplav 4, S.A. Goryaynov 4, V.N. Kurlov 5, I.V. Reshetov 3, A.A. Potapov 4, V.V. Tuchin 6,7,8; 1 - Bauman Moscow State Technical Univ., 2 - Prokhorov General Physics Inst. RAS, 3 - Sechenov First Moscow State Medical Univ., 4 - Burdenko Neurosurgery Inst., 5 - Inst. of Solid State Physics RAS, 6 - Saratov State Univ., 7 - Inst. of Precision Mechanics and Control RAS, 8 - Tomsk State Univ., Russia
Modern progress in terahertz (THz) diagnostics of malignancies, including non-invasive, least-invasive and intraoperative techniques is briefly discussed. Special attention is paid to intraoperative diagnosis of brain tumors, which is a rapidly developing field nowadays. We discuss our recent results in this research field, which are associated with (i) in vitro studies the THz dielectric response of gelatin-embedded human brain tumors (including gliomas and meningiomas featuring different grades), (ii) analysis an ability for differentiation between normal and pathological tissues of the brain relying on the methods of THz spectroscopy and imaging, and, finally, (iii) development of novel THz instrumentation for the intraoperative detection of margins of tumors in order to guarantee its gross total resection.

822
WeSMB-26 12:50-13:05
Clinical application of terahertz reflectometry for sensing of corneal tissue and tear film
I.Ozheredov 1, M.Mischenko 1, M.Prokopchuk 1, T.Saphonova 2, E.Sikach 2, A.Balakin 1,3, P.Solyankin 3, A.Shkurinov 1,3; 1 - Lomonosov Moscow State Univ., Russia 2 - Inst. of Eye Diseases RAS, Russia; 3 - Crystallography and Photonics Federal Research Center RAS, Russia
Terahertz frequency-domain reflectometry is applied for sensing of human corneal tissue hydration level and dynamical control of the tear film in clinical applications.

674
WeSMB-27 13:05-13:20
Terahertz sensing of protein solutions
O.P. Cherkasova 1,2, M.M. Nazarov 3, A.P. Shkurinov 4,5; 1 - Inst. of Laser Physics of SB RAS, 2 - National Research Tomsk State Univ., 3 - Kurchatov Inst. National Research Center, 4 - Crystallography and Photonics Federal Research Center RAS, 5 - Lomonosov Moscow State Univ.,

Russia
Terahertz time-domain spectroscopy has been used for measuring of protein low concentrations. The transmission and the attenuated total internal reflection geometries have been combined for precise analyzing of bovine serum albumin aqueous solutions spectra at 0.07-3.2 THz. We do not confirm anomalous absorption increase at concentration below 17 mg/ml published by other teams.

880
WeSMB-28 13:20-13:35
Glycerol dehydration of native and diabetic animal tissues studied by THz-TDS and NMR methods
O.A. Smolyanskaya 1, E.L. Odlyanitskiy 1, I.J. Schelkanova 1, M.S. Kulya 1, A.N. Tcypkin 1, Ya.V. Grachev 1, I.S. Goryachev 1, Ya.G. Toropova 2, V.V. Tuchin 1,3,4; 1 - ITMO Univ., 2 - Almazov National Medical Research Centre, IEM, 3 - Saratov State Univ. (National Research), 4 - Inst. of Precision Mechanics and Control RAS, Russia
Optical clearing method has been widely used for different spectral ranges where it provides tissue transparency. The aim of this research is to study the enhanced penetration of the terahertz waves inside biological tissues treated with glycerol solutions inducing changes of optical and dielectric properties. It was supported by the observed trend of free-to-bound water ratio measured by the nuclear magnetic resonance (NMR) method. The terahertz clearing efficiency was found to be less for diabetic samples than for normal ones. Results of numerical simulation proved that pulse deformation is due to bigger penetration depth caused by reduction of absorption and refraction at clearing.

512
WeSMB-29 15:00-15:20 Invited
Laser technologies of targeted opening of blood-brain barrier for drug brain delivery
O.V.Semyachkina-Glushkovskaya 1, E.U. Rafailov 2, S.G. Sokolovsky 2, E.G. Borisova 3, V. Mantareva 4, I. Angelov 4, A. Shirokov 5, N. Navolokin 6, N.A. Shushunova 1, A.P. Khorovodov 1, A.V. Terskov 1, A.A. Bodrova 1, M.V. Ulanova 1, E. Shrif 1, V.V. Tuchin 1,7,8, J. Kurths 1,9,10; 1 - Saratov State Univ., Russia; 2 - Aston Univ., UK; 3 - Inst. of Electronics BAS, 4 - Inst. of Organic Chemistry with Center of Phytochemistry BAS, Bulgaria; 5 - Inst. of Bioorganic Chemistry RAS, 6 - Saratov State Medical Univ., 7 - Tomsk State Univ., 8 - Inst. of Precision Mechanics and Control RAS, Russia; 9 - Humboldt Univ., 10 - Potsdam Inst. for Climate Impact Research, Germany
Here we show the photodynamic treatment (PDT) causes significant increase in the permeability of the blood-brain barrier (BBB) in healthy mice. Using different doses of laser (635 nm, 10-40 J/cm2) and photosensitizer (5-aminole-vulinic acid – 5-ALA, 20 and 80 mg/kg, i.v.), we found the optimal PDT for the reversible opening of BBB that is 15 J/cm2 and 5-ALA, 20 mg/kg, when the brain tissues recover 3 days later. Further increase in the laser or 5-ALA doses has not amplifying effect on the BBB but associated with severe damages of brain tissues. These results can be good informative platform for the further studies of new strategies in brain drug delivery and for the better understanding of mechanisms underlying cerebrovascular effects of PD-related fluorescence guided resection of brain tumor.

73
WeSMB-30 15:20-15:40 Invited
New data processing algorithms for laser ektacytometry of red blood cells
S.Yu.Nikitin; Lomonosov Moscow State Univ., Russia
The problem of measuring red blood cell deformability by laser diffractometry in a shear flow (ektacytometry) is considered. New data processing algorithm is proposed to measure the variance of the erythrocyte deformability.

599
WeSMB-31 15:40-16:00 Invited
Biomedical applications of sapphire shaped crystals
V. N. Kurlov 1,2, I.A. Shikunova 1, G.M. Katyba 1,3, K.I. Zaytsev 2,3,4, N.V. Chernomyrdin 2,3,4, I.N. Dolganova 1,2,3, V.V. Tuchin 5,6,7, I.V. Reshetov 2; 1 - Inst. of Solid State Physics RAS, 2 - Sechenov First Moscow State Medical Univ., 3 - Bauman Moscow State Technical Univ., 4 - Prokhorov General Physics Inst. RAS, 5 - Saratov State Univ., 6 - Inst. of Precision Mechanics and Control RAS, 7 - Tomsk State Univ., Russia
We have proposed novel medical instruments based on sapphire shaped crystals fabricated using the edge- defined film-fed growth (EFG) or related techniques. Due to the favorable combination of the unique properties of sapphire (high thermal strength and mechanical hardness, impressive melting point and chemical resistance, transparency in a wide spectral range) the developed instruments could help to solve numerous important problems of medical diagnosis, therapy, and surgery.

1049
WeSMB-32 16:00-16:20 Invited
Printing brain in vitro at 3D scaffolds: materials and patterns
S.G. Sokolovski 1, J.A Crowe 2, D. Nagel 2, E.J. Hill 2, A. El-Tamer 3, A.V. Koroleva 3, R. Parri 2, B.N. Chichkov 3, E.U. Rafailov 1; 1 - Aston Inst. of Photonic Technologies, Aston Univ., 2 - School of Life and Health Sciences, Aston Univ., UK; 3 - Laser Zentrum Hannover e.V., Germany
Recently, advancements in human induced pluripotent stem cell (hiPSCs) technology has allowed differentiation into cortical neuronal and glial subtypes. However, most model hiPSCs-based systems focus on 2D monolayer cultures which fail to recapitulate in-vivo like 3D architecture and likely restrict cell morphology and function. The research seeks to provide fabricated reproducible scaffolds that can be produced on a large scale.

83
WeSMB-33 16:20-16:35
The changes of cerebral hemodynamics during ketamine induced anesthesia in a rat model
J. Bae 1, T.J. Shin 2, S. Kim 1, D.-H. Choi 1, D. Cho 1, J. Ham 1, S. Jeong 3, J.G. Kim 1; 1 - Inst. of Integrated Technology, 2 - Gwangju Inst. of Science and Technology (GIST), 3 - Seoul National Univ., 4 - Chonnam National Univ. Medical School, South Korea
Concurrent electroencephalogram based consciousness monitoring technique is vulnerable to specific clinical conditions. However, hemodynamics is more fundamental and well-preserved parameter to evaluate under severe clinical situations. In this study, we applied near-infrared spectroscopy system in rats to measure hemodynamic change during ketamine anesthesia. The result showed a biphasic change of oxy-hemoglobin concentration during Ketamine infusion that could be explained by the mechanism of ketamine.

927
WeSMB-34 16:35-16:50
Quantitative tissue assessment using microstructural cross-polarization optical coherence tomography in glioma surgery
K.S. Yashin 1, E.B. Kiseleva 1, A.A. Moiseev 1,2, S.S. Kuznetsov 1, I.A. Medyanik 1, L.Ya. Kravets 1, N.D. Gladkova 1; 1 - Nizhny Novgorod State Medical Academy, 2 - Inst. of Applied Physics RAS, Russia
Optical coherence tomography (OCT) is a promising method of glial tumors borders visualisation. Nowadays it is possible to use hand-held and microscope mounted OCT devices during tumor removal. The quantitative analysis of ex vivo biopsy specimens of brain tissue and glioma cross-polarization OCT allowed to find out differences between glioma and brain tissue.

929
WeSMB-35 16:50-17:05
Effect of laser-induced porogenesis in cartilage on speckle image
O.I. Baum, A.V. Yuzhakov, E.N. Sobol; Federal Scientific Research Centre "Crystallography and Photonics" RAS, Russia

Dynamics and temperature dependences of contrast and the Pearson correlation coefficient of speckle patterns of the cartilage surface in the course of laser irradiation were studied to develop a method to monitor laser-induced changes in the porous structure of costal cartilage.

273
WeSMB-36 17:30-17:50 Invited
Skin optical properties modifications using optical clearing agents: experimental and modelling results
W. Blondel 1,2, P. Rakotomanga 1,2, G. Khairallah 1,2,3, C. Soussen 1,2,4, W. Feng 5,6, D. Zhu 5,6, H. Chen 1,2, C. Daul 1,2,A. Delconte 2, F. Marchal 1,2, M. Amouroux 1,2; 1 - Univ. de Lorraine, 2 - Centre National pour la Recherche Scientifique, 3 - Metz-Thionville Regional Hospital, 4 - Univ. Paris-Sud et Ecole Centrale Supélec, France; 5 - Univ. of Science and Technology, Wuhan, 6 - Britton Chance Center and MOE Key Laboratory for Biomedical Photonics, China
This work investigates the modifications of (i) spatially resolved diffuse reflectance and autofluorescence spectraand (ii) estimated optical properties of skin tissue resulting from optical clearing agent application.

47
WeSMB-37 17:50-18:10 Invited
Tissue optical clearing as a diagnostic tool for tissue pathology differentiation
L. Oliveira 1,2, I. Carneiro 3, S. Carvalho 3, R. Henrique 3,4, D. K. Tuchina 5,6, P. A. Timoshina 5,6, A. N. Bashkatov 5,6, E. A. Genina 5,6, V. V. Tuchin 5,6,7; 1 - Polytechnic of Porto, 2 - Centre of Innovation in Engineering and Industrial Technology, 3 - Portuguese Oncology Inst. of Porto, 4 - Inst. of Biomedical Sciences Abel Salazar – Univ. of Porto, Portugal; 5 - Saratov State Univ., 6 - Tomsk State Univ., 7 - Inst. of Precision Mechanics and Control RAS, Russia
To establish a reliable diagnosis and monitoring of disease development, a clinician needs to rely on accurate measured data. Certain clinical conditions, like cancer and other pathologies, such as diabetes mellitus, are sometimes difficult to detect with simple methods. When suspicion exists, tissue resection must be performed and the biopsied samples are submitted to further analysis. Normal and pathological tissues are known to have different blood and water contents and such difference may be used to establish a new diagnostic tool. The optical immersion clearing technique has been used to increase tissue transparency, improving tissue depth for laser surgery and image contrast. With the objective of developing a complementary diagnostic tool, we have used the immersion clearing method and studied normal and pathological colorectal tissues under treatment with glucose and glycerol solutions with different osmolarities. These studies have demonstrated that free water content in pathological tissues is approximately 5% higher than in normal tissues. The same experimental data allowed also differentiating between the diffusion properties of optical clearing agents (OCAs) in normal and pathological tissues. The calculated data can be used as reference for colorectal cancer detection and fast diagnosis establishment. Similar studies can be performed in other tissues to discriminate the free water content and OCA diffusion properties between normal and pathological tissues, in particular for differentiation of normal and glycated tissues at diabetes. The complications of diabetes are related to the glycation of body proteins which is initiated by a non-enzymatic reaction between the amide proteins and the carbonyl group of the sugar, followed by cross-linking of proteins. Tissue permeability for chemical agents allows for assessing the structure change of tissue, which can be used as a biomarker of tissue protein glycation degree. To prove the concept, the studies were performed for ex vivo skin and myocardium samples of Winstar white outbred male laboratory rats by using a 70%-glycerol solution as an OCA. Obtained results have showed decrease of myocardium permeability for glycerol from (11.8±6.1)×10–5cm/s to (1.04±0.65)×10–5cm/s and for skin from (1.68±0.88)×10–5 cm/s to (1.16±0.74)×10–5 cm/s in four weeks of alloxan diabetes, respectively. Thus, much slower diffusion of probe molecules for diabetic tissues is found, that can be used as a criterion of tissue pathology development of internal important for human life organs.

266
WeSMB-38 18:10-18:30 Invited
Dynamic optical coherence elastography of soft tissue
K.V. Larin; Univ. of Houston, USA
Optical coherence elastography (OCE) is relatively new emerging method allowing to assess biomechanical properties of tissues in situ and in vivo in 3D. In this talk I will overview recent progress made in the quantitative assessment of viscoelasticity of ocular and cardiac tissues.

446
WeSMB-39 18:30-18:45
Monitoring of slow deformations in laser tissue reshaping with optical coherence elastography
V.Y.Zaitsev 1, L.A.Matveev 1, A.L. Matveev 1, A.A. Sovetsky 1, D.V. Shabanov 1, G.V. Gelikonov 1, O.I. Baum 2, A. Yuzhakov 1,2, E.N. Sobol 1,2; 1 - Inst. of Applied Physics RAS, 2 - Inst. of Photonic Thechnologies RAS, Russia
We apply optical coherence elastography to monitor slow deformations of collagenous tissues subjected to thermo-mechanical reshaping by moderate heating with an IR laser. Insufficiently relaxed internal stresses may slowly distort the tissue shape with strain rate ~10^-4 1/s. Ability of the developed method to monitor slow strains with uncertainly ~10^-5 sufficient for intra-operational shape-stability verification of cartilaginous implants is demonstrated.

534
WeSMB-40 18:45-19:00
NIR hyperspectral holography applied for quantitave phase retrieval of the demodex mite
G.S. Kalenkov 1, S.G. Kalenkov 2, M.A. Karpilova 3, A.E. Shtanko 4; 1 - Microholo Ltd., 2 - Moscow Polytechnic Univ., 3 - Research Inst. of Eye Diseases, 4 - Moscow State Univ. of Technology "STANKIN", Russia
The problem of quantitative phase retrieval in NIR (near infrared) of the demodex mite by means of hyperspectral holography is considered. It is shown that the phase distribution of the demodex can be obtained for the wavelength longer than 0.7 μm. For the shorter wavelength its structure is diffusive and phase map is covered by speckle noise.

604
WeSMB-41 19:00-19:15
Erythrocyte size distribution retrieval via laser diffractometry and hyperspectral holography of blood smears
A. Lugovtsov 1, S. Nikitin 1,2, V. Ustinov 3, A. Semenov 1,2, N. Zaalishvili 4, G. Kalenkov 5, A. Shtanko 6, S. Kalenkov 4, A. Priezzhev 1,2; 1-3 - Lomonosov Moscow State Univ., 4 - Moscow Polytechnic Univ., 5 - Microholo Ltd, 6 - Moscow State Univ. of Technology "Stankin", Russia
The problem of measuring the erythrocytes size distribution on a dry blood smear by means of laser diffractometry is considered. To solve the inverse scattering problem, a new erythrocyte model is proposed. This model is developed on the basis of experimental data on three-dimensional shapes of erythrocytes obtained by the method of hyperspectral holography.

791
WeSMB-42 19:15-19:30
OCT-based label-free 3D mapping of lymphatic vessels and transparent interstitial-fluid-filled dislocations
L.A. Matveev 1, V.V. Demidov 2, A.A. Sovetsky 1, A.A. Moiseev 1, A.L. Matveyev 1, G.V. Gelikonov 1, V.Y. Zaitsev 1, A. Vitkin 2,3,4; 1 - Inst. of Applied Physics RAS, Russia; 2 - Univ. of Toronto, 3 - Univ. Health Network, Princess Margaret Cancer Centre, 4 - Univ. of Toronto, Department of Radiation Oncology, Canada
Approach to OCT-lymphangiography and interstitial-fluid-filled dislocations mapping that complement SV OCT angiography is presented. OCT-LA can be extracted from the OCT raw datasets that were acquired for SV OCT. Lymphatic vessels and interstitial dislocations with transparent fluids can be separated from the blood vessels and tissue. In vivo application of the OCT-LA approach is demonstrated on mouse with BX-PC3 tumor.

78
WeSMB-p01 15:00-19:00
Optical spectroscopy for skin fibrosis
Y.V. Chursinova, D.A.Kulikov, D.A. Rogatkin, I.A. Raznitsyna, D.V.Mosalskaya; Moscow Regional Research and Clinical Inst. "MONIKI", Russia
In modern medicine, the development of methods for rapid, non-invasive, quantitative assessment of a tissues state is extremely topical. To date, the diagnosis of skin fibrosis relies on subjective, non-quantitative methods or requires invasive procedures. The results of preliminary studies suggest that optical methods can be used as a quantitative method for diagnostics of fibrosis.

98
WeSMB-p02 15:00-19:00
Features of the dc component of the laser Doppler signal during arterial occlusion
D.G. Lapitan, D.A. Rogatkin; Moscow Regional Research and Clinical Inst. named after M.F. Vladimirsky (MONIKI), Russia
The dc component of the laser Doppler signal was studied experimentally during arterial occlusion. It was shown that the dc component strongly depends on the tissue blood volume. It can be used for evaluation of the tissue ischemia.

117
WeSMB-p03 15:00-19:00
Conformity of Monte Carlo and analytical solutions for one 2D scattering problem in biomedical optics
A.P.Tarasov 1,2, I.A. Raznitsyna 2, D.A.Rogatkin 2; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Moscow Regional Research and Clinical Inst. MONIKI, Russia
2D direct problem of light transport in turbid media in the single-scattering approximation was considered. It was shown that Monte Carlo model strongly depends on corresponding analytical solution on which it was based and, hence, should be used as a reference method very carefully.

151
WeSMB-p04 15:00-19:00
Low-cost laminar optical tomography: phantom study
M.A. Ansari, G.Y. Simakani; Shahid Beheshti Univ., Iran
Laminar optical tomography (LOT) is a fast and high-resolution optical imaging for superficial living tissue. Here, we introduce a low cost LOT with sub-millimeter 3D resolution that can be applied for small animal neuroimaging.

167
WeSMB-p05 15:00-19:00
Non-invasive measurement of hemodynamic change during transcranial ultrasound brain stimulation using near-infrared spectroscopy
E. Kim 1, E. Anguluan 2, J.G. Kim 1,2; 1 - Gwangju Inst. of Science and Technology, 2 - Gwangju Inst. of Science and Technology, Korea
Transcranial ultrasound stimulation (tUS) is a promising non-invasive approach to modulate brain circuits. The application is gaining popularity. However the full effect of acoustic stimulation is still unclear, and further investigation is needed. This study aims to apply near-infrared spectroscopy (NIRS) to provide a non-invasive way to monitor the cerebral hemodynamic change during tUS. The results show hemodynamic alteration caused by acoustic stimulation. We believe the implementation of NIRS during tUS can provide critical information useful to the understanding of brain stimulation.

173
WeSMB-p06 15:00-19:00
Refractive properties of human adipose tissue at hyperthermic temperatures
I.Yu. Yanina 1,2, E.N. Lazareva 1,2, A.N. Bashkatov 1,2, E.A.Genina 1,2, V.V. Tuchin 1,2,3; 1 - Saratov State Univ., 2 - Tomsk State Univ., 3 - Precise Mechanics and Control Inst. RAS, Russia
The refractive index (RI) of human adipose tissue (AT) in the visible and near-infrared ranges were measured at heating (from 40°C up to 50°C). For the first time, RI temperature increment was quantified for a wide wavelength range. The critical temperatures corresponding to lipid phase transitions of AT were determined.

260
WeSMB-p07 15:00-19:00
A subject-specific layered head model for Monte Carlo fitting in Time-domain near-infrared spectroscopy
S. Mahmoodkalayeh, M. A. Ansari; Shahid Beheshti Univ., Iran
Obtaining the absolute values of absorption coefficient in brain tissue has been a challenge in Near-infrared spectroscopy. Here a new layered head model is introduced based on the shape of each individual head surface to estimate absorption coefficient. Monte Carlo simulations are used to calculate distributed time of flight (DTOF) for each source-detector channel. These results can be used for fitting of experimental DTOFs obtained from Time-domain near-infrared spectroscopy.

341
WeSMB-p08 15:00-19:00
Sub-wavelength-resolution imaging of biological tissues using THz solid immersion microscopy
N.V. Chernomyrdin 1,2,3, A.S. Kucheryavenko 1, G.S. Kolontaeva 1, A.O. Schadko 1, S.-I.T. Beshplav 4, K.M. Malakhov 1, G.A. Komandin 2, V.E. Karasik 1, I.E. Spector 2, V.V. Tuchin 5,6,7, and K.I. Zaytsev 1,2,3; 1 - Bauman Moscow State Technical Univ., 2 - Prokhorov General Physics Inst. RAS, 3 - Sechenov First Moscow State Medical Univ., 4 - Burdenko Neurosurgery Inst., 5 - Saratov State Univ., Russia; 6 - Inst. of Precision Mechanics and Control RAS, 7 - Tomsk State Univ., Russia
We have proposed a method of THz solid immersion microscopy, which yields imaging soft biological tissues with the sub-wavelength resolution. We have assembled an experimental setup and examined its resolution using numerical simulations and experimental studies. In order to highlight the prospective of the proposed THz imaging modality, we have applied the experimental setup for imaging of representative examples of biological tissues.

495
WeSMB-p09 15:00-19:00
In vitro terahertz spectroscopy of malignant brain gliomas embedded in gelatin slab
N.V. Chernomyrdin 1,2,3, K.M. Malakhov 1, S.T. Beshplav 4, A.A. Gavdush 1, G.A. Komandin 2, I.E. Spector 2, V.E. Karasik 1, S.O. Yurchenko 1, I.N. Dolganova 1,3, S.A. Goryaynov 4, I.V. Reshetov 3, A.A. Potapov 4, V.V. Tuchin 5,6,7, K.I. Zaytsev 1,2,3; 1 - Bauman Moscow State Technical Univ., 2 - Prokhorov General Physics Inst. RAS, 3 - Sechenov First Moscow State Medical Univ., 4 - Burdenko Neurosurgery Inst., 5 - Saratov State Univ., 6 - Inst. of Precision Mechanics and Control RAS, 7 - Tomsk State Univ., Russia
In our work, we have performed in vitro terahertz (THz) measurements of gelatin-embedded malignant human brain gliomas using the THz pulsed spectroscopy. The gelatin embedding yields sustain the THz response of tissues close to that of the freshly-excised ones for a long time after the resection. We have observed significant differences between the THz responses of normal and pathological tissues of the brain, which highlights a potential of the THz technology in label-free intraoperative neurodiagnosis of tumors.

531
WeSMB-p10 15:00-19:00
Investigation of ophthalmic drug diffusion in soft contact lenses by means of laser interferometry technique
E.V. Dorofeeva 2, P.Yu. Lobanov 1, I.S. Manuylovich 1, O.E. Sidoryuk 1; 1 - R&D Inst. "Polyus", 2 - Inst. of Bioorganic Chemistry RAS, Russia
The present work is devoted to the creation of a technique for estimating the parameters of diffusion processes of various drugs in soft contact lenses. It is based on the use of an auxiliary sample that acts as an absorber. In the case of contact lenses a ball of transparent polyacrylamide (PAM) hydrogel is convenient as a sample object. Analysis of the mass transfer dynamics in the PAM volume was carried out using control of the wavefront distortions with radiation passing through the sample by means of laser phase-shifting interferometry. Quantitative results of diffusion parameters were obtained by comparing the experimental pattern with mathematical modeling data using finite element analysis.

541
WeSMB-p11 15:00-19:00
Results of the investigation of increasing the optical depth of detection of CaCO3 particles in the skin with OCT by optical clearing
S.M. Zaytsev 1, Yu.I. Svenskaya 1, E.V. Lengert 1, A.N. Bashkatov 1,2, V.V. Tuchin 1,2, E.A. Genina 1,2; 1 - Saratov State Univ., 2 - Tomsk State Univ., Russia
We present the result of optimizing the composition of immersion solutions for optical skin clearing in order to increase the optical depth of detection of microparticles inserted into rat hair follicles ex vivo. The greatest optical depth of detection was achieved using a solution of oleic acid and PEG-400 in a ratio of 20: 80% and amounted to 404 ± 37 microns after 25 minutes of optical skin clearing.

638
WeSMB-p12 15:00-19:00
Confocal scanning laser ophthalmoscopy and the screening of optic nerve pathology
Zh. Yu. Alyabyeva, O.V. Agaptseva; RNRMU, Russia
Abstract: With the development of the optic coherent tomography technology the scanning laser ophthalmoscopy, though almost always present in every such device, as well as in fluorescent angiography laser systems, is not used efficiently enough. The possibility to use the scanning laser ophthalmoscopy for screening of the optic nerve pathology is analyzed.

645
WeSMB-p13 15:00-19:00
Spectrally selective soft X-ray microscopy in studies of biological objects
I.A.Artyukov, N.L.Popov, A.V.Vinogradov; Lebedev Physical Inst. of the RAS, Russia
The paper deals with the analysis of absorption contrast of histological and cytological images, which can be produced in soft x-ray/EUV microscopic studies using monochromatic or quazi-monochromatic radiation at the wavelengths 2-14 nm. We present also the experimental results obtained with a laser-plasma source and X-ray multilayer optics in the spectral region of high transparency of carbon-containing materials (4.5-5 nm, "carbon window").

655
WeSMB-p14 15:00-19:00
Non-contact laser speckle anemometry of microcirculatory bloodstream
O.A. Golovan, E.N. Velichko, M.A. Baranov, E.T. Aksenov; Peter the Great St. Petersburg Polytechnic Univ., Russia
In the work the scheme of the differential sensor for non-invasive distant anemometry of microcirculatory bloodstream is described. The sensor is designed on base of the laser speckle theory. Some important parameters like maximal distance and time of measurement are calculated. Experimental results on blood speed determination are presented.

665
WeSMB-p15 15:00-19:00
Terahertz time-domain spectroscopy for non-invasive assessment of water content in biological samples
M.A. Borovkova 1,2, M.K. Khodzitsky 1, O.P. Cherkasova 1,3, A.P. Popov 2, I.V. Meglinski 1,2; 1 - ITMO Univ., Russia; 2 - Univ. of Oulu, Finland, 3 - Inst. of Laser Physics RAS, Russia
We apply terahertz time-domain spectroscopy for quantitative non-invasive assessment of water content in biological samples: tree leafs and pork muscles. The Landau-Looyenga-Lifshitz-based model is used for calculation of water concentration within the samples. The obtained results show that water content in biological samples can be measured non-invasively, with a high accuracy, utilizing terahertz waves in transmission and reflection modes.

777
WeSMB-p16 15:00-19:00
Peculiarities of red blood cells aggregation and deformability in patients with arterial hypertension: assessement with optical techniques
A.E. Lugovtsov 1, A.N. Semenov 1,2, P.B. Ermolinskiy 2, A.I. Maslyanitsina 2, N.M. Povalyaev 3, L.I. Dyachuk 3, E.P. Pavlikova 3, Yu.I. Gurfinkel 3, A.V. Priezzhev 1,2; 1 - International Laser Center, Lomonosov Moscow State Univ., 2 - Lomonosov Moscow State Univ., 3 - Medical Research and Education Center, Lomonosov Moscow State Univ., Russia
Red blood cells aggregation parameters is assessed with optical techiques: diffuse light scattering, optical trapping and manipulation and capillaroscopy. Peculiarities of the cells aggregation and its effect on capillary blood flow in patients with arterial hypertension are discussed.

817
WeSMB-p17 15:00-19:00
Fabrication and characterization of agar and silica gel based biotissue-mimicking phantoms in THz frequency range
E.L. Odlyanitskiy, O.A. Smolyanskaya, O.V. Kravtsenyuk; ITMO Univ., Russia
The study revealed the most promising candidates for phantoms mimicking different biological tissues in the terahertz frequency range. The tissue-like phantom consisting of agar gel and drops of silica gel was designed as a model with scattering in terahertz frequency region. Optical properties of this phantom were experimentally measured and the depth of radiation penetration was estimated. The process of terahertz beam propagation and angular distribution of transmitted radiation as well as the scattering anisotropy factor were simulated.

859
WeSMB-p18 15:00-19:00
Method of intraoperative spectroscopic detection of tumor tissues in neurosurgery
T.A. Savelieva 1,2, K.G. Linkov 1, A.V. Borodkin 1, V.V. Volkov 1, S.A. Goryajnov 3, A.A. Potapov 3, V.B. Loschenov 1,2; 1- Prokhorov General Physics Inst. RAS, 2 - NRNU MEPhI, 3 - Burdenko National Scientific and Practical Center for Neurosurgery, Russia
The proposed method provides neurosurgical intraoperative navigation using optical spectroscopy and neurophysiological stimulation. The device contains a spectrometer, sources of optical radiation and fiber-optic probe, the working part of which is made in one body with a cannula of neurosurgical aspirator and can be used also as a monopolar stimulant for the system of intraoperative neuromonitoring.

872
WeSMB-p19 15:00-19:00
Temporal changes of polarization-optical properties of collagen fibers during immersion clearing process
M.E. Shvachkina, D.D. Yakovlev, A.B. Pravdin, D.A. Yakovlev; Saratov State Univ., Russia
Results of the experimental study of kinetics of average birefringence index and diattenuation of collagen fibers in the process of optical immersion clearing are reported.

546
WeSMB-p20 15:00-19:00
Optical coherence tomography of tissues using the recovery of depth distributions of the backscattering efficiency
E.V. Ushakova 1, S.A. Yuvchenko 1,2, E.M. Artemina 3, A.A. Isaeva 1, E.A. Isaeva 1, D.A. Zimnyakov 1,2; 1 - Saratov State Technical Univ., 2 - Inst. of Precision Mechanics and Control RAS, 3 - Saratov State Medical Univ., Russia
We consider an approach to OCT characterization and imaging of the tissue structure using the recovery of depth distributions of the backscattering efficiency based on removal of the exponential trend in OCT signals.

979
WeSMB-p21 15:00-19:00
Optical clearing of brain in vitro by glycerol solution
D.K. Tuchina 1,2, A.N. Bashkatov 1,2, N.A. Navolokin 3, V.V. Tuchin 1,2,4; 1 - Saratov State Univ., 2 - Tomsk State Univ., 3 - Saratov State Medical Univ., 4 - Inst. of Precision Mechanics and Control RAS, Russia
We report the results of in vitro brain optical clearing by glycerol solution in order to increase light penetration depth. The result can be useful for improvement the modern optical methods of diagnostic and treatment of various brain diseases.

909
WeSMB-p22 15:00-19:00
Nonlinear optical effects during the formation of implantation material for bone-cartilaginous joints
P.N. Vasilevsky, M.S. Savelyev, A.Yu. Gerasimenko, U.E. Kurilova, V.M. Podgaetsky; National Research Univ. of Electronic Technology, Russia
This article presents the studies results for nonlinear optical characteristics of protein aqueous dispersions (bovine serum albumin and bovine collagen) with single-walled carbon nanotubes. These characteristics were obtained using Z-scan experiments and fixed sample location experiments with a fixed position of the sample. Calculations were made using a method based on the radiation transfer equation.

168
WeSMB-p23 15:00-19:00
Thermal imaging by means of IR-fiber bundle for medical applications
E.A. Korsakova, L. V. Zhukova, A. S. Korsakov, A.S. Shmygalev, M.S. Korsakov; Ural Federal Univ., Russia
In this study we proposed a thermal imaging setup with an ordered bundle of silver halide IR-fibers. This bundle allowed us to obtain thermal images of objects with linear dimensions equivalent to the diameter of an individual fiber in the bundle. We expect such bundles will be applied in surgery monitoring systems for the tissues temperature estimation during laser cutting.

5th International A.M. Prokhorov Symposium on Lasers in Medicine and Biophotonics. Section C. Photonics and nanobiotechnology

487
WeSMC-01 15:00-15:25 Invited
Optical biosensors based on surface plasmons and their applications in medical diagnostics
Jiri Homola; Inst. of Photonics and Electronics, Czech Republic
The presented research is concerned with plasmonic affinity biosensors and their applications in medical diagnostics.

939
WeSMC-02 15:25-15:50 Invited
Ultrasensitive plasmonic biosensing
F. Wu 1, J.P. Singh 1, P.A. Thomas 1, O. Ivasenko 2, S. De Feyter 2, V.G. Kravets 1, P.J.R. Day 1, A.N. Grigorenko 1; 1 - Univ. of Manchester, UK; 2 - Univ. of Leuven, Belgium
We demonstrate ultrasensitive detection of malaria aptamers performed with the help of graphene protected copper plasmonics. Using better morphology of copper surface as compared to gold, phase sensitive surface plasmon resonance schemes and graphene functionalization protocol for attaching end-tethering of DNA probes we were able to improve the detection level of malaria aptamers by an order of magnitude. This opens a way to associate a dormant bacterial population with chronic inflammatory diseases in blood samples using simple label-free optical detection.

945
WeSMC-03 15:50-16:10 Invited
Light induced time and site specific drug delivery
M. Gai 1, M. Kurochkin 2, O. Sindeeva 2, J. Frueh 3, D. Luo 1, .J. Gould 1, G.B. Sukhorukov 1,2; 1 - Queen Mary Univ. of London, UK; 2 - Saratov State Univ., Russia; 3 - Harbin Inst. of Technologies, China
Delivery of bioactive compounds on precise amounts on site and time defined manner is actual task of bionanotechnology. Delivery systems can be made of polymers and nanopartiucles which harvest the light and induce release of encapsulated materials. This papers describes methods of microencapsulation and micropackaging of bioactive materials and their ability to release it in response on light inside cells and to induce cell transformation locally.

607
WeSMC-04 16:10-16:30 Invited
Nanophotonic functional imaging and related nanotoxicity issues
A. Sukhanova 1,2, P. Chames 3, D. Baty 3, F. Ramos-Gomes 4, F. Alves 4, I. Nabiev 1,2; 1 - Univ. de Reims Champagne-Ardenne, France; 2 - National Research Nuclear Univ. MEPhI, Russia; 3 - Aix Marseille Univ., CNRS, France; 4 - Max Planck Inst. for Experimental Medicine & Univ. Medical Center, Germany
Early detection of the micrometastases is still a challenge. Here, we demonstrate the use of nanoprobes engineered from the single-domain antibodies and fluorescent quantum dots for single- and two-photon detection and imaging of human micrometastases in ex vivo biological samples of breast and pancreatic metastatic tumour models and analyze the nanotoxicity issues related to their potential for in vivo applications.

401
WeSMC-05 16:30-16:45
Direct immobilized nanostructured myoglobin for CO detection by surface plasmon resonance
G. Dyankov 1, V. Serbezov 2, E. Borisova 2, H. Kisov 1, E. Belina 1; 1 - Inst. of Optical Materials and Technology BAS, 2 - Inst. of Electronics BAS, Bulgaria
Announced is nanostructured myoglobin (Mb) layer directly immobilized by modified pulsed laser deposition. The biological activity of Mb nanostructured layer is proven by its CO sensing capability.

418
WeSMC-06 16:45-17:00
Label-free method for multiplex investigation of dynamics of protein-protein interactions
A.V. Orlov 1,2, V.A. Bragina 1, B.G. Gorshkov 1; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia
A multiplex optical label-free method has been developed for direct quantitative determination of kinetic parameters of protein-protein interactions by real-time monitoring of molecular recognition processes. The method permits simultaneous registration of dynamics of several pair-to-pair interactions on a single sensor chip with spectral-correlation interferometry. The method has been successfully demonstrated by recording interactions of several different monoclonal antibodies with antigens.

93
WeSMC-07 17:30-17:50 Invited
SERS-based platforms for immunoassay
B. N. Khlebtsov; Inst. of Biochemistry and Physiology of Plants and Microorganisms RAS, Russia
Focusing on several basic elements in SERS immunoassays, typical structures of SERS nanoprobes, productive optical spectral encoding strategies, and popular immunoassay platforms are highlighted. Additionally, in this report, we assumed gap enhanced Raman tags (GERTs) based on reporter molecules embedded inside Au@Au core/shell particles. The multiplex capability of the SERS dot immunoassay was illustrated by a proof-of-concept experiment involving simultaneous one-step determination of different target molecules with a mixture of fabricated GERTs conjugates.

810
WeSMC-08 17:50-18:10 Invited
Multifunctional nanoagents for Llogic-gated chemosensing, dDiagnostics and drug delivery
M.P. Nikitin; Moscow Inst. of Physics and Technology (State Univ.), Prokhorov General Physics Inst. RAS, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia
Stimuli-responsive smart materials are promising for different biomedical applications ranging from in vitro diagnostics to bioimaging and drug delivery. Here we demonstrate fabrication and performance testing of multifunctional smart nanoagents capable of logic-gated processing of biochemical and physical stimuli. We show capabilities of the optically-active agents using imaging flow cytometry, SPR biosensors and microscopy.

89
WeSMC-09 18:10-18:30 Invited
Nanoscale luminescent labels of organic and inorganic nature for bioassay
I.Yu.Goryacheva, A.M. Vostrikova, A.A. Kokorina, A.S. Novikova, A.M. Sobolev, D.D. Drozd, A.A.Bakal, A.N. Nikolaeva, D.V. Shpuntova, O.A.

Goryacheva; Saratov State Univ., Russia
Semiconductor luminescent quantum dots and luminescent carbon nanoparticles are discussed in the term of application for bioassay: current state, perspectives, advantages and disadvantages.

697
WeSMC-10 18:30-18:50 Invited
Immunoassays using nanoparticle as labels: advantages and current state
S.A. Eremin; Lomonosov Moscow State Univ., Russia
Enzyme-linked immunosorbent assay (ELISA), lateral flow immunoassay (immunochromatographic strip-test) and Fluorescence Polarization Immunoassay (FPIA) are more commonly used immunoassays for detection of mycotoxins and antibiotics in food samples. These methods could be modified by using nanoparticles and quantum dots.

411
WeSMC-11 18:50-19:05
Quantum Dots in basic research and practical applications: the role of size and quasi-multivalency
A.V. Salova 1, T.N. Belyaeva 1, V.V. Kosheverova 1, E.A. Leontieva 1, M.V. Kharchenko 1, E. S. Kornilova 1,2,3; 1 - Inst. of Cytology RAS, 2 - Peter the Great St. Petersburg Polytechnic Univ., 3 - St. Petersburg State Univ., Russia
QDs are fluorophores with high quantum yield and exclusive photostability. This suggests QDs applications for multi-color staining and detection during long time in live cells. However, big size of QD and multiple binding sites for a ligand (quasi-multivalency) could affect intracellular behavior of QD-labelled ligand. We analysed in detail effect of QD implication as label for EGF on EGF-receptor endocytosis.

516
WeSMC-12 19:05-19:20
TAM identification by fluorescence lifetime on different models
Yu.S. Maklygina 1, G.M. Yusubalieva 2, I.D. Romanishkin 1, A.V. Ryabova 1, V.P. Chekhonin 2, V.B. Loschenov 1; 1 - Prokhorov General Physics Inst. RAS, 2 - Serbskij State Research Center of Forensic and Social Psychiatry, Russia
Nowadays problem of cell differentiation in vivo is the topical in oncology. Laser time-resolved spectroscopy allows to evaluate the activity of different types of cells in a tumor microenvironment, in particular tumor associated macrophages (TAM), considering specific cell's features of photosensitizer (PS) accumulation. The technique is based on the fluorescence lifetime estimation, which allows one to judge the degree of PS interaction, thereby distinguishing the type of cells.

806
WeSMC-13 19:20-19:35
Combined method for laser selection, positioning and analysis of micron and submicron cells and particles
E.A. Savchenko, E.N. Velichko, E.T. Aksenov, E.K. Nepomnyashchaya; Peter the Great St. Petersburg Polytechnic Univ., Russia
The concept of a combined measuring system for determination of the physical and dynamical parameters of a single micron and submicron particle is proposed in this paper. The results of an experimental testing and approbation of functional parts of the suggested system are presented.

237
ThSMC-14 09:00-09:20 Invited
Nanomaterials for biosensing and phototherapy applications
A. Rakovich; King's College London, UK
Great demand exists for the development of advanced healthcare solutions for early detection of diseases and effective methods of treatment. The immense progress of nanomaterials research over the last few decades suggests that it could be the source of such solutions and could include, for example, substrate-based optical antenna systems for improved biosensing applications and colloidal nanomaterials for photodynamic therapy.

798
ThSMC-15 09:20-09:40 Invited
Targeting of tumor tissues with magnetic nanoparticles
M. Goncalves 1, R. Schwartz-Albiez 1, P.I. Nikitin 2, M.P. Nikitin 3, F. Momburg 1; 1 - Antigen Presentation and T/NK Cell Activation Group, Clinical Cooperation Unit Applied Tumor Immunity, German Cancer Research Center, Heidelberg, Germany; 2 - Prokhorov General Physics Inst. RAS, Russia; 3 - Moscow Inst. of Physics and Technology (State Univ.), Russia
Magnet-enforced targeting of drug-loaded superparamagnetic iron oxide nanoparticles (SPIO-NP) towards malignant tumors appears to be a desirable tool. In order to make magnetic targeting feasible for non-superficial tumors we propose to create a 'magnetic interface' in the tumor microenvironment by targeting red blood cells loaded with SPIO-NP towards specific receptors on tumor endothelial cells by means of surface-bound antibodies.

232
ThSMC-16 09:40-10:00 Invited
Magnetic cell therapy for vascular disease
B. Polyak; Drexel Univ. College of Medicine, USA
This study demonstrates that magnetically-mediated repopulation of endothelial cells in the injured artery prevented the development of in-stent stenosis nearly two-fold earlier and with a two-fold greater magnitude at the site of successful cell delivery. The methodology investigated here may provide the basis for designing the next generation of cell-based therapy for vascular healing after stent angioplasty.

346
ThSMC-17 10:00-10:15
Towards magnetoencephalography based on ultra-sensitive laser pumped non-zero field magnetic sensor
A.E. Ossadtchi 1, N.K. Kulachenkov 2, D.S. Chuchelov 3, S.P. Dmitriev 4, A.S. Pazgalev 4, M.V. Petrenko 4, A.K. Vershovskii 4; 1 - National Research Univ. "Highter School of Economics", 2 - JSR Electropribor, 3 - Lebedev Physical Inst., 4 - Ioffe Inst., Russia
The principal possibility of creating optically pumped compact magnetic sensor for MEG operating in a wide magnetic field range is experimentally proved.

295
ThSMC-18 10:15-10:30
Microscopy of tunable assembly of cells in external alternating electric fields
E.V. Yakovlev 1, S.A. Korsakova 1, K.I. Zaytsev 1,2, I.N. Aliev 1, S.O. Yurchenko 1; 1 - Bauman Moscow State Technical Univ., 2 - Prokhorov General Physics Inst. RAS, Russia
In this work, we present the results of particle-resolved studies, obtained by microscopy, of clusters and chains of red blood cells (RBCs), formed during their self-assembly in external alternating electric field. The results prove efficiency and prospectively of electric fields for manipulation with cells and their clusters.

882
ThSMC-19 10:30-10:45
Fluorescent superparamagnetic and paramagnetic agents for bioimaging, sensing and cell targeting
I.L. Sokolov 1,2, A.V. Vasilyeva 1, A.V. Lunin 1, A.V. Yaremenko 1, V.R. Cherkasov 1; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, Russia
Nanocomposite materials are of great interest as a multipurpose instrument for various biomedical applications. In the presented work, we demonstrate the capability of fluorophore-modified nanoparticles based on iron oxides and oxyhydroxides crystallites to act as multimodal agents that combine specific recognition of target cells with properties of materials used for fluorescent bioimaging and MRI-contrasting.

405
ThSMC-20 10:45-11:00
High-sensitive analytical systems for rapid on-site detection of haptens
N.V. Guteneva 1,2, A.V. Orlov 1,2, V.A. Bragina 1, B.G. Gorshkov 1, S.L. Znoyko 1; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia
Analytical systems for rapid, specific and sensitive registration of different types of haptens such as B vitamins, thyroid hormones and drugs of abuse have been developed. The limits of detection are on the level of time-consuming laboratory methods. However, the developed systems are much faster, simpler and can be use on-site. These features are due to advanced assay formats with optimal antibodies and conjugation procedures revealed by real-time characterization of binding kinetics of the reagents with the original label-free interferometric biosensors. The developed test systems are promising for medical diagnostics, criminalistics, toxicology, food quality control and environmental monitoring.

793
ThSMC-21 11:30-11:50 Invited
Eco-photonics: Micro-encapsulated probe as implantable sensor for monitoring the physiological state of water organisms
*A. Popov 1, A. Bykov 1, A. Gurkov 2, E. Borvinskaya 2, A. Sadovoy 3, M. Timofeev 2; I. Meglinski 1,2,3,6; 1 - Univ. of Oulu, Finland; 2 - Irkutsk State Univ., Russia, 3 - A*STAR, Singapore*
Presently there is a highly growing interest to the natural evolutionary changes and especially those that driven by environmental pollution and climate change. Based on the developed micro-encapsulated implantable sensors we present an approach for non-invasive assessment of stress conditions felt by water organisms due to environmental variations and climatic changes.

914
ThSMC-22 11:50-12:10 Invited
In vivo study of cell division with stimulated Raman scattering
M. Veres, L. Himics, I. Rigó, A. Nagy, S. Tóth, Sz. Kugler, P. Baranyai, A. Czitrovszky, T. Váczi; Wigner Research Centre for Physics HAS, Hungary
Stimulated Raman scattering (SRS) is non-linear vibrational spectroscopic technique with sub-millisecond sampling times allowing to perform video rate imaging on biological objects including even few tens of cells simultaneously. In this work SRS was used for in vivo study of cell division in zebrafish embryo in order to get insight into temporal evolution of the related processes.

975
ThSMC-23 12:10-12:30 Invited
Giant electromagnetic field in periodic metal-silicone metasurface and SERS sensors
A.K. Sarychev 1, K.N. Afanasev 1, I.V. Bykov 1, I.A. Boginskaya 1, E.G. Evtushenko 2, A.V. Ivanov 1, I.N. Kurochkin 2,3, A.N. Lagarkov 1, A.M. Merzlikin 1, V.V. Mikheev 4, D.V. Negrov 4, I.A. Ryzhikov 1, M.V. Sedova 1; 1 - Inst. for Theoretical and Applied Electrodynamics RAS, 2 - Lomonosov Moscow State Univ., 3 - Emanuel Inst. of Biochemical Physics RAS, 4 - Moscow Inst. of Physics and Technology, Russia
Anomalous optical response for the metamaterial fabricated from silicon bar resonators is investigated. The resonators are manufactured in form of two-dimensional bars and covered by semicontinuous silver film. The calculations as well as real experiments demonstrate Wood anomalies in visible and near IR spectral ranges associated with excitation of the surface waves in metamaterial by means of diffraction of the incident light on the periodic bars. The multiple metal-dielectric resonances result in much enhanced local electromagnetic fields in-between metal particles placed on the surface of dielectric bars. The resonances can be tuned by varying angle of incidence, polarization, and geometry of the dielectric bars. It opens new venue in R&D SERS substrates including sensors detecting specific substances.

451
ThSMC-24 12:30-12:50 Invited
Plasmonic fractal shells for drug delivery: broadband response, synthesis, and laser release
V. P. Drachev 1,2, V. C. de Silva 1, P. Nyga 3; 1 - Univ. of North Texas, USA; 2 - Skolkovo Inst. of Science and Technology, Russia; 3 - Military Univ. of Technology and Inst. of Optoelectronics, Poland
Gold fractal shells of 1, 2, or 4 microns are synthesized and after silica core etching preserve its shape and morphology. Light goes mostly through the epsilon-near-zero shell with approximately wavelength independent absorption rate from 0.5 to 20 microns. The shells can be open up using laser pulse light-induced changes due to the coalescence or ablation of the nanostructures.

869
ThSMC-25 12:50-13:05
Development of SPR based tool for monitoring of self-assembly of heterogenous nanoparticle complexes
K.G. Shevchenko 1, A.V. Babenyshev 1, A.A. Tregubov 1, I.L. Nikitina 2, V.R. Cherkasov 1; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, Russia
Self-assembling nanomaterials are a convenient tool for various biomedical applications due to easily adjustable physical, chemical and biological properties. Here we show the use of SPR shift analysis for real-time monitoring of assembly and disassembly of various heterogenous nanoparticle complexes. Proposed instrument would be particularly suitable for constructing novel types of in situ biosensors and drug delivery systems.

309
ThSMC-26 13:05-13:20
Surface-enhanced infrared spectroscopy for cortisol analysis
I.A. Milekhin 1, O.P. Cherkasova 2, A.G. Milekhin 3, S.A.Kuznetsov 2, E.E. Rodyakina 3,2, V.A. Minaeva 4, A.V.Latyshev 3,2; 1 - Novosibirsk State Univ., 2 - Inst. of Laser Physics SB RAS, 3 - Rzhanov Inst. of Semiconductor Physics, Russia; 4 - Bohdan Khmelnitsky National Univ., Ukraine
The method of nanostructuring metal surfaces by means of nanolithography was optimized and Au nanoantenna arrays with the controllable parameters on the Si surfaces were formed. The surface-enhanced infrared spectroscopy was used for analysis of steroid hormone cortisol in blood plasma.

230
ThSMC-27 13:20-13:35
Highly sensitive precision scanner for fluorescent and colorimetric microarrays with excitation by using single mode pigtailed semiconductor lasers
V.A. Elokhin 1, V.A. Gotlib 1, S.A. Klotchenko 2, D. A. Makarov 1, A.V. Vasin 2; 1 - Scientific Instruments JSC,2 - FGBU Influenza Research of Health

Ministry of Russian Federation, Russia
Optical schematic, rationalities for choosing of excitation lasers, filters and imaging lenses of fluorescent and colorimetric microarrays scanner are presented. High sensitivity, excellent resolution and accuracy of this microarray scanner are show by using comparative testing with prototypes of two different modern microarrays scanners. Represented results of laboratory testing performed by using protein microarrays for interleukin markers detection.

815
ThSMC-28 15:00-15:20 Invited
Mueller polarimetry as a tool for optical biopsy of tissue
T. Novikova 1, J. Rehbinder 1, J. Vizet 1, A. Pierangelo 1, R. Ossikovski 1, A. Nazac 2, A. Benali 3, P. Validire 3; 1 - LPICM, CNRS, Ecole Polytechnique, 2 - Univ. Hospital of Bicêtre, 3 - Hospital IMM, France
Multi-spectral imaging Mueller polarimetry holds promise to become a new tool for optical biopsy of tissue. Significant increase in contrast between malignant lesions and healthy human tissue was observed on wide field polarimetric images acquired with in-house built Mueller polarimeter. Both theoretical and numerical studies explored the origin of the observed enhancement of polarimetric image contrast.

128
ThSMC-29 15:20-15:40 Invited
Composite plasmonic SERS tags with embedded Raman reporters
N.G. Khlebtsov 1,2, B.N. Khlebtsov 1,2, D.N. Bratashov 2; 1 - Inst. of Biochemistry and Physiology of Plants and Microorganisms RAS, 2 - Saratov National Research State Univ., Russia
Gold and composite Au@Ag layered nanoparticles, in which Raman molecules are embedded in a nanometer-sized gap between metal layers, have great potential in biomedical applications. Another type of efficient SERS tags are the tip functionalized Au@Ag nanorods operating in off-resonance mode. Here, we summarize our recent efforts in fabrication, electromagnetic simulation, and bioimaging application of both SERS probes.

582
ThSMC-30 15:40-16:00 Invited
Novel nanocomposite photoacoustic contrast agents
M.V. Novoselova 1,2, D.N. Bratashov 2, M. Sarimollaoglu 3, D.A. Nedosekin 3, B. N. Khlebtsov 2,4, E.I. Galanzha 3, V.P. Zharov 3, D.A. Gorin 1,2; 1 - Skolkovo Inst. of Science and Technology, 2 - Saratov State Univ., Russia; 3 - Univ. of Arkansas for Medical Sciences, USA; 4 - Inst. of Biochemistry and Physiology of Plants and Microorganisms, Russia
Nanostructured carriers have a good perspective for personalized and preventive medicine. However, application of such objects is hampered by absence of effective detection method for in vivo monitoring of carrier biodistribution and biodegradation processes without altering its structure. Here, we have found optimal composition and structure of carrier shell from point of view of photoacoustic signal intensity required for detection of nanostructured carriers in vitro and in vivo. The nanostructured carriers that exhibited the highest photoacoustic signal were utilized combination of gold nanorods and organic dye dispersed in the matrix of biodegradable polymers.

544
ThSMC-31 16:00-16:15
Holographic monitoring of cell death pathways induced by reactive oxygen species
A.V. Belashov 1, A.A. Zhikhoreva 1,2, D.A. Rogova 3, T.N. Belyaeva 4, E.S. Kornilova 3,4, A.V. Salova 4, I.V. Semenova 1, O.S. Vasyutinskii 1; 1 - Ioffe Inst., Russia; 2 - ITMO Univ., 3 - Peter the Great St. Petersburg Polytechnic Univ., 4 - Inst. of Cytology RAS, Russia
Results of HeLa cells death monitoring by means of holographic microscopy and holographic tomography are presented. The observed dynamics of phase shift after photodynamic treatment evidences dose-dependent effect and substantially different pathways of cell death.

530
ThSMC-32 16:15-16:30
Optimization of upconversion nanoparticles excitation regimes for selective heating and effective thermometry in biological tissues
D.V. Pominova, A.V. Ryabova, P.V. Grachev, I.D. Romanishkin, V.Yu. Proydakova, S.V. Kuznetsov, V.V. Voronov, P.P. Fedorov, V.B. Loschenov; Prokhorov General Physics Inst. RAS, Russia
Upconversion nanoparticles have many advantages for bioimaging. Laser heating of upconversion nanoparticles and thermo sensitive luminescence bands enable to perform photothermal therapy with temperature control. However, the upconversion excitation wavelength 980 nm is well absorbed by water. Optimization of the excitation wavelength allows to ensure the selectivity of heating and an intense luminescent signal for effective thermometry.

108
ThSMC-33 16:30-16:45
A crystal host selection for aqueous colloidal luminescent nanocrystals doped by Nd3+ used for bioimaging in first biological window
Yu.V. Orlovskii 1,2, A.V. Popov 1, E.O. Orlovskaya 1, A.S. Vanetsev 1,2, I. Sildos 2, P.V. Grachev 1, A.V. Ryabova 1; 1 - Prokhorov General Physics Inst. RAS, Russia; 2 - Univ. of Tartu, Estonia
Simple criteria for crystal host selection for Nd3+ doped nanocrystals using as fluorescent agents in the first biological window of wavelengths is set. It is a ratio of Judd-Ofelt intensity parameters Ω4/Ω6, which must be as large as possible to reduce the fluorescence Nd*-Nd self-quenching and Nd*-OH-quenching caused by vibrations of molecular groups positioned in the volume of nanocrystals.

976
ThSMC-34 16:45-17:00
Anomalous optical response of silicon tip-shaped metasurface
A.K. Sarychev 1, K.N. Afanasev 1, I.V. Bykov 1, I.A. Boginskaya 1, A.V. Ivanov 1, I.N. Kurochkin 2,3, A.N. Lagarkov 1, I.A. Ryzhikov 1, M.V. Sedova 1; 1 - Inst. for Theoretical and Applied Electrodynamics RAS, 2 - Lomonosov Moscow State Univ., 3 - Emanuel Inst. of Biochemical Physics RAS, Russia
Anomalous optical response for the metasurface fabricated from silicon resonators is investigated. Resonators have form of 3D micro cones - tips that are covered by semicontinuous silver film. Thus prepared metasurface exhibits anomalous optical response due to the excitation of metaldielectric resonances in visible and near IR spectral ranges. We investigate the effect of the “extraordinary” optical diffraction by tip-shaped metasurface. The multiple metal-dielectric resonances result in huge enhancement of the local electric field in-between metal particles placed on the surface of dielectric cones. SERS phenomenon is investigated by immobilization of DTNB (5,5’- dithio-bis-[2-nitrobenzoic acid]) molecules of on the metasurface.

567
ThSMC-35 17:30-17:50 Invited
Connecting biochemistry and elelctronics with artificial allosteric protein biosensors
Zh. Guo, J. Whitfield , S. Edwardraja, K. Alexandrov; Univ. of Queensland, Australia
The idea that biological systems can be built from standard components is the central tenet of Synthetic Biology. Although proteins control most of real time information and energy flow in a cell, our ability to create protein-based switches and thereon based circuits is woefully underdeveloped. We addressed this by developing a generally applicable strategy for converting constitutively active enzymes into allosterically controlled switches. This was

achieved by constructing chimeric enzymes where the enzymatically active part is fused with a conformational switch. We demonstrated that such basic signaling units could be compiled into higher order biosensor systems capable of detecting potentially any analyte. Specifically using this approach we constructed electrochemical and optical biosensors specific to ions, small molecule drugs and proteins.

526
ThSMC-36 17:50-18:10 Invited
Prerequisites of human stress states diagnostics with the use of THz radiation
E.E. Berlovskaya 1, A.S. Sinko 1, I.A. Ozheredov 1, T.V. Adamovich 1, E.S. Isaychev 1, S.A. Isaychev 1, O.P. Cherkasova 2, A.M. Makurenkov 1, A.M. Chernorizov 1, A.P. Shkurinov 1,3; 1 - Lomonosov Moscow State Univ., 2 - Inst. of Laser Physics SB RAS, 3 - Crystallography and Photonics Federal Research Center RAS, Russia
Variations of psychophysiological characteristics, biochemical parameters and terahertz images of a human face were studied during the special test pass which modeled stress situations.

807
ThSMC-37 18:10-18:25
Laser correlation spectroscopy for immune testing
E.K. Nepomnyashchaya, E.N. Velichko, E.T. Aksenov, T.A. Bogomaz; Peter the Great St. Petersburg Polytechnic Univ., Russia
New results about the immune status of a human body estimation by dynamic light scattering (laser correlation spectroscopy) method are presented. A designed scheme of the laser correlation spectroscopy device allowed us to conduct measurements of blood proteins' sizes and dynamics under the influence of external factors. These results will be used for development of preliminary diagnosis of immune diseases.

974
ThSMC-38 18:25-18:40
New technology based on femtosecond optical lithography for fabrication of nanowire devices.
M.A.Tarkhov 1,2, N.V. Minaev 1, B.S.Shavkuta 1, A.M. Mumlyakov 2, A.V. Terentyev 2, Y.V. Anufriev 2, E.V. Zenova 2, and V. N. Bagratashvili 1; 1 - Inst. of Photonic Technologies, FSRC, 'Crystallography and Photonics' RAS, 2 - Inst. of Nanotechnology and Microelectronics RAS, Russia
This report describes a new technology based on nonlinear femtosecond optical lithography for fabrication of nanowire devices. The nonlinear femtosecond optical lithography method allows the formation of planar structures with a spatial resolution of ~50 nm.

568
ThSMC-39 18:40-18:55
Designing a capacitive immunosensor for detection of hepatitis B surface antigen
E. Alipour 1, H. Ghourchian 1,2, S.L. Znoyko 3, P.I. Nikitin 3,4; 1 - Univ. of Tehran, 2 - NBIC Research Center, Univ. of Tehran, Iran; 3 - Prokhorov General Physics Inst. RAS, 4 - National Research Nuclear Univ. MEPhI, Russia
A capacitive immunosensor for monitoring capacitance changes due to hepatitis B surface antigen (HBsAg) was designed. There are three factors affecting capacitive biosensors: surface area, distance between the capacitor electrodes and dielectric constant of the material between the electrodes. Our results indicate that the presence of HBsAg mostly affects the surface area of the capacitors and causes an increase in the capacitance. This method is simple, fast, low-cost, and the experiments were devoted to improvement of its accuracy and limit of detection. The results were achieved by developing a sandwich type immunoassay capacitor by using gold nanoparticles as amplifiers. The experiments were also conducted on accuracy enhancement by monitoring each step of the immunochemical reactions in real-time with new advanced optical methods and by using different designs of electrodes and magnetic nanoparticles.

378
ThSMC-40 18:55-19:10
Smart biolayers on solid phase: rational design and investigation by spectral-phase interferometry
A.V. Pushkarev 1,2, E.N. Mochalova 1,2, S.L. Znoyko 2, M.P. Nikitin 1, A.V. Orlov 1,2; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst.RAS, Russia
Smart biomolecular layers, which enable/forbid binding of molecules depending on the presence in the microenvironment of certain analytes or ligands, have been self-assembled on solid phase. The spectral-phase interferometry was used for rational design of such layers, allowed estimation of kinetic parameters of reactions and determining the sensitivity of the smart layers to concentration of the ligands.

932
ThSMC-41 19:10-19:25
Novel wearable VCSEL-based blood perfusion sensor
E. Zherebtsov 1, S. Sokolovsky 1, V. Sidorov 2, I. Rafailov 4, A. Dunaev 3, E.U. Rafailov 1; 1 - Aston Univ., UK; 2 - SPE "LAZMA" Ltd., Russia; 3 - Orel State Univ., Russia; 4 - Aston Medical Technology Ltd., UK
A wearable 850 nm VCSEL-based blood perfusion sensor operating on the principles of laser Doppler flowmetry (LDF) and Dynamic Light Scattering (DLS) has been developed and tested. The sensitivity of the sensor to changes in skin blood perfusion has been demonstrated.

111
ThSMC-p01 15:00-19:00
The tissue optical properties impact on measurement of luminescent particles temperature
E.A. Sagaydachnaya 1, V.I. Kochubey 1,2; 1 - Saratov National Research State Univ., 2 - National Research Tomsk State Univ., Russia
Upconversion particles have prospects for producing a local hyperthermia of biotissue with simultaneous temperature control. Aim of the research is analysis of impact of the optical properties of different thickness tissue on measurement of temperature by upconversion particles NaYF4:Er,Yb. It is shown that the optical properties of the relatively thin tissue has little or no effect on determine particles temperature in a certain temperature range. The distort in the other temperature range make it possible to detect tissue coagulation.

152
ThSMC-p02 15:00-19:00
Time-resolved multiple-probe infrared spectroscopy studies of carbon monoxide migration through internal cavities in hemoglobin
S.V. Lepeshkevich 1, I.V. Sazanovich 2, M.V. Parkhats 1, S.N. Gilevich 3, B.M. Dzhagarov 1; 1 - Stepanov Inst. of Physics NASB, Belarus; 2 - STFC Rutherford Appleton Lab., UK; 3 - Inst. of Bioorganic Chemistry NASB, Belarus
Time-resolved multiple-probe picosecond to millisecond infrared technique was applied to determine the dynamics of carbon monoxide migration via the internal cavities of human hemoglobin and its isolated chains. We succeeded in following the evolution of photodissociated CO ligand inside the protein matrix during geminate recombination. We managed to detect the photodissociated CO molecules escaped from the protein into external media.

156
ThSMC-p03 15:00-19:00
Cd-free quantum dots for application as biolabels
A.S. Novikova, I.Yu. Goryacheva; Saratov State Univ., Russia

We report an efficient approach to binding the targeting molecules to Cd-free quantum dots (QDs). Direct covalent binding of antibodies to active groups on the hydrophilic QDs' surface by means of cross-linker molecules was investigated.

376
ThSMC-p04 15:00-19:00
Detection of autoimmune disease markers by optical label-free immunosensors
V.A. Bragina 1, N.V. Guteneva 1,2, S.L. Znoyko 1, B.G. Gorshkov 1, A.V. Orlov 1,2; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia
Autoimmune diseases are a significant cause of disability and mortality. We present high-sensitive immunoassay for rapid real-time detection in human blood serum of antibodies to thyroglobulin and thyroid peroxidase. The assay employs optical label-free biosensors based on spectral correlation interferometry. The developed immunosensors can be used for diagnostics and detection of various clinically relevant markers in complex biological liquids.

417
ThSMC-p05 15:00-19:00
Intelligent nanoparticle-based agents for biomedical applications: rapid design using a lateral flow assay
E.N. Mochalova 1,2, A.V. Pushkarev 1,2, P.I. Nikitin 2,3, M.P. Nikitin 1; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, 3 - National Research Nuclear Univ. "MEPhI", Russia
A method is developed for rapid design and easy verification of intelligent nanoparticle-based agents, which implement basic logic YES and NOT functions. The spectral-phase interferometry was used for investigation of kinetic parameters of various candidate molecules to enhance efficiency of the biomolecular interfaces responsible for logic-gating. The developed method provides a convenient powerful tool for creating theranostic agents of required performance and optimal composition before their administration to experimental animals.

581
ThSMC-p06 15:00-19:00
Optical properties of tableted samples containing iron oxides in THz region of spectrum
A.O. Georgieva 1, M.V. Afonin 2, N.S. Balbekin 1, G.Z. Gareev 3, K.G. Gareev 4, A.N. Gorshkov 5, D.V. Korolev 6, V.V. Luchinin 4, O.A. Smolyanskaya 1; 1 - ITMO Univ., 2 - St. Petersburg State Inst. of Technology, 3 - Scientific and Research Center for Security of Technical Systems, 4 - St. Petersburg Electrotechnical Univ. "LETI", 5 - Research Inst. of Influenza, 6 - Almazov National Medical Research Centre, Russia
Magnetic nanoparticles are used as contrast agents in terahertz spectroscopy in vivo. In this work the terahertz spectra of refractive index and absorption index of pressed tableted samples based on iron oxide coated by silica are studied. The possibility of identifying the crystalline phase of iron oxide for both types of nanoparticles is shown.

649
ThSMC-p07 15:00-19:00
Nanocomplexes for in situ detection of small molecules with switchable optical properties
A.V. Babenyshev 1, K.G. Shevchenko 1, A.A. Tregubov 1, I.L. Nikitina 2, V.R. Cherkasov 1; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, Russia
Nanoparticles are a universal tool used in broad range of various applications from constructing of smart materials to biomedicine. One of the most challenging fields is development of multifunctional theranostic agents. We developed and analysed the performance of a novel nanoparticle based smart material able to reversibly change its optical properties in response to presence of small molecules in situ.

719
ThSMC-p08 15:00-19:00
Raman sensor with isotopic resolution for medical applications
Y. Chubchenko 1,2, L. Konopelko 1,2, V. Elizarov 1, A. Grishkanich 1,3,4,5, A. Zhevlakov 1, V Tishkov 4 ,E. Kolmakov 5; 1 - ITMO Univ., 2 - Mendeleyev Inst. for Metrology (VNIIM), 3 - St. Petersburg State Electrotechnical Univ., 4 - Khlopin Radium Inst., 5 - LLC Lasertrack, Russia
Raman sensor is used to measure the ratio of carbon isotopes in the exhaled carbon dioxide, which is used to diagnose the human infection of Helicobacter pylori and the influence of the Helicobacter pylori bacterium on the occurrence of gastritis, gastric and duodenal ulcers. A method for the analysis of human infection with Helicobacter pylori was developed on the basis of measurements of the ratio of 13C / 12C carbon isotopes in human exhaled air with a high level of measurement accuracy.

759
ThSMC-p09 15:00-19:00
Experimental investigation of the properties of pharmaceutical aerosols with laser-based optical measurement techniques
Sz. Kugler, A. Kerekes, A. Nagy, A. Czitrovszky; Wigner Research Centre for Physics of the HAS, Hungary
The goal of our study was to determine the aerosol particle deposition in the upper airways from a dry powder inhaler (DPI) measuring with an Aerosol Particle Sizer (APS) Spectrometer. Different inhalation profiles were used for the investigation and the MMAD (mass median aerodynamic diameter) was determined for each profile.

773
ThSMC-p10 15:00-19:00
QDs-cysteine luminescence kinetics: comparative analysis on live and fixed cells
I.K. Litvinov 1,2, T.N. Belyaeva 1, A.S. Bazhenova 2, E.A. Leontieva 1, A.O. Orlova 2, E.S. Kornilova 1,2,3; 1 - Inst. of Cytology RAS, 2 - ITMO Univ., 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia
Photophysical properties of quantum dots based on CdSe/ZnS solubilized by L-Cysteine shell, were compared in solutions of cell culture medium and in live and fixed HeLa cells. We show that the luminescence kinetics of nanocrystals in fixed cells were similar to those obtained in the case of intravital samples that is important for adequate interpretation of the data obtained.

778
ThSMC-p11 15:00-19:00
Modified liposomes as optical probes, magnetic labels, and drug carriers
A.V. Lunin 1, A.V. Vasilyeva 1, B.G. Gorshkov 2, I.L. Sokolov 1,2, V.R. Cherkasov 1; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, Russia
Liposomes are a very attractive type of nanoparticles to design advanced agents for targeted drug delivery and bioimaging. We have fabricated multifunctional and multimodal liposomes. In particular, we have employed several physical and chemical methods to introduce external and internal high-affinity agents, as well as fluorescent and magnetic markers. A variety of applications is demonstrated for the constructed liposomes.

910
ThSMC-p12 15:00-19:00
Particularity Of Polylactide Modification By Ethylene Glycol Monomethyl Ether In Medium Of Superfluid Carbon Dioxyde

O.O. Vasilieva 1,2, N.N. Glagolev 2, N.V. Minaev 3, V.T. Shashkova 2 , I. A. Matveeva 2, P.S. Timashov 3, A.B Solovieva 2; 1 - Moscow Inst. of Physics and Technology, 2 - Semenov Inst. of Chemical Physics RAS, 3 - Inst. of Laser and Information Technologies, Russia
Crosslinking of modificated polylactide by means of two-photon laser stereolithography.

931
ThSMC-p13 15:00-19:00
Synthesis of luminescent magnetic nanoparticles with controllable surface properties
I.V.Zelepukin 1,2,3, V.O. Shipunova 1,2,3, A.B. Mirkasymov 1,2, P.I. Nikitin 3,4, M.P. Nikitin 1,2,4, S.M. Deyev 1,3; 1 - Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, 2 - Moscow Inst. of Physics and Technology (State Univ.), 3 - National Research Nuclear Univ. MEPhI, 4 - Prokhorov General Physics Inst. RAS, Russia
Luminescent magnetic nanoparticles are attractive agents for many biomedical applications such in vivo imaging, biosensing and drug delivery. Each of these applications needs particles with specific properties. Here we synthesized a library of magnetic luminescent nanoparticles with controlled sizes and zeta-potentials using silicate chemistry. Labeling of tumor cells with these nanoparticles and studying their pharmacokinetics was also discussed.

933
ThSMC-p14 15:00-19:00
Detection of morphological changes in cisplatin-treated ovarian cancer cells by digital holographic microscopy
A.A. Zhikhoreva 1,2, A.V. Belashov 1, V.G. Bespalov 2,3, V.A. Romanov 2,3, A.L. Semenov 3, N.T. Zhilinskaya 3,4, I.V. Semenova 1, O.S. Vasyutinskii 1; 1 - Ioffe Inst., 2 - ITMO Univ., 3 - Petrov National Medical Research Center of Oncology, 4 - Peter the Great St. Petersburg Polytechnic Univ., Russia
Morphological changes in cells of ascitic fluid samples from Wistar rats with ovarian cancer were analyzed using digital holographic microscopy. It was shown that cells morphology in samples taken from rats treated with cisplatin differs significantly from those taken from untreated animals.

937
ThSMC-p15 15:00-19:00
Real-time optical methods for development of nanoparticle-based biosensors for detection of hepatitis B surface antigen
S.L. Znoyko 1, V.A. Bragina 1, E. Alipour 2, H. Ghourchian 2, P.I. Nikitin 1,3; 1 - Prokhorov General Physics Inst. RAS, Russia; 2 - Univ. of Tehran, Iran; 3 - National Research Nuclear Univ. MEPhI, Russia
Label-free spectral interferometric methods were employed for optimization of functionalized nanoparticles and reagents, and for development of immunochromatographic and capacitive biosensors. The immunochromatographic sensors use volumetrically detected magnetic nanolabels. In the capacitive sensors, nanoparticles amplify signal. The developed immunosensors were tested for rapid quantitative detection of hepatitis B surface antigen, which is the major marker for diagnostics of hepatitis B.

855
ThSMC-p16 15:00-19:00
Investigation by the DLS method of sizes of components aggregates in laser-solders during heated
D.I. Ryabkin, B.A. Kvasnov, A.Yu.Gerasimenko, A.V. Kuksin, V.M. Podgaetsky; National Research Univ. of Electronic Technology, Russia
The change in the dimensions of the aggregates of the laser solders components during their heating and subsequent denaturation has been investigated. It has been revealed that only the bovine serum albumin aggregates with a hydrodynamic radius of 4.1 ± 0.7 nm are subject to denaturation, and the aggregates of multiwalled carbon nanotubes do not affect denaturation.

738
ThSMC-p17 15:00-19:00
Flavin-mononucleotide-doped jelly-like gelatin as a fully biological optical material for holography and biophotonics applications
V.M.Katarkevich, T.Sh.Efendiev; Stepanov Inst. of Physics, NAS, Belarus
Jelly-like gelatin doped with flavin-mononucleotide is proposed as a novel (fully biocompatible and biodegradable) self-developing photosensitive material for volume holography and biophotonics. As an example, the use of such material for optical recording of volume phase gratings with a diffraction efficiency of ~20% and an angular selectivity of ~18 angl. min. is demonstrated with a 488 nm CW Ar laser as a light source. Due to its valuable properties, the proposed medium seems to be promising for creating nanostructured biophotonics devices including biological distributed feedback lasers.

5th International A.M. Prokhorov Symposium on Lasers in Medicine and Biophotonics. Section D. Photodynamic processes in biology and medicine

448
ThSMD-01 09:00-09:20 Invited
Photochemical activity and luminescence of dissolved oxygen molecules upon direct laser excitation under ambient conditions. A review of currently available results
A.A. Krasnovsky; Bach Inst. of Biochemistry RAS, Russia
The photochemical activities and luminescence of dissolved molecular oxygen upon direct laser excitation of the red, dark red and infrared oxygen spectral bands were studied using measurement of oxygenation rates of singlet oxygen traps and detection of IR (1270 nm) phosphorescence under ambient conditions. Summary of currently available results is presented. Biomedical importance of the data is discussed.

252
ThSMD-02 09:20-09:40 Invited
Targeted photodynamic therapy as potential treatment modality for cancer and cancer stem cells
H. Abrahamse, N. Hodgkinson, C. Kruger; Univ. of Johannesburg, South Africa
Colorectal cancer is commonly treated by tumour resection, as chemotherapy and radiation have proven to be less effective, especially if the tumour has metastasized. Resistance to therapies occurs in almost all patients with colorectal cancer, especially in those with metastatic tumours. Cancer stem cells have the ability to self-renew, and their slow rate of cycling enhances resistance to treatment and increases the likelihood of tumour recurrence. Most metastatic tumours are unable to be surgically removed, thus creating a need for treatment modalities that target cancers directly and destroy cancer stem cells. Photodynamic therapy involves a photosensitizer that when exposed to a light source of a particular wavelength becomes excited and produces a form of oxygen that kills cancer cells. Photodynamic therapy is currently being investigated as a treatment modality for colorectal cancer, and new studies are exploring enhancing photodynamic therapy efficacy with the aid of drug carriers and immune conjugates. These modifications could prove effective in targeting cancer stem cells that are thought to be resistant to photodynamic therapy. In order for photodynamic therapy to be an effective treatment in colorectal cancer, it requires treatment of both primary tumours and the metastatic secondary disease that is caused by colon cancer stem cells. This review focuses on current photodynamic therapy treatments available for colorectal cancer and highlights proposed actively targeted photosynthetic drug uptake mechanisms specifically mediated towards colon cancer stem cells, as well as identify the gaps in research which need to be investigated in order to develop a combinative targeted photodynamic therapy regime that can effectively control colorectal cancer primary and metastatic tumour growth by eliminating colon cancer stem cells.

983
ThSMD-03 09:40-10:00 Invited
Therapeutic efficacy gains for rigorous treatment planning in Photodynamic Therapy
L. Lilge; Univ. Health Network, Canada
Photodynamic Therapy, in contrast to standardized planning of ionizing radiation, is applied mostly on empirically derived protocols. Showed that compared to standard protocols the number of fibre sources can be reduced while achieving an equal or better coverage of a tumour. Additionally, the exposure of the host tissue is reduced by up to 50% and the light treatment time reduced by over 25%.

59
ThSMD-04 10:00-10:20 Invited
Experimental and clinical application of near-infrared fluorescence diagnostics and photodynamic therapy
G.Papayan, A.Akopov, N.Petrishchev; Pavlov First State Medical Univ., Russia
We provide examples of fluorescence imaging techniques used during open and endoscopic surgery with Indocyanine Green as an NIR fluorescent dye, demonstrates applications of the technique for experimental and clinical purposes:for intraoperative imaging of bile ducts, blood and lymphatic vessels; for detection of tumours and sentinel lymph nodes; for assessment of tissue, organ, or anastomotic blood supply; its use in conjunction with photodynamic therapy (photodynamic theranostics).

971
ThSMD-05 10:20-10:40 Invited
Photodynamic therapy (PDT) in combined treatment of malignant tumours
M.L. Gelfond, E.V. Levchenko, A.S. Barchuk, G.I. Gafton, V.V. Anisimov, I.A. Baldueva, O.YU. Mamontov, Yu.V. Semiletova, T.L. Nekhaeva, M.Yu. Myasnyankin; National Medical Research Center of Oncology, Russia
Based on clinical experience from 2000 to 2018, it should be concluded that photodynamic therapy is an effective component of combined treatment of some nosological forms of malignant neoplasms.

302
ThSMD-06 10:40-11:00 Invited
Cellular reactions of organic nanoparticles during PDT
R.W. Steiner 1,4, C. Scalfi-Happ 1, Z. Zhu 1, A. Wiehe 2, A. Ryabova 3,4, V. Loschenov 3,4, R. Wittig 1; 1 - Univ. Ulm, 2 - Biolitec Research GmbH, Germany; 3 - Natural Science Center of Prokhorov General Physics Inst. RAS, 4 - National Research Nuclear Univ. MEPhI, Russia
Organic crystalline nanoparticles (NPs) are not fluorescent due to the crystalline structure of the flat molecules organized in layers. For Aluminum Phthalocyanine (AlPc)-derived NPs, preferential uptake and dissolution by macrophages were demonstrated recently. Therefore, inflamed tissue or cancer tissue with accumulated macrophages (M1; M2 polarization state) may exhibit specific fluorescence in contrast to normal tissue, which does not fluoresce. The present study addresses the photo-biological effects of NP generated from the clinically utilized photosensitizer Temoporfin (mTHPC).

301
ThSMD-07 11:30-11:50 Invited
A unique DDS for cancer chemotherapy with nanodiamond as drug carrier
E. Osawa 1, D. Ho 2, E. Chou 3, A. Zarrinpar 4, H. Huang 5; 1 - NanoCarbon Res. Inst., ,Japan; 2 - Dept. Bioeng. UCLA, USA; 3 - National Singapore Univ., Singapore; 4 - Dept. Surgery, UCLA, USA; 5 - Shanghai Inst. Eng., China
This is the first paper that introduces a new DDS using nanodiamond as drug carrier at the moment exclusively developed for cancer chemotherapy since 2007 by a small team of scientists in US, Singapore, China, and Japan. The development stage has just reached the first human clinical tests planned to start in early 2018.

944
ThSMD-08 11:50-12:10 Invited
Nanoparticle-based mTHPC delivery in the photodynamic therapy of cancer
L. Bezdetnaya; Lorraine Univ., Inst. de Cancérologie de Lorraine, France
Application of meta-tetra(hydroxyphenyl)chorin (mTHPC) one of the most effective photosensitizer in photodynamic therapy of solid tumors encounters

several complications resulting from its insolubility in aqueous medium. Various strategies of nanoparticles-based delivery of mTHPC were proposed to improve efficiency of mTHPC-PDT.

471
ThSMD-09 12:10-12:30 Invited
Biomedical image processing with thin films of bacteriorhodopsin for breast
D.V.G.L.N. Rao; Univ. of Massachusetts Boston, USA
Real time medical image processing is demonstrated by recording and reconstructing transient photo isomerization grating formed in Bacteriorhodopsin films using transient Fourier Holography. Exploiting the fact that the diffraction efficiency of the grating is optimum when the intensity of the object and reference beams is matched, we are able to display micro calcifications in mammograms for possible early detection of breast cancer.

46
ThSMD-10 12:30-12:45
Effects of photodynamic treatment on mesenteric microvessels
T. G. Grishacheva 1,2, I. A. Mikhailova 1, A.I. Krivchenko 3, N. N. Petrishchev 1,2; 1 - Pavlov First St. Petersburg State Medical Univ.; 2 - North-West Federal Medical Research Centre; 3 - Sechenov Inst. of Evolutionary Physiology and Biochemistry RAS, Russia
In the current report the photobiostimulation caused by laser irradiation (λ = 532; 635 & 662 nm) of microvessels and influence of photoactivated photosensitizers (Bengal Rose, Radachlorin, Coproporphyrin) on microvessel blood flow velocity is studied. The objects of study are rat mesenteric venules. In vivo imaging techniques was used to register microvessel photoreactivity. The methods of analytical processing of the experimental data including integration, trending, Fourier transforms are used. The comparative description of velocity and acceleration of blood flow in the presence of different photosensitizers is presented. The local laser irradiation (red region of the spectrum (λ = 635nm, 30 J/cm2 and 662 nm, 33,4 J/ cm2) of experimental group venules caused increase of mean blood velocity. But there was no similar significant effect as a result of green laser light irradiation (532 nm, 36 J/ cm2). I. v. injection of photosensitizer followed by laser irradiation results in microvascular disturbances and progressive decrease of mean blood velocity in venules. The most pronounced effect was observed in experiments with Radachlorin.

18
ThSMD-11 12:45-13:00
Luminescence properties of novel Phosphorus(V) porphyrin photosensitizers in solutions
I.V.Semenova 1, V.P.Belik 1, D.M.Beltukova 1, I.N. Meshkov 2, Yu.G. Gorbunova 2,3, O.S.Vasyutinskii 1; 1 - Ioffe Inst. 2 - Frumkin Inst. of Physical Chemistry and Electrochemistry RAS; 3 - Kurnakov Inst. of General and Inorganic Chemistry RAS, Russia
Luminescence spectra of two novel P(V) porphyrin-based photosensitizers in aqueous and ethanol solutions were recorded in the visible and near IR spectral range. The singlet oxygen contribution into the luminescence signal was determined and singlet oxygen lifetimes were measured.

188
ThSMD-12 13:00-13:15
Studies of photophysical characteristics and in vitro photocytotoxicity of photosensitizer Dimegin
A.V. Dadeko 1, L. Lilge 2, P.Kaspler 2, I.M. Belousova 1, T.D. Murav'eva 1, A.M. Starodubtcev 1, G.V. Ponomarev 3; 1 - Vavilov State Optical Inst., Russia; 2 - Princess Margaret Cancer Centre, Univ. Health Network and Department of Medical Biophysics Univ. of Toronto, Canada; 3 - Inst. of Biomedical Chemistry, Russia
In represented work was made a research of low-toxic photosensitizer Dimegin. Quantum yields of singlet oxygen generation, fluorescence and photobleaching of Dimegin were investigated. Photocytotoxicity was studied on four cell lines: U87, RG2, HT1372, AY27. Fluorescence microscopy images were used to detect the location and the luminescent intensity of Dimegin in cell cultures, used in photocytotoxicity study.

239
ThSMD-13 13:15-13:30
Photosensitized properties of tetraphenylporphyrins immobilized on calcium alginate aerogels in the photooxidation process
A.B.Solovieva 1, N.A.Aksenova 1, M.A.Savko 1, N.V.Menshutina 2, S.F.Timashev 1;1 - Semenov Inst. of Chemical Physics, 2 - Mendeleev Univ. of Chemical Technology, Russia
The photocatalytic systems based on tetraphenylporphyrins immobilized on calcium alginate solid gels in the conditions of thermal drying on air (xerogel), freeze drying in vacuum (cryogel) and supercritical drying in the supercritical carbon dioxide (aerogel) were prepared. As a test reaction to measure the prepared systems' efficiency, we studied the tryptophan photooxidation. It was shown the systems with aerogel exhibited the highest photocatalytic efficiency.

388
ThSMD-14 15:00-15:20 Invited
Time-resolved spectroscopy and data mining techniques
G. Ferrini; Univ. Cattolica del Sacro Cuore, Italy
The use of ultrafast optical techniques to study the dynamics of metallic nanostructures or aggregates of molecules of biological interest is briefly reviewed. The use of data mining analysis to discriminate samples with different properties, based solely on the experimental data and without previous knowledge of the sample properties is illustrated in selected examples. These analysis techniques are shown to have the potential to detect and characterize nanostructures in complex environments that are of interest in medicine and biology. Moreover, the use of surface sensitive optical techniques adds the possibility to enhance the detection of surface molecular complexes. Finally, the use of these optical techniques and the correlated analysis are discussed in the perspectives of real-world applications.

28
ThSMD-15 15:20-15:40 Invited
Multiphoton femtosecond laser spectroscopy of anisotropic molecular probes
O.S. Vasyutinskii; Ioffe Inst., Russia
The talk reviews theoretical and experimental investigations of polarized fluorescence in anisotropic molecular probes excited via two-color two-photon transitions by femtosecond laser pulses. Investigation of polarized fluorescence from molecular probes imbedded into biological structures opens a new information channel on protein structure, folding, hydration, and the mechanisms of redox reactions in living organisms.

132
ThSMD-16 15:40-16:00 Invited
Structural pecularities of shungite nanocarbon hybrids in dispersions and films
N.N. Rozhkova 1, A.S. Goryunov 2, A.G. Borisova 2, A.O. Kucherik 3, S.S. Rozhkov 1; 1 - Inst. of Geology Karelian Research Center RAS, 2 - Inst. of Biology Karelian Research Center RAS, 2 - Vladimir State Univ., Russia
The stable dispersions of the hybrid shungite carbon (ShC)-Me(Ag, Au) nanoparticles were produced in water dispersions of ShC nanoparticles and corresponding metals affected by laser impulses of various durations. Films, occurring as periodic structures that contain graphene-like carbon without a hydration constituent, are formed upon condensation of such dispersions.

538
ThSMD-17 16:00-16:15
Comparitive accumulation study of chlorin group photosensitizers on monolayer and multicellular tumor spheroids of cell culture.
D.S. Farrakhova 1,2, I.V. Yakavets 3,4,5, V.B. Loschenov 1,2, L.N. Bolotine 4,5, V.P. Zorin 3,6; 1 - National Research Nuclear Univ. «MEPHI», 2 - Prokhorov General Physics Inst. RAS, Russia; 3 - Belarusian State Univ., Belarus; 4 - Univ. de Lorraine, France; 5 - Inst. de Cancérologie de Lorraine, France; 6 - Belarusian State Univ., Belarus
The comparitive analisys of the new photosensitizer for photodynamic therapy were conducted for increasing of oncological diseases effecient treatment.

5
ThSMD-18 16:15-16:30
Thin photocatalytic and bactericidal coatings based on carbon or metal oxide nanoparticles
S.K. Evstropiev 1, A.V.Karavaeva 2, K.V. Dukelskii 1,3, K.S. Evstropyev 1, E.V. Kolobkova 1, I.M. Belousova 4, V.M. Kiselev 4, N.V. Nikonorov 1; 1 - ITMO Univ., 2 - St. Petersburg State Chemical-Pharmacy Academy, 3 - Bonch-Bruevich State Univ. of Telecommunications, 4 - Vavilov State Optical Inst., Russia
The application of liquid polymer-salt method allows to form transparent oxide coatings on the glass surface. Prepared coatings are thin (200-250 nm) and uniform and fully cover the glass surface. Experimental data show that these coatings consist of small (10-20 nm) nanocrystals. Transparent nanocoatings demonstrate high bactericidal properties and the ability to generate singlet oxygen under UV irradiation.

960
ThSMD-19 16:30-16:45
Application of Ugleron® as a new means for laser and microwave hyperheat therapy
A.N. Ponomarev; Peter the Great St. Petersburg Polytechnic Univ., Russia
The virulicidal ability of Ugleron (one of sulfo-adducts of the car-bon clusters) against AIDS was first founded in 2010 [1]. It was discovered now that laser or microwaves irradiation of the Ugleron can be used as a hyper heat therapy against oncology diseases.

707
ThSMD-20 16:45-17:00
Laser structuring protein biostructures with carbon nano frame for bone & cartilage cells proloferation
A.Yu.Gerasimenko 1, O.E.Glukhova 2, M.M.Slipchenkov 2, V.M.Podgaetsky 1; 1 - National Research Univ. of Electronic Technology, 2 - Saratov State Univ., Russia
The results of biostructures formation based on carbon nano frame in a protein matrix are presented. The binding mechanism of single-walled carbon nanotubes under the influence of laser radiation is described. The energy change during the formation of the nano frame covalent bonds reaches -7.36 eV/atom. Experiments on growing bone and cartilage tissue cells on samples were conducted.

725
ThSMD-21 17:30-17:45
Investigations of layers of composite nanomaterials upon exposure laser radiation
L.P. Ickitidze 1, A.Yu.Gerasimenko 1, V.M. Podgaetsky 1, S.V. Selishchev 1, A.A. Dudin 2, A.A. Pavlov 2; 1 - National Research Univ. of Electronic Technology, 2 - Inst. of Nanotechnology of Microelectronics RAS, Russia
The layers (thickness 0.3-100 μm) of composite nanomaterials in the matrix of collagen (CG) and filler of single-walled carbon nanotubes (SWCNT) are studied. The layers were prepared by applying an aqueous dispersion of CG/SWCNT (~1 wt.% CG, 0.1 wt.% SWCNT, remaining water) on the substrates by silk-screening and evaporation of the liquid part under normal conditions or under the action of laser radiation (LR). It is established that the density ρ and the specifice conductivity σ of the layers change under the action of LR. It is predicted that the obtained values of ρ≈1.4÷1.9 g/cm3 and σ ~10-1÷102 S/m are acceptable for the use of CG/SWCNT layers in medical applications.

548
ThSMD-22 17:45-18:00
Study of new infrared photosensitizers for photodynamic inactivation of pathogenic bacteria based on synthetic bacteriochlorin derivatives
E.V. Akhlyustina 2, G.A. Meerovich 1,2, I.G. Tiganova 3, E.A. Makarova4, N.V. Alekseeva 3, N.I. Philipova 3, E.A. Lukyanets 4, Yu.M. Romanova 3, V.B. Loschenov 1,2; 1 - Prokhorov General Physics Inst. RAS, 2 - National Research Nuclear Univ. "MEPHI", 3 - Gamaleya Research Inst. of Epidemiology and Microbiology, 4 - Organic Intermediates and Dyes Inst., Russia
Cationic bacteriochlorin derivatives which molecules differing by lipophilicity and positive charge degree have been investigated in vitro as photosensitizers for photodynamic inactivation of biofilm bacteria.

722
ThSMD-23 18:00-18:15
Controlled chemical modification of biomolecules by femtosecond laser in polar liquids
V. Gruzdev 1, D. Korkin 2, B.P. Mooney 3,4,7, J.F. Havelund 5,6, I.M. Møller 5, J.J. Thelen 4, 7; 1 - Univ. of Missouri; 2 - Worcester Polytechnic Inst.; 3,4 - Univ. of Missouri, USA; 5 - Aarhus Univ., 6 - Univ. of Southern Denmark, Denmark; 7 - Univ. of Missouri, USA
Permanent chemical modifications of peptides and human insulin by ultrashort laser pulses in room-temperature polar liquids have highly nonlinear scaling with laser intensity. Mass spectroscopy analysis of the products obtained in several liquids, including isotope marked liquids, and in argon atmosphere suggest strong participation of dissolved air oxygen and interaction of the biomolecules with laser-modified molecules of the liquids.

775
ThSMD-24 18:15-18:30
Laser fiber optic equipment for embedding video photodynamic diagnostic and therapy control features into standard surgical instruments
M.V. Loshchenov 1, T.A. Savelieva 1, D.A. Golbin 2, K.G. Linkov 1, V.B. Loschenov 1; 1 - Prokhorov General Physics Ins. RAS, 2 - Federal State Autonomous Inst. «Burdenko National Scientific and Practical Center for Neurosurgery» of the Ministry of Healthcare of the Russian Federation, Russia
Novel equipment for surgery navigation thru photodynamic diagnosis is presented with laser fluorescence excitation and dual channel video registration. This equipment could be incorporated in a standard surgery tool like aspirator canule. It is based on fiberoptic endoscope with special channels for laser illumination in red and blue spectral ranges and video head based on two spectrally-resolved cameras.

764
ThSMD-25 18:30-18:45
All optical detection for Photo-acoustic imaging
W.-I. Lin, M. Pollard, M. Lassen; Danish Fundamental Metrology, Denmark
Infrared microscopy is a method of choice for label free mapping of biomarkers leading to automated histopathology. However, infrared microscopy image acquisition speed is slow and offers limited spatial resolution. We address these limitations by using a photoacoustic method and present a novel and

very sensitive method for measuring the acoustic and ultrasonic waves by using an all optically detection method using a probe laser and an interferometric readout.

659
ThSMD-26 18:45-19:00
Laser-assisted pore formation in tissues
O.I. Baum; Inst. Photonic Technologies of Federal Scientific Research Centre "Crystallography and Photonics" of RAS, Russia
Theoretical model predicting the optimal laser setting for modification of tissue shape and structure has been developed in application for three new laser methods: normalization of intraocular pressure in glaucomatous eyes; correction of eye cornea shape and refraction; laser reshaping of rib cartilage for larynx stenosis surgery.

174
ThSMD-27 19:00-19:15
Method of laser-induced fluorescent diagnostics of enamel microcracks using aluminum phthalocyanine nanoparticles
J.O. Zolotareva (Kuznetsova) 1, V.B. Loschenov 1,2; 1 - National Research Nuclear Univ. MEPhI, 2 - Prokhorov General Physics Inst. RAS, Russia
In this paper the method of fluorescence diagnostics (FD) of tooth enamel using aluminum phthalocyanine nanoparticles and sur-factant for identify enamel microcracks of enamel and pathogenic microflora accumulation has been presented.

16
ThSMD-p01 15:00-19:00
Albumin-containing solutions equalize quantum yields of porphyrinic photosensitizers
I.M. Belousova 1, T.D. Muraviova 1, T.K. Krisko 1, E.V. Kriukova 2; 1 - Vavilov State Optical Inst., 2 - ITMO Univ., Russia
Fluorescent and singlet oxygen quantum yields of chlorin-based photosensitizer Photoditazin were compared with those of porphyrin-based preparations in the environment of phosphate buffer and albumin. The albumin addition reduced both fluorescence and sensitizing properties of all the agents under study, equalizing quantum yield values of chlorin-based and porphyrin-based preparations. Complex formation between albumin and agent molecules was supposed to be the reason of the effect.

450
ThSMD-p02 15:00-19:00
Absorption of dark red laser light by oxygen molecules in organic media. Results of photochemical and luminescence measurements
A.S. Benditkis, A.S. Kozlov, S.E. Goncharov, A.A. Krasnovsky Jr; Federal Center for Biotechnology, Bach Inst. of Biochemistry RAS, Russia
Absorption of dark red laser light by oxygen molecules in organic media. Results of photochemical and luminescence measurements of IR phosphorescence under direct excitation of oxygen by diode lasers.

506
ThSMD-p03 15:00-19:00
Generation of singlet oxygen by chlorophyll and related pigments in aqueous systems: results of photochemical and luminescence studies
A.S. Kozlov, A.A. Krasnovsky Jr; Research Center of Biotechnology RAS, Russia
Photosensitization of singlet oxygen by chlorophyll α, photoditazin (or fotoditazin) and dimegin were studied in water and aqueous detergent dispersions using the oxygenation of chemical traps of singlet oxygen and detection of IR luminescence of singlet oxygen under pulse laser excitation. Quantum yields of singlet oxygen production have been obtained. Preliminary results of application of similar technique to singlet generation by chlorophyll in chloroplast structures are reported.

698
ThSMD-p04 15:00-19:00
Vibrational spectroscopy of tissue-engineered structures based on chitosan and carbon nanotubes
Yu.O. Fedorova, A.A. Polokhin, D.T. Murashko, M.S. Savelyev, A.Yu. Gerasimenko; National Research Univ. of Electronic Technology, Russia
This paper presents the study of structures based on chitosan and single-walled carbon nanotubes carried out by vibrational spectroscopy methods. Volumetric structures were created by the layer-by-layer laser evaporation of aqueous dispersion. The nature of the intermolecular bonds between nanotubes and chitosan has been clarified. These structures can be used for the cellular and tissue engineering of the cardiovascular system.

831
ThSMD-p05 15:00-19:00
Influence of laser radiation on conductivity of a nanocomposite based on carbon nanotubes in an organic matrix
A.A. Polokhin 1, A.Yu. Gerasimenko 1, P.Yu. Privalova 1, L.P. Ichkitidze 1, A.P. Orlov 2, A.A. Pavlov 2; 1 - National Research Univ. of Electronic Technology, 2 - Inst. of Nanotechnology of Microelectronics RAS, Russia
In this work laser radiation influence to conductivity of the nanocomposite was studied. Thin layer of the nanocomposite based on carbon nanotubes in organic matrix irradiated by laser radiation instead thermal treatment, had more the 4 times higher conductivity for continuous wave laser method and more than 2 times - for pulsed laser method. This increasing related with forming the nanotubes scaffold under laser radiation. As a result, new electrical contacts is obtained in carbon nanotubes connect places and it leads to reducing of nanocomposite resistivity and increasing of conductivity.

204
ThSMD-p06 15:00-19:00
Photosensitized singlet oxygen production and photophysical properties of cationic Porphyrin - Transferrin complexes
M.V. Parkhats 1, S.V. Lepeshkevich 1, A.G. Gyulkhandanyan 2, A.A. Zakoyan 2, G.V. Gyulkhandanyan 2, B.M. Dzhagarov 1; 1 - Inst. of Physics, NASB, Belarus; 2 - Inst. of Biochemistry, NASA, Armenia
Photophysical properties of new tumor targeted photosensitizers based on cationic porphyrins and human transferrin were investigated. It was demonstrated that incorporation of the porphyrins into the protein causes slight changes of the photophysical properties of the photosensitizers. The kinetics of singlet oxygen luminescence photosensitized by porphyrin-transferrin complexes were studied.

261
ThSMD-p07 15:00-19:00
Optimization of selective photodestruction by laser radiation of the yellow-green range of capillary angiodysplasia of the skin
A.A. Sirotkin 1, G.P. Kuzmin 1, N.E. Gorbatova 2,3, T.E. Yushina 2, A.G. Dorofeev 2, A.V. Brynsev 2, S.A. Zolotov 2, O.V. Tikhonevich 1, D.S. Drozdov 4; 1 - Prokhorov General Physics Inst. RAS, 2 - Clinical and Research Inst. of Emergency Pediatric Surgery and Trauma, 3 - Federal State Autonomous Inst. "National Medical Research Center of Children's Health", 4 - Moscow Inst. of Physics and Technology (State Univ.), Russia
A laser medical device has been created to conduct an exact photodestruction of the vascular formations of the skin and subcutaneous tissue. Conducted studies on model biological objects for confirmation the possibility of realizing the optimal parameters of laser radiation providing photodestruction of

hemoglobin containing tissues.

307
ThSMD-p08 15:00-19:00
Enhancement of the thermal effect from the NIR laser radiation on bio-tissue using nanosized dielectric particles doped with Yb3+
S.A. Khrushchalina, A.N. Belyaev, O.S. Bushukina, M.A. Dvoryanchikova, O.A. Kuznetsova, P.A. Ryabochkina, I.A. Yurlov; Ogarev Mordovia State Univ., Russia
Experiments in-vitro and in-vivo on the effect of laser radiation with a wavelength of 970 nm and a power of ~ 1 W on a biotissue with preliminary deposited Yb-containing nanoparticles and without preliminary deposition of nanoparticles have been performed. It is shown that the thermal effect is more pronounced in the case of using nanoparticles than without the use of nanoparticles.

737
ThSMD-p09 15:00-19:00
Photothermal effect of nanoparticles in biological tissues under laser irradiation
E. M. Kasianenko 1, A. I. Omelchenko 1, P. Y. Gulyaev 2; 1 - Federal Scientific Research Centre "Crystallography and Photonics" RAS, 2 - Ugra State Univ., Russia
The photothermal effect of nanoparticles of oxide bronzes impregnated in the porcine cartilage rib tissue during laser heating was studied. A comparison of the magnitude of the photothermal effect showed that more high value of the effect of laser radiation on the cartilaginous tissue is demonstrated by the samples impregnated with molybdenum oxide bronzes nanoparticles.

795
ThSMD-p10 15:00-19:00
Photosensitizing effect of curcumin on bacterial cells and animal cells in culture
A.V. Mikulich 1, L.G. Plavskaya 1, A.I. Tretyakova 1, I.A. Leusenka 1, T.S. Ananich 1, V.Yu. Plavskii 1, O.A. Kazyuchits 2, I.I. Dobysh 2, E.S. Nikolaevich 2; 1 - Stepanov Inst. of Physics NASB, 2 - RMUE «Academpharm», Belarus
The regularities of photodynamic inactivation of various types of bacterial cells (gram-positive Staphylococcus aureus, gram-negative Escherichia coli, yeast-like fungi Candida albicans) sensitized with natural dye curcumin are studied. It is shown that the rate of photoinactivation induced by endogenous photosensitizers of porphyrin and flavin nature increases due to the photodynamic effect of curcumin in 2.8-5.2 times when exposed to laser radiation with wavelength of 445 nm and 13.5-42 times when exposed to radiation with wavelength of 405 nm. The dose of irradiation, at which the complete inhibition of the growth of strains is observed, varies in the range of 3-15 J/cm2. S. aureus and C. albicans showed higher sensitivity to photodynamic action than E. coli. The ability of curcumin to sensitize photodamage of animal cells in culture is also shown.

804
ThSMD-p11 15:00-19:00
Characterisation of biological smoke generated by short pulse lasers
A. Nagy, M. Veres, A. Czitrovszky; Wigner Research Centre for Physics of the HAS, Hungary
Optical aerosol instrumentation and spectroscopic tools were utilized to characterize aerosols released upon the interaction of short pulse lasers and biological tissues.

813
ThSMD-p12 15:00-19:00
Laser spectroscopy investigations of dark and photoinduced oxidation transformations of tetrahydrobiopterin coferments, a potential factors of melanogenesis disorder
A.S. Nizamutdinov 1, I.I. Farukhsin 1, T. A. Telegina 1,2, Yu.L. Vechtomova 1,2, E.E. Orlova 1, E.V. Lukinova 1, E.I. Madirov 1, V.V. Semashko 1; 1 - Kazan Federal Univ., 2 - Bach Inst. of Biochemistry, Russia
The aim of this work is to study phototransformation of tetrahydrobiopterin exposed to UV laser irradiation in the process of its oxidation. A multifunctional Ce: LiCaAlF6 and Ce: LiY0,3Lu0,7F4 UV lasers were realized with wavelength tuning and pulse durations from 10 ns to 200 ps. Here we discuss role of H4Bip oxidation products and its UV irradiation on melanogenesis disorder.

830
ThSMD-p13 15:00-19:00
Photodamage of cells sensitized with bilirubin upon exposure to laser and LED sources
T.S. Ananich 1, V.M. Katarkevich 1, V.V. Keropyan 2, V.N. Knyukshto 1,I.A. Leusenka 1, P.A. Mazmanyan 2, G.G. Margaryan 3, A.V. Mikulich 1, L.G. Plavskaya 1, V.Yu. Plavskii 1, A.N. Sobchuk 1, A.I. Tretyakova 1; 1 - Stepanov Inst. of Physics, NASB, Belarus; 2 - Scientific Research Center of Maternal and Child Health Protection, 3 - Muratsan Hospital Complex, Armenia
It is shown that radiation of laser and LED sources corresponding to the absorption spectrum of bilirubin can cause damaging effect on animal cells in culture that are in the exponential growth phase and pre-incubated with bilirubin. Light-induced cell death is due to photochemical reactions involving singlet oxygen. At close wavelengths of laser radiation and LED photodynamic effect is more pronounced when exposed to non-monochromatic radiation. Photodynamic action spectrum does not correspond to the absorption spectrum of bilirubin in solution or its complexes with proteins. It is concluded that photoproducts of bilirubin are involved in sensitization effect.

856
ThSMD-p14 15:00-19:00
Iron oxide nanoparticles conjugated with Zn phthalocyanine for photoinduced anticancer immune response
A.V. Ryabova 1, E.A. Luk'yanets 2, A.I. Klimov 3, D.V. Pominova 1, V.I. Makarov 1, I.D. Romanishkin 1, I. Herrmann 4, R. Steiner 5,6, V.B.Loschenov 1,6; 1 - Prokhorov General Physics Inst. RAS, 2 - State Scientific Center "Inst. of Organic Intermediates and Dyes", 3 - Lomonosov Moscow State Univ., Russia; 4 - Swiss Federal Laboratories for Materials Science and Technology (Empa), Switzerland; 5 - Inst. für Lasertechnologien in der Medizin und Meßtechnik, Germany; 6 - National Research Nuclear Univ. MEPhI, Russia
The possibility of using iron oxide (III) nanoparticles conjugated with Zn phthalocyanine for phototherapy of cancer was studied experimentally.

870
ThSMD-p15 15:00-19:00
Study of the toxicity of the highly specific substrate of luciferase NanoLuc for the development of deep tissue photodynamic therapy methods
V.O. Shipunova 1,2,3, P.A. Kotelnikova 2,3, O.N. Shilova 2, E.I. Shramova 2, P.I. Nikitin 1,4, M.P. Nikitin 2,3,4, S.M. Deyev 1,2, G.M. Proshkina 2; 1 - National Research Nuclear University MEPhI, 2 - Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, 3 - Moscow Inst. of Physics and Technology (State Univ.), MIPT, 4 - Prokhorov General Physics Inst. RAS, Russia.
Bioluminescent pair of luciferase NanoLuc and its highly specific substrate furimazine is a promising platform for the development of a number of methods for photodynamic therapy of deep tissue tumors. However, no detailed studies have been carried out to study the toxicity of furimazine both in vitro and in vivo. Here, we describe a study regarding the toxicity of furimazine in vitro on several cell lines and in vivo with its multiple injections into the