THE 13TH INTERNATIONAL CONFERENCE ON PHOTONICS AND APPLICATIONS (ICPA-13)

HỘI NGHỊ QUANG HỌC QUANG PHỔ TOÀN QUỐC LẦN THỨ 13 (HNQHQP-13)

Ha Noi, Vietnam

October 14 - 17, 2024

ABSTRACTS & PROGRAM

https://iop.vast.vn/icpa/13/
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2024

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THE 13th INTERNATIONAL CONFERENCE ON PHOTONICS AND APPLICATIONS (ICPA-13)

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Vietnam National University Ho Chi Minh city, Vietnam

Vietnam Physical Society, Vietnam

Vietnam Society of Optics & Spectroscopy, Vietnam

International Centre of Physics, Vietnam

Institute of Physics, Vietnam

Institute of Molecular Sciences of Orsay (ISMO), CNRS, France

Institute of Laser Engineering, Osaka Uni., Japan

Advanced Photonics Research Institute, GIST, Korea

Institute of Physics, National Academy of Sciences of Belarus, Belarus

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CONFERENCE TOPICS

Optics, Photonics and Spectroscopy
Advanced Laser Light Sources
Optoelectronics and Integrated Optics
Spectroscopy of Nano and Photonic Materials
Applications of Optics, Photonics and Spectroscopy
Photonics Materials and Devices
Nonlinear Optics

CONFERENCE SECRETARIAT

Nguyen Thi Khanh Van (IOP, VAST)
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HỘI NGH QUANG HỌC QUANG PHỔ TOÀN QUỐC LẦN THỨ 13

CƠ QUAN TỔ CHỨC

Viện Hàn lâm Khoa học và Công nghệ Việt Nam

Đại học Quốc gia thành phố Hồ Chí Minh

Hội Vật lý Việt Nam

Hội Quang học Quang phổ

Trung tâm Vật lý Quốc tế, Viện Vật lý

Viện Vật lý, VAST

Viện Khoa học quang phân tử, CNRS. CH. Pháp

Viện Kỹ nghệ Laser, Đại học Osaka, Nhật Bản

Viện Nghiên cứu Quang tử tiên tiến, GIST, Hàn Quốc

Viện Vật lý, Viện Hàn lâm KH Belarus

BAN TỔ CHỨC

Chủ tịch Hội nghị

Huỳnh Thành Đạt (Bộ Khoa học và Công nghệ)
Nguyễn Đại Hưng (Hội Vật lý Việt Nam)

Đồng Trưởng Ban tổ chức

Đinh Văn Trung (IOP, VAST, Việt Nam)
Thomas Pino (ISMO, CNRS, CH. Pháp)
Do-Kyeong Ko (APRI, GIST, Hàn Quốc)
Nobuhiko Sarukura (Đại học Osaka,Nhật Bản)
Elmer S. Estacio (Đại học Quốc gia Philippines Diliman, Philippines)
Philippe Brechgnac (Paris Saclay, CH. Pháp)
V. A. Orlovich (IOP, NAS, Belarus)
Đào Văn Lập (Đại học Công nghệ Swinburne, Úc)
Vũ Đình Lãm (GUST, VAST, Việt Nam)

HỘI NGHỊ QUANG HỌC QUANG PHỔ TOÀN QUỐC LẦN THỨ 13 (HNQHQP-13)

ĐƠN VỊ TÀI TRỢ

Viện Hàn lâm Khoa học và Công nghệ Việt Nam (VAST)

Đại học Quốc gia thành phố Hồ Chí Minh (VNU-HCM)

Viện Vật lý (IOP), VAST

Trung tâm Vật lý Quốc tế (ICP), IOP - VAST

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CHỦ ĐỀ KHOA HỌC CỦA HỘI NGHỊ

Quang học, Quang tử và Quang phổ
Quang tích hợp và quang điện tử
Quang phổ của vật liệu nano và quang tử
Các ứng dụng quang học, quang phổ và laser
Các thiết bị và linh kiện quang học, quang tử
Quang học phi tuyến…

BAN THƯ KÝ HỘI NGHỊ

Nguyễn Thị Khánh Vân (IOP, VAST)
Dương Thị Mân (IOP, VAST)

Email Hội nghị: hnqhqp.icpa@gmail.com
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BRIEF PROGRAMME

Time \ Date	Monday 14/10/2024	Tuesday 15/10/2024	Wednesday 16/10/2024	Thursday 17/10/2024
8:30 ÷ 12:00		- Registration - *Official Opening* – In Honor of Prof. Nguyen Dai Hung & Laser Physics) - PLENARY SESSION	- SESSION A - SESSION B	Ninhbinh Tour
		Lunch	Lunch	
13:30 ÷ 17:00	- Registration - CIP meeting (16:30-17:30, Room 312A)	- SESSION A - SESSION B - POSTER SESSION I - Round Table discussion JINR - Vietnam	- SESSION A - SESSION B - POSTER SESSION II - *Official Closing*	
		Conference Party		Return to Hanoi

- SESSION A: PHOTONICS AND APPLICATIONS (Room 810, 8th floor, Institute of Physics)
- SESSION B: OPTICS AND SPECTROSCOPY (Room 811, 8th floor, Institute of Physics)

PROGRAM

PLENARY SESSION

(NGUYEN VAN HIEU HALL)

PROGRAM

15 October, 2024 (Tuesday)

(NGUYEN VAN HIEU HALL)

08: 00 - 08: 30 **Registration**

08: 30 - 09: 30 **Official Opening – In Honor of Prof. Nguyen Dai Hung & Laser Physics**

- Opening speech by Prof. Dinh Van Trung (IOP, Vietnam)
- Welcoming speech by Prof. Huynh Thanh Dat (MOST, Vietnam)
- Welcoming speech by VAST representative (VAST, Vietnam)
- Welcoming speech by Prof. Lam Quang Vinh (VNU HCM, Vietnam)
- Speech by Prof. Totaro Imasaka (Kyushu Uni., Japan)
- Speech by Prof. Nobuhiko Sarukura (Osaka Uni., Japan)
- Speech by Prof. Do-Kyeong Ko (APRI, GIST, Korea)
- Speech by Prof. Thomas Pino (ISMO, CNRS, France)
- Speech by Prof. Philippe Brechignac (Saclay Uni., France)
- Speech by Prof. V. A. Orlovich (IOP, NAS, Belarus)
- Speech by Dr. Nguyen Thi Thanh Ha (MOST, Vietnam)

09:30 - 09:40 **CONFERENCE PHOTOGRAPH**

PLENARY SESSION

Chairperson:

Prof. Nobuhiko Sarukura (Osaka Uni., Japan)
Prof. Nguyen Huy Bang (Vinh Uni., Vietnam)

PL-01
09:40 - 10:05 **EPITAXIAL GROWTH OF NITRIDE SEMICONDUCTORS BY PLASMA PROCESS AND ITS APPLICATION TO OPTICAL DEVICES**

Hiroshi Fujioka* and Kohei Ueno

Institute of Industrial Science, Japan

PL-02 **INTRODUCTION TO RESEARCH ACTIVITIES OF JINR**

10:05 - 10:30

Dr. Dmitry Kamanin

Joint Institute for Nuclear Research (JINR), Russia

10:30 - 10:45 **COFFEE BREAK**

Chairperson:

Prof. Nobuhiko Sarukura (Osaka Uni., Japan)
Prof. Nguyen Huy Bang (Vinh Uni., Vietnam)

PL-03 **REALIZATION OF BLUE-EMITTING PEROVSKITE QDS WITH HIGH COLOR PURITY**

10:45 - 11:10

Chang-Lyoul Lee

Advanced Photonics Research Institute (APRI-GIST), Korea

PL-04 **INTRODUCTION TO THE INSTITUTE OF PHYSICS AND THE INTERNATIONAL CENTER OF PHYSICS**

11:10 - 11:35

Dinh Van Trung

Institute of Physics, VAST, Vietnam.

PL-05 **MULTIMODAL COMPLEXES BASED ON NANODIAMONDS AND PORPHYRINS FOR THE THERANOSTICS OF VARIOUS DISEASES**

11:35 - 12:00

V.A. Lapina, Dinh Van Trung, Ju.A. Kalvinkovskaya, S.A. Bushuk, T.A. Pavich

National Academy of Sciences of Belarus, Belarus

12:00 – 13:30 **LUNCH**
(at THUY NGA PLAZA, 463 Doi Can Str., Ba Dinh, Ha Noi)

SESSION A

PHOTONICS AND APPLICATIONS

(Room 810, 8th floor, Institute of Physics)

SESSION A:
PHOTONICS AND APPLICATIONS
October 15, 2024 (Tuesday)

Chairperson:

Prof. Do-Kyeong Ko (APRI, GIST, Korea)

A-01
13:30 - 13:50

DETERMINATION OF PSYCHOACTIVE SUBSTANCES BY FEMTOSECOND LASER IONIZATION MASS SPECTROMETRY

(Invited talk)

Totaro Imasaka*, Katsunori Yoshinaga and Tomoko Imasaka

Kyushu University, Japan

A-02
13:50 -14:10

TWO-DIMENSIONAL NONLINEAR SPECTROSCOPY IN THE EXTREME ULTRAVIOLET

(Invited talk)

Khuong Ba Dinh, Khoa Anh Tran and Lap Van Dao*

Swinburne University of Technology, Australia

A-03
14:10 - 14:30

ARTIFICIAL INTELLIGENCE FOR CHARACTERIZING BIOFUELS BASED ON FEMTOSECOND LASER IONIZATION MASS SPECTROMETRY

(Invited talk)

Tomoko Imasaka*, Katsunori Yoshinaga and Totaro Imasaka

Kyushu University, Japan

A-04
14:30 - 14:45

ELECTROCHEMICAL PERFORMANCE OF POLYVINYL ALCOHOL (PVA) AND POLYACRYLONITRILE (PAN) BASED COMPOSITE CARBON NANOFIBERS FOR ENERGY STORAGE APPLICATIONS

Kaung Kyaw Naing*, Ye Chan

Pyay University, Myanmar

A-05
14:45 -15:00

HIGH-POWER FIBER LASER FABRICATION-FACTORS AFFECTING THE QUALITY OF FIBER SPLICING JOINTS

Do Viet Hoang, Ngo Hai Long, Cao Khac Thien, Le Van Binh, Banh Quoc Tuan*

NACENTECH, Vietnam

A-06

15:00 - 15:15 **SPECTROSCOPIC CHARACTERIZATION AND SCINTILLATION PROPERTIES OF POTENTIAL GLASS SCINTILLATORS FOR LASER FUSION EXPERIMENTS**

(Invited talk)

Melvin John F. Empizo

University of the Philippines Diliman, Philippines

15:15 - 15:30 **COFFEE BREAK**

15:30 - 16:15 **POSTER SESSION I**

Chairperson:

Prof. Totaro Imasaka (Kyushu Uni., Japan)

A-07

16:15 - 16:35 **NOVEL OPTICAL MATERIALS AS SOLID-STATE LIGHT EMITTERS AND LASER MEDIA**

(Invited talk)

Nobuhiko Sarukura

Institute of Laser Engineering, Osaka University, Japan

A-08

16:35 - 16:55 **BROADBAND TERAHERTZ METASURFACES FOR 6G AND BEYOND - DESIGN CHALLENGES AND APPLICATIONS**

(Invited talk)

Bhagwat Singh Chouhan and Gagan Kumar

Indian Institute of Technology Guwahati, India

A-09

16:55 - 17:10 **HIGH-SENSITIVITY NON-ENZYME OPTICAL BIOSENSORS FOR GLUCOSE DETECTION BASED ON ZNO NANOSTRUCTURES**

Van Thanh Pham, Thuy Quynh Mai, Anh Duc Tran, Tuan Duy Nguyen Duc, Hanh Hong Mai*

University of Science, VNU Hanoi, Vietnam

18:00 - 20:00 **CONFERENCE PARTY**

(at CTM PLAZA, 131 Nguyen Phong Sac Str., Cau Giay, Ha Noi)

SESSION A:
PHOTONICS AND APPLICATIONS
October 16, 2024 (Wednesday)

Chairperson:

Prof. Ye Chan (University of Yagon, Myanmar)

A-10
08:30 - 08:50 **DOWNSTREAMING OF NATURAL MATERIALS HUTA GINJANG QUARTZ SAND DOPED WITH Nd_2O_3 FOR LASER MEDIUM APPLICATION**

(Invited talk)

Juniastel Rajagukguk

Universitas Negeri Medan, Indonesia

A-11
08:50 - 09:10 **DEVELOPMENT OF THE FUNCTIONAL COMPOSITE SCINTILLATORS WITH CONSIDERATION OF THE REFRACTIVE INDEXES**

(Invited talk)

Kei Kamada*, Other Authors

Tohoku University, Japan

A-12
09:10 - 09:25 **TRITIUM DETECTION: CHALLENGES AND PHOTONIC APPROACHES**

Yuji Hatano

Tohoku University, Japan

A-13
09:25 - 09:45 **APPLICATION OF MICROSOLITON COMB TO 560 GHZ WIRELESS COMMUNICATION**

(Invited talk)

Yu Tokizane*, Hiroki Kishikawa, Naoya Kuse and Takeshi Yasui

Tokushima University, Japan

A-14
09:45 - 10:00 **GENERATION OF THE UNIDIRECTIONAL P-ELECTRON ROTATION IN AN AROMATIC RING MOLECULE USING THE PHOTO-DRESSED STATES**

Hirobumi Mineo, Quang Huy Ho, Ngoc Loan Phan, Yuichi Fujimura

Van Lang University, Vietnam

A-15 **DEVELOPMENT OF Nd_2O_3 DOPED CA-NA-AL BORATE GLASS AS CALIBRATING MATERIAL FOR LUMINESCENCE SPECTROMETER**

10:00 - 10:15

N. Jarucha, Y. Ruangtaweep*, P. Meejitpaisan, H.J. Kim, N. Intachai, S. Kothand, P.H. Minh, J. Kaewkhao

Nakhon Pathom Rajabhat University, Thailand

10:15 - 10:30 COFFEE BREAK

Chairperson:

Prof. In-Sang Yang (Ewha Womans University, Korea)

A-16 **IMPACT OF LASER PARAMETERS ON THE FORMATION AND FUNCTIONALITY OF LASER INDUCED GRAPHENE**

10:30 - 10:50

(Invited talk)

Ye Chan*, Hnin Wut Yi, Haymar Aung Kyaw, Pho Kaung

University of Yangon, Myanmar

A-17 **ENHANCING ANGULAR GOOS-HÄNCHEN SHIFT AT SURFACE PLASMON RESONANCE FOR SENSING APPLICATIONS**

10:50 - 11:05

(Invited talk)

Cherrie May Olaya

Innovative Photon Manipulation Research Team, RIKEN Center for Advanced Photonics, Japan

A-18 **METAMATERIALS AND NANOPHOTONICS OPEN UP NEW POSSIBILITIES FOR CONTROLLING LIGHT AND TERAHERTZ WAVES**

11:05 - 11:25

(Invited talk)

Yoshiaki Kanamori

Tohoku University, Japan

A-19 **RAPID IDENTIFICATION OF WAVE NUMBER FROM UNFOCUSED IMAGES BY DEEP NEURAL NETWORK**

11:25 - 11:45

(Invited talk)

Mayuko Koga*, Hayato Tsuchiya

University of Hyogo, Japan

A-20 **INTINS CO. LTD INTRODUCTION**

11:45 - 12:00

Nguyen Nhat Nam*, Hoang Gia Bao

Intins Co. Ltd, Vietnam

12:00 - 13:30 **LUNCH**
(at THUY NGA PLAZA, 463 Doi Can Str., Ba Dinh, Ha Noi)

Chairperson:

Prof. H. Rillera-Bardolaza (University of the Philippines)

A-21
13:30 - 13:50 **A REVIEW ON SPIN ROTATIONAL EXCITATIONS IN HEXAGONAL $RMnO_3$ (R=Y, RARE-EARTHS) STUDIED BY RESONANCE RAMAN SPECTROSCOPY**

(Invited talk)

In-Sang Yang

Ewha Womans University, Korea

A-22
13:50 - 14:05 **EMISSION LIGHTS DEPENDENCE OF EXCITATIONS AND ENERGY TRANSFER OF EU^{3+}/ TB^{3+} CO-DOPED OXYFLUORO-PHOSPHOSILICATE GLASS FOR RED AND GREEN LIGHT EMITTING DEVICES**

P. Meejitpaisan*, P.H.Minh, J. Kaewkhao

Nakhon Pathom Rajabhat University, Thailand

A-23
14:05 - 14:20 **ELECTROMAGNETICALLY INDUCED GRATING IN A THREE-LEVEL V-TYPE ATOMIC MEDIUM VIA AMPLITUDE AND PHASE MODULATIONS**

Nguyen Thi Thu Hien*, Nguyen Huy Bang, Dinh Xuan Khoa, Hoang Minh Dong, Nguyen Tuan Anh, Le Nguyen Mai Anh, Nguyen Ngoc Tai Em, Nguyen Van Ai and Le Van Doai

Ho Chi Minh City University of Industry and Trade, Vietnam

A-24
14:20 - 14:40 **DIRECT LIGHT PATTERNING OF METALLIC NANOSTRUCTURES AND DEMONSTRATION OF ITS NONLINEAR OPTICAL EFFECT**

(Invited talk)

Quang Truong Pham, Adriana Umbria Fandino, Gia Long Ngo, Clement Lafargue, Isabelle Ledoux-Rak and Ngoc Diep Lai*

ENS Paris-Saclay, France

A-25
14:40 - 15:00 **CHARACTERISATION OF PHOTONIC MATERIALS USING XAFS AT PHOTON FACTORY**

(Invited talk)

Hitoshi Abe

Institute of Materials Structure Science, KEK/Ibaraki University, Japan

A-26 **MATERIAL SCIENCE ON THE IBR-2 REACTOR**

15:00 - 15:15 **Sergei Kichanov**

Joint Institute for Nuclear Research – JINR, Russia

15:15 - 15:30 **COFFEE BREAK**

15:30 - 16:00 **POSTER SESSION II**

Chairperson:

Prof. Pham Hong Minh (IOP, VAST, Vietnam)

A-27 **16:00 - 16:20** **NEAR-INFRARED PLASMONIC METASURFACES FOR BIOIMAGING AND BIOSENSING: SIMULATION AND FABRICATION**

(Invited talk)

Quang Minh Ngo*, Huu Tu Nguyen, Xuan Bach Nguyen, Thanh Son Pham

USTH, VAST, Vietnam

A-28 **16:20 - 16:35** **LENSLESS FOURIER HOLOGRAPHIC FIBER BUNDLE ENDOSCOPE FOR REFLECTANCE IMAGING OF UNSTAINED TISSUES**

Thi Van Anh Nguyen, Munkyu Kang, Dinh Hoang Tran, Tran Thinh Le, Youngwoon Choi* and Wonshik Choi*

Korea University

A-29 **16:35 - 16:50** **ZERO-POINT VIBRATIONS OF SOLID HYDROGEN STUDIED BY STATISTICAL MOMENT METHOD**

Ho Khac Hieu*, Nguyen Trong Tam, Hai Hoang, Le Thu Lam

Duy Tan University, Vietnam

A-30 **16:50 - 17:10** **EXPLOITING MULTIPLE SCATTERING FOR DEEP-TISSUE IMAGING AND ALL-OPTICAL MACHINE LEARNING**

(Invited talk)

Wonshik Choi

Korea University

17:15 - 17:30 **OFFICIAL CLOSING**

SESSION B

OPTICS AND SPECTROSCOPY

(Room 811, 8th floor, Institute of Physics)

SESSION B:
OPTICS AND SPECTROSCOPY
October 15, 2024 (Tuesday)

Chairperson:

Prof. Tran Quoc Tien (IMS, VAST, Vietnam)

B-01 **BLUE LASER APPLICATION FOR WHITE LIGHT CONVERSION**

13:30 - 13:50 *(Invited talk)*

Joo, Jae Young

Korea Photonics Technology Institute, Korea

B-02 **ALL-OPTICAL MAGNETIZATION SWITCHING IN $NiCO_2O_4$ THIN FILMS**

13:50 -14:10 *(Invited talk)*

Hiroki Wadati

University of Hyogo, Japan

B-03 **PRE-CALIBRATION OF PHASE ERRORS IN PROGRAMMABLE PHOTONIC INTEGRATED CIRCUITS**

14:10 - 14:30 *(Invited talk)*

Ming-Chang M. Lee*, Kuo-Wei Lee, Bo-Hsien Ko, Hong Thuy Trinh, The Anh Nguyen

National Tsing Hua University, Taiwan

B-04 **ULTRASENSITIVE DETECTION OF ORGANIC DYES USING SURFACE-ENHANCED RAMAN SCATTERING ON AU - AG HYBRID MATERIAL**

14:30 - 14:45

Nguyen Tran Truc Phuong, Nguyen Bao Tran, Le Thanh Tam, Le Van Hieu, Tran Thi Thanh Van, Dung Van Hoang, Hanh Kieu Thi Ta, Ngoc Xuan Dat Mai, Nhu Hoa Thi Tran*

University of Science, VNUHCMC, Vietnam

B-05 **STUDY OF HIGH HARMONIC GENERATION IN ARGON-NEON GAS MIXTURES**

14:45 -15:00

Dinh Ba Khuong, Tran Anh Khoa, Nguyen Ba Hoi, Vuong Van Cuong, Ho Phuoc Tien, Nguyen Thi Anh Thu and Dao Van Lap

Swinburne University of Technology, Australia

B-06

15:00 - 15:15 **IMPACT OF ANNEALING TIME ON THE PROPERTIES OF Sm_2O_3-DOPED BOROTELLURITE GLASSES FOR PHOTONIC APPLICATIONS**

P. Yamchumporn, W. Thanyaphirak, S. Khondara, K. Boonin, P. Yasaka, N. Sangwaranatee* and J. Kaewkhao

Nakhon Pathom Rajabhat University, Thailand

15:15 - 15:30 **COFFEE BREAK**

15:30 - 16:15 **POSTER SESSION I**

Chairperson:

Prof. Yoshiaki Kanamori (Tohoku Uni., Japan)

B-07

16:15 - 16:35 **DEVELOPMENT OF MELT GROWTH METHOD FOR B-GA_2O_3 SINGLE CRYSTALS UNDER PRECIOUS METAL CRUCIBLE FREE CONDITION**

(Invited talk)

Akira Yoshikawa*, TaketoshiTomida, Vladimir V. Kochurikhin, Yasuhiro Shoji, Kei Kamada, Masanori Kitahara, Koichi Kakimoto

Tohoku University, Japan

B-08

16:35 - 16:55 **LIGHT SCATTERING DEPOLARIZATION FOR MEASUREMENT OF TURBIDITY**

(Invited talk)

Joon Heon Kim* and Jung Su Park

*Advanced Photonics Research Institute (APRI-*GIST), *Korea*

B-09

16:55 - 17:10 **STUDY ON THE ENCHANCED PERFORMANCE OF INFRARED PHOTODETECTOR BASED ON HYBRID STRUCTURE BETWEEN REDUCED GRAPHENE OXIDE AND LEAD SULFIDE NANOPARTICLES**

Quang Khoi Le Nhat, Phan Phuong Ha La, Huynh Tran My Hoa, Nhu Hoa Tran Thi, Le Vu Tuan Hung, Duc Anh Ngo, Le Thai Duy, Kien Quoc Luu, Vinh Quang Dang*

University of Science, Ho Chi Minh City, Vietnam

18:00 - 20:00 **CONFERENCE PARTY**
(at CTM PLAZA, 131 Nguyen Phong Sac Str., Cau Giay, Ha Noi)

SESSION B:
OPTICS AND SPECTROSCOPY
October 16, 2024 (Wednesday)

Chairperson:

Prof. Tran Thi Thanh Van (VNU-HCM, Vietnam)

B-10
08:30 - 08:50 **EXPANDING LASER APPLICATIONS IN INTERDISCIPLINARY FIELDS: FROM CULTURAL HERITAGE ANALYSIS TO AGRICULTURAL PRODUCT PROTECTION**

(Invited talk)

Noriko Chikumoto*, Nobuhiko Sarukura, Toshihiko Shimizu, Kazuhiko Yamamoto

Osaka University, Japan

B-11
08:50 - 09:05 **FLUORESCENCE CHARACTERISTIC OF ANTHOCYANIN IN PURPLE SWEET POTATO USING PHOTOLUMINESCENCE TECHNOLOGY**

Nguyen Thi Thu Hien, Dinh Son Thach, Pham Tran Ngoc Ngan, Le Tran Anh Kiet, Pham Van Duong, Tran Boi An, Nguyen Van Tam*

Van Lang University, Vietnam

B-12
09:05 - 09:25 **SIMULATIONS OF RELATIVISTIC QUANTUM EFFECTS WITH BINARY WAVEGUIDE ARRAYS**

(Invited talk)

Truong X. Tran

Le Quy Don Technical University, Vietnam

B-13
09:25 - 09:40 **SYNTHESIS OF SILVER NANODECAHEDRA FOR DETECTING CYPERMETHRIN BY USING SURFACE- ENHANCED RAMAN SCATTERING TECHNIQUE**

Pham Thi Nga, Tran Thu Trang, Pham Thi Thu Ha, Ngo Thi Lan, Nguyen Dac Dien, Doan Thi Thao Anh, Dong Thi Linh and Vu Xuan Hoa*

TNU-University of Sciences, Vietnam

B-14
09:40 - 10:00 **NEW RAMAN LASERS: EFFICIENCY INCREASE AND LASER THRESHOLD REDUCTION**

(Invited talk)

S.M. Pershin*, V.A. Orlovich, A. D. Kudryavtseva

Prokhorov General Physics Institute Russian Academy of Sciences, Russia

B-15 **GROWTH OF LARGE CSLIB6O10 CRYSTALS FOR DUV LIGHT SOURCE APPLICATION**

10:00 - 10:20

(Invited talk)

M. Yoshimura*, Y. Takahashi, R. Murai, Y. Mori, K. Kohno, H. Tanaka, K. Shibuya, G. Okada and J. Nishimae

Institute of Laser Engineering, Osaka University, Japan

10:20 - 10:30 COFFEE BREAK

Chairperson:

Prof. Mai Hong Hanh (VNU University of Science, Vietnam)

B-16 **DESIGN AND FABRICATION OF SEMICONDUCTOR TERAHERTZ PHOTOCONDUCTIVE ANTENNA AND SPINTRONIC TERAHERTZ EMITTER DEVICES AT THE NATIONAL INSTITUTE OF PHYSICS**

10:30 - 10:50

(Invited talk)

H. Bardolaza*, J. Ferrolino, L. N. Dela Rosa, I. Verona, V. Juguilon, J. Arcilla, K. Alaba, K. Fernandez, R. Loberternos, G. Catindig, A. Somintac, A. Salvador, E. Estacio

University of the Philippines, Diliman, Philippines

B-17 **RARE-EARTH DOPED $NaYF_4$ MATERIALS AND APPLICATIONS**

10:50 - 11:10 *(Invited talk)*

Tran Thi Thanh Van*, Cao Thi My Dung, Nguyen Ba Tong, Vuong Thanh Tuyen, Bui Quang Vu Huy, Le Van Hieu, Lam Quang Vinh

University of Science, VNU-HCM, Vietnam

B-18 **STUDY ON THE INFLUENCE OF pH AND ANNEALING TIME ON THE STRUCTURE AND SIZE OF $CoAl_2O_4$ NANOCRYSTALS, APPLIED IN DIGITAL COLOR PRINTING**

11:10 - 11:25

Nguyen Trung Kien, Bui Thi Thuy Linh, Dinh Xuan Loc, Nguyen Thi Minh Thuy, Nguyen Xuan Ca,

Thai Nguyen University of Sciences, Vietnam

B-19 **DEVELOPMENT OF A RADIATION IMAGING DETECTOR USING AN OXIDE SINGLE-CRYSTAL SCINTILLATORS**

11:25 - 11:45

(Invited talk)

Masao Yoshino, Kei Kamadaa, Kazuya Omuroc, Seiichi Yamamoto, Kohei Nakanishie, and Akira Yoshikawa

Tohoku University, Japan

B-20 **INTRODUCTION OF HAMAMATSU PHOTONICS K.K. (HPK)**

11:45 - 12:00 **Gregory Quek**

Hakuto Singapore Pte Ltd

12.30 - 13.30 **LUNCH**

(at THUY NGA PLAZA, 463 Doi Can Str., Ba Dinh, Ha Noi)

Chairperson:

Prof. V.A. Lapina (National Academy of Sciences of Belarus)

B-21 **SOLAR MODULATION ENABLED BY VO_2 NANOPARTICLES FOR THERMOCHROMIC SMART WINDOWS**

13:30 - 13:50

(Invited talk)

Le Thi Ngoc Loan*, Hoang Thi Hang, Nguyen Minh Vuong, Ewald Janssens

Faculty of Natural Sciences, Quy Nhon University

B-22 **STUDY ON BROADBAND OPTICAL VORTEX BEAMS FORMATION IN LIQUID USING NANOSTRUCTURED ALL-GLASS COMPONENTS**

13:50 - 14:05

Hue Thi Nguyen*, Bien Chu Van, Hieu Le Van, Hai Tran Thi, Thanh Tung Nguyen, Thuy Linh Nguyen, Rafal Kasztelanic, Ryszard Buczynski

Hong Duc University, Vietnam

B-23 **EVOLUTION OF THE ELECTRONIC HEAT CAPACITY ACROSS LOW DIMENSIONS**

14:05 - 14:25

(Invited talk)

Rayda P. Gammag* and Czarowitz Joss O. Bercasio

Mapúa University, Philippines

B-24 **INTEGRATED RF-MEMS TECHNOLOGY FOR RECONFIGURABLE SPOOF-SURFACE-PLASMON-POLARITON DELAY-LINE**

14:25 - 14:45

(Invited talk)

Minh Van Nguyen* and Yoshiaki Kanamori

Tohoku University, Japan

B-25

14:45 - 15:00 **RESEARCH ON REFLECTION AND ABSORPTION CHARACTERISTICS OF METAL – DIELECTRIC – METAL STRUCTURES DEPENDING ON POLARIZATION AND ANGLE OF INCIDENT LIGHT**

Tu Nguyen Huu*, Minh Ngo Quang, Bach Nguyen Xuan, Son Pham Thanh

Graduate University of Science and Technology, VAST, Vietnam

B-26

15:00 - 15:15 **CHARACTERIZATION OF Eu^{3+}-DOPED BORATE GLASSES SYNTHESIZED USING MICROWAVE AND CONVENTIONNAL MELTING METHODS FOR RED LIGHT-EMITTING APPLICATION**

Nakarin Singkiburin*, Nattapon Srisittipokakun, R. Rajaramakrishna, Chayani Setiades Sarumaha, Wuttikrai Busayaporn, Anon Angnanon, Nuttawadee Intachai, Suchart Kothan, Hong Joo Kim, Jakrapong Kaewkhao

Nakhon Pathom Rajabhat University, Thailand

15:15 - 15:30 **COFFEE BREAK**

15:30 - 16:00 **POSTER SESSION II**

Chairperson:

Prof. Tran Xuan Truong (Le Quy Don Technical Uni., Vietnam)

B-27

16:00 - 16:20 **RECENT ADVANCES IN TRANSILLUMINATION IMAGING TOWARD REALIZATION OF OPTICAL COMPUTED TOMOGRAPHY**

(Invited talk)

Trung Nghia Tran*, Hoang Nhut Huynh, Ngoc An Dang Nguyen And Koichi Shimizu

Ho Chi Minh City University of Technology, Vietnam

B-28

16:20 - 16:35 **POLISHING OF OPTICAL LENSES WITH FAST PROCESSING TIME, HIGH ACCURACY AND HIGH REPRODUCIBILITY USING MODERN TECHNOLOGY**

Le Duy Tuan, Le Hoang Hai, Ta Van Duong*

Le Quy Don Technical University, Vietnam

B-29

16:35 - 16:50 **SYNTHESIS AND STUDY OF THE STRUCTURE AND OPTICAL PROPERTIES OF Tb3+- DOPED ZnO SEMICONDUCTOR NANOSTRUCTURES**

Trinh Thi Thu Huong, Nguyen Thi Hien, Nguyen Thi Minh Thuy, Nguyen Xuan Ca*

University of Science/ Hanoi University of Industry, Vietnam

B-30 **SPIN AND ORBITAL HALL EFFECT IN PARAXIAL LIGHT BEAMS**

16:50 - 17:10 *(Invited talk)*

Alexey A. Kovalev*, Victor V. Kotlyar

Samara National Research University, Russia

17:15 - 17:30 ***OFFICIAL CLOSING***

POSTER SESSION

POSTER SESSION I

October 15, 2024 (Tuesday)

Chairperson:

Prof. Chu Manh Hoang (HUST, VAST)
Dr. Nguyen Thi Minh Hien (IOP, VAST)

PI-01 SPECTRAL CHARACTERISTICS OF POLYMETHINE DYE IN MODEL BACTERIAL ENVIRONMENTS UNDER PHOTOIRRADIATION

Voropay E.S., Lyashenko L.S.*, Tabolich A.A.

Belarusian State University, Belarus

PI-02 CLASSIFICATION OF MOSAIC TESSERAE BY HIERARCHICAL CLUSTER ANALYSIS IN PRINCIPAL COMPONENT SPACE OF X-RAY FLUORESCENCE SPECTRA

V. Aseev, K. Gavrilova, A. Leonidova, M. Basmanov, M. Khodasevich*, P. Kulikovskay

B. I. Stepanov Institute of Physics,National Academy of Sciences of Belarus

PI-03 IMPROVING THE QUALITY OF FLUORESCENCE THERMOMETRY WITH HO-DOPED GLASSES BY MULTIVARIATE DATA ANALYSIS

I. Khodasevich, M. Khodasevich, P. Kulikovskaya*, A. Piotukh

B. I. Stepanov Institute of Physics,National Academy of Sciences of Belarus

PI-04 INVESTIGATION OF SIZE-DEPENDENT BAND GAP AND SPECTRA OF SPHERICAL AND TETRAGONAL I-III-VI 2 QUANTUM DOTS

Jonelle Mae B. Guzman* and Rayda P. Gammag

Mapúa University, Philippines

PI-05 SIMULATING THE GROWTH TEMPERATURE EFFECTS ON THE PHOTOCARRIER DENSITY OF LOW-TEMPERATURE GROWN GALLIUM ARSENIDE PHOTOCONDUCTIVE ANTENNA

Eros Henry Jay D. Acosta*, Jose Mari Sebastian C. Arcilla, Kenneth Alaba, Ivan Cedrick M. Verona, Lourdes Nicole F. Dela Rosa, Hannah R. Bardolaza and Elmer S. Estacio

University of the Philippines, Diliman, Philippines

PI-06 NEAR-INFRARED FLUORESCENCE ENHANCEMENT BY PLASMONIC METASURFACES

Tran Anh Tu, Nguyen Xuan Bach*

University of Science and Technology of Hanoi, Vietnam

PI-07 DUAL-MODE GREEN EMISSION PROPERTIES OF RARE-EARTH-ELEMENT-DOPED CAZRO 3 PEROVSKITE PHOSPHOR

Nguyen Thi Thu, Nguyen Thi Hong Tham, Do Danh Bich, Nguyen Van Hai, Hoang Nhu Van*

Phenikaa University, Vietnam

PI-08 FLUORESCENCE EXCITATION ENHANCEMENT BY PLASMONIC SILVER-COATED POLYMER PILLAR METASURFACE

Minh Quy Tran, Xuan Bach Nguyen, Thanh Son Pham, Quang Minh Ngo*

VNU University of Science, Vietnam

PI-09 INTENSITY-DEPENDENT REFRACTIVE INDEX IN RESONANT PHOTONIC STRUCTURES

Nguyen Duc Thang and Ngo Quang Minh*

University of Science and Technology Hanoi, Vietnam

PI-10 ANALYSIS OF DISPERSION CHARACTERISTICS OF POLARIZATION MODES IN DUAL-PBG08 CORE PHOTONIC CRYSTAL FIBERS WITH UV710 SUBSTRATE AND HEXAGONAL LATTICE

Ngoc Vo Thi Minh, Thu Chu Minh, Nam Nguyen Trong, Phuong Nguyen Thi Hong, Ben Chu Van, Trang Do Mai, Hieu Le Van, Lanh Chu Van*

Vinh University, Vinh City, Vietnam

PI-11 A DESIGN OF MAGNETO-INDUCTIVE WAVEGUIDE IN MHZ FREQUENCY RANGE SWITCHABLE BY LASER DIODES

Kim Hoan Vu, Xuan Hung Nguyen, Xuan Thanh Pham, The Anh Nguyen, Thanh Son Pham*

Hanoi University of Industry, Vietnam

PI-12 CHARACTERISTIC CONTROLLED FABRICATION OF FLEXIBLE SERS SUBSTRATES BY MODIFICATION OF GLASS FIBER FILTER SURFACE

Nguyen Thi Bich Ngoc*, Nguyen Duc Toan, Nguyen Thi Thuy, Nguyen Trong Nghia, Nghiem Thi Ha Lien

Institute of Physics, VAST, Vietnam

PI-13 SYNTHESIS OF A COUNTER ELECTRODE (CE) BASED ON REDUCED GRAPHENE OXIDE (RGO)-CU 2S BY A ONE-STEP ELECTROCHEMICAL METHOD APPLIED TO QUANTUM DOT PHOTOSENSITIZED PHOTOVOLTAIC CELLS (QDSSC).

Nguyen Thi My Hanh, Dang Huu Phuc*

Industrial University of Ho Chi Minh City

PI-14 APPLICATION OF FRACTAL GEOMETRY IN EVALUATING THE EFFECTIVENESS OF CAMOUFLAGE NETS IN THE VISIBLE LIGHT SPECTRUM

Nguyen Thanh Lam, Do Xuan Doanh*

Academy of Military Science and Technology, Vietnam

PI-15 FABRICATION AND CHARACTERISTICS PHOTOCATALYS OF TiO_2/N-GQDs

Thien Xuan Phan, Huong Nguyen Thi Mai, Binh Nguyen Thanh, Huong Le Thi Thu, Huong Le Thi, Son Bach Thanh, Thuy Phan Thi

Institute of Physics, VAST, Vietnam

PI-16 MICROMETER-SIZED RANDOM LASERS BASED ON POROUS POLYMER MICROSPHERES

Ngo Thi Lien*, Nghiem Thi Ha Lien, Ta Van Duong

Institute of Physics, VAST, Vietnam

PI-17 INVESTIGATION ON THE FABRICATION AND SPECTRAL PROPERTIES OF DOPED GRAPHENE QUANTUM DOTS WITH CHANGING EMISSION COLORS IN THE VISIBLE REGION

Le Xuan Hung*, Nguyen Thi Mai Huong, Trinh Thi Hue, Dao Nguyen Thuan, Alizée Roux, Julien Laverdant, Pham Thu Nga

Duy Tan University, Vietnam

PI-18 FABRICATION OF SILICON WIRES BASED ON NANO IMPRINTING TECHNOLIOGY FOR APPLICATION IN OPTIC WAVEGUIDES

Bui Phu Quy, Hoang Minh Quang, Nguyen Ngoc Minh, Trinh Thi Ha, Chu Manh Hoang

Hanoi University of Science and Technology, Vietnam

PI-19 TAMM PLASMON RESONANCE IN METAL-COATED POROUS SILICON PHOTONIC STRUCTURES

Thuy Van Nguyen*, Bui Huy, Pham Thanh Binh, Vu Duc Chinh, Tran Thi Cham, Nguyen Hai Yen, Nguyen Dang Khanh, Hoang Manh Trung, Pham Thanh Son, Hoang Thi Hong Cam and Pham Van Hoi

Institute of Materials Science, VAST, Vietnam

PI-20 DESIGN AND SIMULATION OF SURFACE RESONANCE IN TWO-DIMENTIONAL Ag ARRAY FOR NEAR-INFRARED REFRACTIVE INDEX SENSING

Le Huy Hieu Trung, Nguyen Xuan Bach, Pham Thanh Son, Ngo Quang Minh*

University of Science and Technology of Hanoi, Vietnam

PI-21 EXPERIMENTAL STUDY ON THE PHOTOTHERMAL PROPERTIES OF NANOFLUID CONTAINING GRAPHENE OXIDE-SILVER NANOPARTICLE HYBRID MATERIALS

Nguyen Thi Ngoc Mai, Mone Phommahaxay, Dinh Do Dat, Tran Thi Thu Phuong, Nguyen Thi Xiem, Vu Xuan Hoa, Tran Thu Trang, Pham The Tan, Nguyen Van Hao* and Pham Van Trinh*

TNU-University of Science, Vietnam

PI-22 NANO-ZNO-MODIFIED LOTUS FIBERS: A NOVEL APPROACH FOR NONVOLATILE MEMRISTORS

Ngoc Hong Nguyen, Hau Huu Do Ho, Hieu Thi Le, Kiet Tuan Tran, Thinh Phong Hoang Ho, Hanh Kieu Thi Ta, Anh Tuan Thanh Pham, Truong Huu Nguyen, Sungkyun Park, Ngoc Kim Pham*

VNUHCM - University of Science, Vietnam

PI-23 CLASSIFICATION OF MOTOR IMAGERY USING MACHINE LEARNING ON EEG DATA AND BRAIN MAPPING

Thien Le Tran Thuan, Quoc Khai Le*

Ho Chi Minh University of Technology, Vietnam

PI-24 NUMERICAL SIMULATION OF NONLINEAR PROPERTIES OF HOLLOW-CORE CIRCULAR LATTICE PHOTONIC CRYSTAL FIBERS FILLED WITH $C_2H_4Br_2$

Hoang Trong Duc, Chu Van Lanh, Le Tran Uyen Tu, Nguyen Nhat Khanh, Nguyen Thi Thuy*

University of Education, Hue University, Vietnam

PI-25 ADVANCES IN SYNTHESIS OF DOPED GRAPHENE QUATUMS DOTS FROM INDIGO EXTRACTED FROM INDIGO LEAVES IN THE MOUNTAIN REGIONS OF NORTHERN VIETNAM

Le Thi Thu Huong*, Nguyen Thi Mai Huong, Le Thi Huong, Phan Thi Thuy, Pham Thu Nga, Vu Thi Hong Hanh

Institute of Physics, VAST, Vietnam

PI-26 OPTICAL PROPERTIES AND ANNEALING EFFECTS OF CE^{3+}-DOPED $LU_3AL_5O_{12}$ SINGLE CRYSTAL GROWN BY MICRO-PULLING-DOWN METHOD WITH W CRUCIBLE

Doan Thi Kieu Anh*, Takahiko Horiai, Masao Yoshino, Yuka Abe, Pham Hong Minh, Mai Hong Hanh, Akira Yoshikawa

Institute for Materials Research, Tohoku University, Japan

PI-27 EFFECT OF FREQUENCY DETUNING ON ELECTROMAGNETICALLY INDUCED TRANSPARENCY IN ASEMICONDUCTOR QUANTUM WELL WITH A THREE LEVEL LAMDA CONFIGURATION

Nguyen Tien Dung*, Tran Cong Phong, Le Canh Trung

School of Engineering and Technology, Vietnam

PI-28 FABRICATION OF MEMRISTOR CROSSBAR ARRAY BY STENCIL LITHOGRAPHY

Phu-Quan Pham, Tai Vo Van Anh, Thuy-Anh Tran, Juergen Brugger, Chengxiang Zhang, Thuat Tran Nguyen, Ngoc Kim Pham*

University of Science, VNU-HCM, Vietnam

PI-29 IMPROVEMENT OF ABSORPTION FIGURE OF MERIT ON CUO THIN FILMS FABRICATED BY SOLUTION PROCESSING AND OXYGEN-ATMOSPHERE ANNEALING

Nguyen Van Loi, Phan Quoc Minh, Vu Thi Huyen Trang, Bui Nguyen Quoc Trinh

Academy of Cryptography Techniques, Vietnam

PI-30 A COMPARATIVE STUDY OF CONFINEMENT LOSS AND EFFECTIVE REFRACTIVE INDEX OF PCFs INFILTRATED WITH 1,2-DIBROMOETHANE AND NITROBENZENE

Trong Dang Van, Ben Chu Van, Thuy Nguyen Thi, Trung Le Canh, Thanh Thai Doan, Thuy Hoang Van, Trang Do Mai, Lanh Chu Van*

Vinh University, Vietnam

PI-31 ANALYSIS OF DISPERSION AND NONLINEAR COEFFICIENT CHARACTERISTICS OF PHOTONIC CRYSTAL FIBERS INFILTRATED WITH CARBON TETRACHLORIDE

Bao Tran Le Tran, Anh Le Thi Ngoc, Anh Le Ba The, Toan Ngo Duc, Thuy Nguyen Thanh, Yen Tran Thi Hai, Hoai Nguyen Thi, Thuy Le Thi, Trung Le Quang, Oanh Tran Thi Hong, Lanh Chu Van*

Vinh University, Vietnam

PI-32 THE SUPERCONTINUUM GENERATION IN SQUARE LATTICE PHOTONIC CRYSTAL FIBER WITH CHALCOGENIDE FOR INVISIBLE BROADBAND

Trong Dang Van, Ben Chu Van, Lan Phan Thi, Lanh Chu Van*

Vinh University, Vietnam

PI-33 DETERMINATION OF OPTIMAL WAVELENGTH OF RADIATION FOR EFFICIENT EXCITATION OF CURCUMIN FOR SENSITIZED INHIBITION OF CANCER CELLS

V. Plavskii*, A. Sobchuk, A. Mikulich, R. Nahorny, L. Plavskaya, A. Tretyakova, T. Ananich, O. Dudinova, N. Prokopenko, A. Svechko, I. Leusenka, S. Yakimchuk

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus

PI-34 PHOTOPHYSICAL AND SENSITIZING PROPERTIES, PHOTOCHEMICAL STABILITY OF NITROFURAN DERIVATIVE DRUGS

V. Plavskii*, N. Prokopenko, A. Mikulich, A. Sobchuk, O. Dudinova, R. Nahorny, A. Tretyakova, L. Plavskaya, T. Ananich, I. Leusenka, S. Yakimchuk

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus

PI-35 THE EFFECT OF BLUE LIGHT ON CELL CYCLE PARAMETERS, VIABILITY, INDUCTION OF APOPTOSIS AND NECROSIS IN CANCER CELLS

V. Plavskii*, A. Svechko, R. Nahorny, A. Mikulich, A. Tretyakova, L. Plavskaya, T. Ananich, O. Dudinova, N. Prokopenko, A. Sobchuk, I. Leusenka, S. Yakimchuk

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus

PI-36 PHASE TRANSFORMATIONS OF LIGHT BEAMS IN PHOTOREFRACTIVE CRYSTALS OF BISMUTH SILICATE

A. L. Tolstik, I. G. Dadenkov, E. A. Melnikova

Belarusian State University, Belarus

PI-37 PHOTODAMAGE TO ERYTHROCYTES INITIATED BY EXCITATION OF ENDOGENOUS PHOTOSENSITIZERS

J. Kruchenok*, O. Dudinova, V. Plavskii

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus

PI-38 TWO-COLOR PICOSECOND RAMAN LASER ON WATER WITH MULTIPLE TEMPORAL COMPRESSION OF THE STOKES PULSE AND PUMP PULSE RETARDATION IN A COLLIMATED BEAM

S. M. Pershin*, V. A. Orlovich, M. YaGrishin, V. N. Lednev, P. A. Sdvizhenskii, E. V. Shashkov

Prokhorov General Physics Institute Russian Academy of Sciences, Russia

PI-39 NEW UP-CONVERSION MATERIAL FOR THERMOMETRY: FLUOROALUMOPHOSPATE GLASSES DOPPED Ho^{3+} AND Yb^{3+} IONS

I. Khodasevich*, A. Grabtchikov, A. Piotukh, O. Korozhan, E. Kolobkova, V. Orlovich

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus

PI-40 UP-CONVERSION OF TRACE THULIUM IONS IN YVO_4 CRYSTAL EXCITED BY NONRESONANT IR RADIATION: MECHANISM AND NONLINEAR EFFECTS

I. A. Khodasevich*, A. S. Grabtchikov, Nguyen Dai Hung, V. A. Orlovich

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus

PI-41 BEHAVIOR OF C60 FULLERENE IN A BINARY MIXTURE OF XYLENE AND ETHANOL

S. A. Bakhramov*, U. K. Makhmanov, B. A. Aslonov,

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus

PI-42 DEVELOPMENT OF A SHORT-GUN TRAINING DEVICE USING INFRARED POSITION SENSORS

Pham Thi Trinh, Ngo Thi Ha, Phan Thi Minh Hao, Vo Thanh Hai, Duong Chi Dung, Nguyen Minh Hue, Phan Nguyen Nhue*

Le Quy Don Technical University, Vietnam

PI-43 PHOTOLUMINESCENCE TEMPERATURE DEPENDENCE STUDY OF CdSe QUANTUM DOTS

Phan Van Cuong

Nha Trang University, Vietnam

PI-44 DECTECTION OF CHLORAMPHENICOL AT LOW CONCENTRATION BY SERS METHOD

Tran Trong Duc, Nguyen The Binh

University of Science Hanoi, Vietnam

PI-45 SPECTROSCOPIC PARAMETERS AT HIGHT TEMPERATURE OF SELF BROADENED CO USING THE CLASSICAL MOLECULAR DYNAMICS SIMULATIONS

Nguyen Thi Huyen Trang, Le Minh Thu, Le Cong Tuong, Ngo Ngoc Hoa*

Hanoi National University of Education, Vietnam

PI-46 RESEARCH ON DEVELOPING A METHOD TO EVALUATE CAMOUFLAGE EFFECTIVENESS BASED ON HISTOGRAM GRAY LEVEL SIMILARITY

Tong Minh Hoa*, Nguyen Thanh Lam

Academy of Military Science and Technology, Vietnam

PI-47 RESEARCH AND DEVELOP A METHOD TO EVALUATE CAMOUFLAGE EFFECTIVENESS BASED ON THE RADIATION ENERGY REDUCTION COEFFICIENT

Tong Minh Hoa*, Nguyen Dinh Phuong

Academy of Military Science and Technology, Vietnam

PI-48 RESEARCH ON OPTIMAL DESIGN OF OPTICAL AND MECHANICAL SYSTEMS MULTI-FUNCTIONAL DIGITAL CAMERA MOBILE DEVICE INTEGRATING DAY, NIGHT AND NIGHT AND LASER CHANNELS

Duong Ngoc Tung*, Thai Hoai Son, Le Van Hoang

Academy of Military Science and Technology, Vietnam

PI-49 INVESTIGATING SLOW-LIGHT SOLITON PROPAGATION IN A TRIPOD-TYPE ATOMIC SYSTEM BY AN ANALYTICAL APPROACH

Thai Doan Thanh, Hoang Minh Dong, Nguyen Tuan Anh, Bui Quoc Trung, Trang Huynh Dang Khoa, Ta Thi Kim Tuyen, Le Mai Trinh, Nguyen Thi Thu Hien, Ho Quang Quy, Le Thi Minh Phuong and Giang Mien Khai

Ho Chi Minh City University of Industry and Trade, Vietnam

PI-50 QUANTUM COHERENCE PROPERTIES IN PULSE PROPAGATION IN DOUBLE EIT WINDOW OF ATOMIC MEDIUM

Hoang Minh Dong*, Thai Doan Thanh, Ho Quang Quy, Nguyen Tuan Anh, Nguyen Thi Thu Hien, Nguyen Huy Bang, Dinh Xuan Khoa, Luong Thi Yen Nga and Le Van Doai

Ho Chi Minh City University of Industry and Trade, Vietnam

PI-51 CONTROLLING OF SYNCHRONOUS ALL-OPTICAL SWITCHING VIA A RELATIVE PHASE UNDER THE INFLUENCE OF SGC

Nguyen Tuan Anh, Bui Quoc Trung, Thai Doan Thanh, Trang Huynh Dang Khoa, Ta Thi Kim Tuyen, Le Mai Trinh, Nguyen Thi Thu Hien, Le Nguyen Mai Anh, Le Thi Minh Phuong and Hoang Minh Dong*

Ho Chi Minh City University of Industry and Trade, Vietnam

PI-52 COMPARISION OF ANTHOCYANIN CONTENT OF PURPLE SWEET POTATO AND RED CABBAGE USING SPECTROSCOPIC TECHNIQUES

Dinh Thi Hai Thuan, Dinh Son Thach, Pham Tran Ngoc Ngan, Le Tran Anh Kiet, Tra Toan Loc, Do Minh Hieu, Nguyen Thi Thu Hien, Tran Boi An, Nguyen Van Tam*

Van Lang University, Vietnam

PI-53 PARTICLE SIZE EFFECTS IN THE ABSORPTION AND SCATTERING SPECTRA OF SPHERICAL GOLD AND SILVER NANOPARTICLES

Nguyen Thanh Lam, Do Xuan Doanh*

Academy of Military Science and Technology, Vietnam

PI-54 SURFACE MODIFICATION OF NITROGEN-DOPED CARBON QUANTUM DOTS FOR ENHANCED FUNCTIONALITIES

Pham Van Duong, Le Anh Thi, Do Minh Hieu, Le Thi Thu Huong, Nguyen Duc Toan, Pham Hong Minh, Nguyen Trong Tuyen, Nguyen Minh Hoa, Nguyen Thanh Binh*

Institute of Physics, VAST, Vietnam

PI-55 SOI SLOTTED L3 PHOTONIC CRYSTAL MOLECULES FOR QUANTUM OPTICS

B. M. Quan, P. V. Nhat, N. L. Lam, P. T. Binh, N. T. Van, C. Alonso-Ramos and H. T. H. Cam

University of Science and Technology of Hanoi, Vietnam

POSTER SESSION II

October 16, 2024 (Wednesday)

Chairperson:

Prof. Pham Hong Minh (IOP, VAST, Vietnam)
Dr. Banh Quoc Tuan (NACENTECH, Vietnam)

PII-01 SINGLE-AND MULTIVARIATE FLUORESCENT THERMOMETRY WITH MPy(OPrOH) 2 PORPHYRIN FOR BIOLOGICAL APPLICATION

M. Khodasevich*, I. Kolesnikov, D. Korolko, M. Kurochkin, Y. Gorbunova

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Belarus

PII-02 CHANGES IN THE MECHANISM OF DARK CHEMICAL REACTIONS INDUCED BY LIGHT AND CURCUMIN IN CANCER CELLS OVER TIME AFTER CESSATION OF LIGHT EXPOSURE

V. Plavskii*, L. Plavskaya, O. Dudinova, A. Tretyakova, A. Mikulich, R. Nahorny, T. Ananich, N. Prokopenko, A. Sobchuk, I. Leusenka, S. Yakimchuk

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Belarus

PII-03 THE DEPENDENCE OF METABOLIC ACTIVITY OF CANCER CELLS AND EFFICIENCY OF INTRACELLULAR GENERATION OF REACTIVE OXYGEN SPECIES ON WAVELENGTH OF AFFECTED RADIATION OF VIOLET AND BLUE SPECTRAL RANGES

V. Plavskii*, O. Dudinova, L. Plavskaya, A. Tretyakova, R. Nahorny, A. Mikulich, T. Ananich, N. Prokopenko, A. Svechko, A. Sobchuk, I. Leusenka, S. Yakimchuk

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Belarus

PII-04 NANOCOMPOSITES OF DETONATION NANODIAMOND WITH FLUORESCENT MEROCYANINE DYES

A. A. Lugovski*, M. P. Samtsov, G. A. Gusakov, D. S. Tarasov, E.S. Voropay, Y. D. Mitskevich

Belarussian State University, Belarus

PII-05 ELECTRICALLY CONTROLLED LIQUID CRYSTALIC FRENEL LENS AND DETERMINATION OF TOPOLOGICAL CHARGE OF OPTICAL VORTICES

Elena Melnikova, Yekatsiaryna Pantsialeyeva, Dmitry Gorbach, Alexei Tolstik

Belarussian State University, Belarus

PII-06 OPTICAL AND ELECTROPHYSICAL PROPERTIES OF GRANULAR SILVER NANOSTRUCTURES

A. D. Zamkovets, S. A. Tikhomirov, R. A. Dynich, A. D. Shirokanov, L.V. Baran, H. S. Kuzmitskaya, V. V. Malyutina-Bronskaya, I. Y. Frolov, Pham Van Duong, Pham Hong Minh

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Belarus

PII-07 EFFICIENCY OF PICOSECOND SRS IN LIGHT WATER VERSUS THE DEPTH OF IMMERSION OF THE FOCAL BEAM WAIST OF EXCITING RADIATION INTO IT

A.I. Vodchits*, V.A. Orlovich, I.A. Khodasevich, S.M. Pershin, M.Ya. Grishin

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Belarus

PII-08 PICOSECOND RANDOM RAMAN LASER BASED ON POLICRYSTALLINE SOLID MIXTURE OF LiOH + $Sr(NO_3)_2$

A.I. Vodchits, I.A. Khodasevich, A.Yu. Pyatyshev, A.V. Skrabatun, A.D. Kudryavtsev, N.V. Tchernega, L.E. Batay and V.A. Orlovich*

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Belarus

PII-09 RAMAN CONVERSION OF MULTIMODE LASER RADIATION: TRANSITION FROM NON-COHERENT TO COHERENT REGIME

A.S. Grabtchikov*, L.E. Batay, A.I. Vodchits, I.A. Khodasevich, V.A. Orlovich, J. Davaasambuu, G. Shilagardi

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Belarus

PII-10 STIMULATED RAMAN SCATTERING IN WATER, EXCITED BY BESSEL BEAM

I.A. Khodasevich*, A.I. Vodchits, S.M. Pershin, V.A. Orlovich, M.Ya. Grishin

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Belarus

PII-11 INVESTIGATION OF TERAHERTZ EMISSION CHARACTERISTICS OF COHERENT INAS/INGAAS QUANTUM-DASH AND QUANTUM-DASH-IN-A-WELL

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University of the Philippines, Diliman, Philippines

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Ivan Cedrick M. Verona*, Kenneth Jay G. Alaba, Hannah R. Bardolaza and Elmer S. Estacio

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Joaquin Tuanquin*, Ivan Cedrick M. Verona, Hannah R. Bardolaza, Nathaniel Hermosa, Arnel A. Salvador and Elmer S. Estacio

University of the Philippines, Diliman, Philippines

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Doan Cat Cong*, Nguyen Trong Nghia, Nguyen Duc Toan

Graduate University of Science and Technology, Vietnam

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Nguyen Thi Hang Nga*, Tran Minh Chien, Nguyen Thai Linh, Le Pham Minh Hung, Nguyen Manh Duc, Pham Nguyet Anh, Nguyen Duc Toan, Nghiem Thi Ha Lien

Institute of Physics, VAST, Vietnam

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Vinh University, Vietnam

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Nguyen Duy Khanh*, Vuong Thi Hoang Lien, Le Vu Tuan Hung, Le Van Ngoc

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HongDuc University, Vietnam

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Nguyen Ngoc Son*, Vu Huu Khanh, Nguyen Anh Tuan, Nguyen Manh Thang

Academy of Military Science and Technology, Vietnam

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Institute of Physics, VAST, Vietnam

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Bui Binh Nguyen*, Tran Quoc Tien, Quang Cong Tong, Nguyen Anh Tuan, Thanh Phuong Nguyen, A. Mikulich

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Van Truong - Nguyen, N. T. T. Hang and P. M. Tan*

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Nguyen Viet Ha, Nguyen Xuan Ca, Tran Ngoc, Phan Van Do*

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Dinh-V-Trung, X.T. Nguyen, T.B. Nguyen

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Vo Thi Le Na*, Nguyen Huu Tuan

Phenikaa University, Vietnam

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Huynh Thi Son An, Do Minh Hieu, Pham Hong Minh, Nguyen Thanh Cong, Pham Van Duong

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Quang Ho Dinh, Lam Chu Thi Thanh, Chung Nguyen Thi Kim

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Nguyen Huy Bang, Dinh Xuan Khoa, Nguyen Van Phu, Luong Thi Yen Nga, Le Nguyen Mai Anh, Nguyen Tuan Anh, Hoang Minh Dong, Nguyen Thi Thu Hien and Le Van Doai

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PII-54 COMPARISON OF THE EFFECTIVE MODE AREA OF POLARIZATION MODES IN DUAL-PBG08 CORE PHOTONIC CRYSTAL FIBERS WITH UV710 SUBSTRATE

Thu Chu Minh, Ngoc Vo Thi Minh, Nam Nguyen Trong, Phương Nguyen Thi Hong, Ben Chu Van, Trang Do Mai, Khoa Dinh Xuan, Lanh Chu Van*

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ABSTRACTS

PLENARY SESSION

PL-01

EPITAXIAL GROWTH OF NITRIDE SEMICONDUCTORS BY PLASMA PROCESS AND ITS APPLICATION TO OPTICAL DEVICES

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Abstract. GaN devices such as LEDs and laser diodes are usually fabricated with MOCVD. However, MOCVD suffers from several serious problems which include high growth temperatures, difficulty for heavy carrier doping, and lack of scalability of sample size. To solve these problems, we have recently developed a new epitaxial growth technique named PSD (pulsed sputtering deposition) which allows us to obtain high quality group III nitride films even at low substrate temperatures with high productivity. [1] In this presentation, we will discuss the use of the low temperature PSD technique for fabrication of light emitting devices and electron devices. Firstly, we have confirmed that the use of PSD allows us to grow high quality AlN on SiC even at room temperature. We have also grown GaN with PSD on GaN templates and found that low temperature PL spectra of unintentionally doped PSD GaN is dominated by luminescence for free excitons X_A. [2] This result indicates that material purity of PSD GaN is quite high.We have also performed PSD growth of n-type and P-type GaN with impurity doping using Si, Ge, and and Mg and found that doping is possible over a wide concentration range while maintaining flat surface and high crystallinity. [3] We found that the electron concentration can be controlled in the range between 1.5 x 10^{16} and 5.0 x 10^{20} cm^{-3} for Ga-polar, N-polar, and semi-polar GaN. Lightly doped GaN with a Si concentration of $2 \times 10^{16}\,cm^{-3}$ shows RT electron mobility as high as $1240\,cm^2\,V^{-1}s^{-1}$, which was dominantly limited by polar optical phonon scattering. With heavily doped samples, a record low resistivity for n-type GaN of 0.16 mΩcm was achieved with an electron mobility of 100 $cm^2V^{-1}s^{-1}$ at a carrier concentration of 3.9×10^{20} cm^{-3}. We have found that the doping efficiency of PSD n-type GaN is close to unity at electron concentrations up to 5.1×10^{20} cm^{-3} based on the results of SIMS and Hall effect measurements. This unique property of PSD GaN can be attributed to the reduction of the compensating acceptor defects due to the highly non-equilibrium growth conditions. These heavily doped samples show very small temperature dependence in their carrier concentrations, which indicates that these materials are highly degenerate. In fact, heavily n-type doped GaN showed the increased optical bandgap of 3.84 eV due to the Moss-Berstein effect. [9] This transparency is quite important for the optical applications of degenerate PSD GaN. Various nitride devices such as LEDs solar cells, MISFET, and HEMTs were already fabricated using PSD and operated successfully. [4,5] For example, we have successfully fabricated RGB full color LEDs on various low cost substrates such as metal foils, graphite sheets, or glass that have not been used for growth of semiconductors so far due to their chemical and thermal vulnerability. [6]

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PL-02

INTRODUCTION TO RESEARCH ACTIVITIES OF JINR

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PL-03

REALIZATION OF BLUE-EMITTING PEROVSKITE QDS WITH HIGH COLOR PURITY

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Abstract. In this study, the blue-emitting perovskite QDs with high color purity was realized. The interaction between the ligands and the precipitation solvent (**Sol. B**) was varied by using different type of **Sol. B** in LARP. As dipole moment of **Sol. B** increased, the particle size of $CH_3NH_3PbBr_3$ QDs decreased, resulting in blue-shift of PL emissions. In addition, the post-treatment of $CsPbBr_3$ QDs to introduce ligand with short alkyl chain length and Cl can suppress formation of Cl vacancies during Cl exchange, resulting in high PLQY and deep blue PL emission.

PL-04

INTRODUCTION TO THE INSTITUTE OF PHYSICS AND THE INTERNATIONAL CENTER OF PHYSICS

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Abstract. The institute of Physics was established 55 years ago with the main focus on fundamental and applied research in physics and related fields. The institute of physics also puts great emphasis on the international scientific collaboration to foster graduate training and research at international level. In this presentation I will review the current research activities and achievements of the institute together with our directions in the future, especially with the help of the International centre of physics, which is the category II centre under the auspices of UNESCO. We hope to expand further our research and training programs with both domestic and international universities.

PL-05

MULTIMODAL COMPLEXES BASED ON NANODIAMONDS AND PORPHYRINS FOR THE THERANOSTICS OF VARIOUS DISEASES

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Abstract. The present paper addresses modern theranostic approach to the photodynamic treatment of oncological diseases based on multimodal structures consisting of a carrier nanoparticle, an optically active therapeutic agent and a selective vector [1, 2]. Novel hybrid supramolecular complexes of nanodiamond - tetraaminophenylporphyrin - hyaluronic acid (ND-TAPP-HA) and nanodiamond - tetracarboxyphenylporphyrin - hyaluronic acid (ND-TCPP-HA) and their zinc analogues have been studied with respect to their spectral-luminescent and kinetic properties, the ability to generate singlet oxygen, interact and destroy cancer cells.

It has been shown that ND-porphyrin complexes can be effective photosensitizers of a new type. Among the studied complexes, the most effective photosensitizing activity was demonstrated by of ND-ZnTCPP-HA and ND-TAPP-HA complexes. Figure 1 shows images of HeLa cells irradiated in suspension in the presence of these complexes and stained with propidium iodide. For the purpose of comparison, the irradiated and non-irradiated regions (left side of images) of the sample were adjacent in the field of view. It is shown that these complexes are effective photosensitizers (up to 60% efficiency). The studied complexes can be also used as visualizers of binding sites with pathologically altered cells for the purpose of diagnosis.

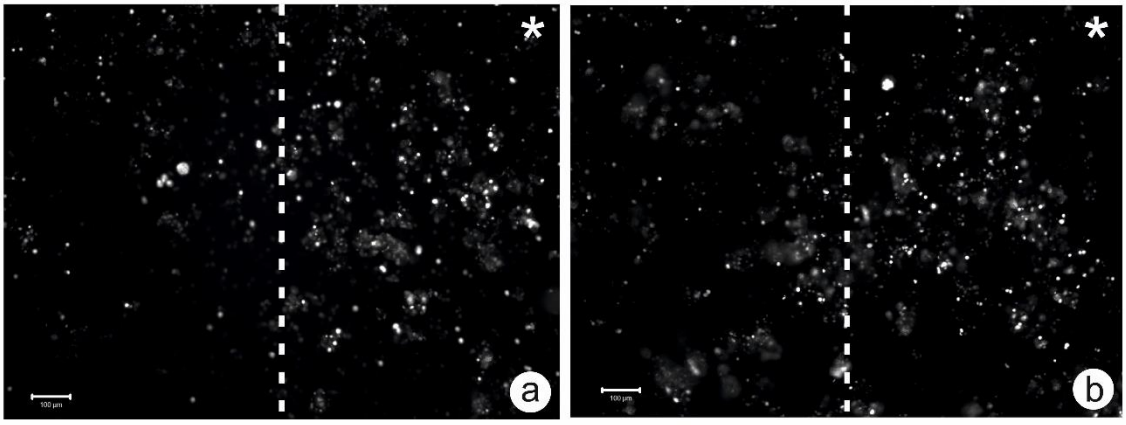

Fig. 1. Images of HeLa cells in the light of propidium iodide fluorescence after photosensitized exposure (∗) with ND-ZnTCPP-HA complex (a) and ND-TAPP-HA complex (b).

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SESSION A

PHOTONICS AND APPLICATIONS

A-01

DETERMINATION OF PSYCHOACTIVE SUBSTANCES BY FEMTOSECOND LASER IONIZATION MASS SPECTROMETRY

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Abstract. Psychoactive substances such as barbiturates are highly susceptible to dissociating in mass spectrometry (MS) because of their long side chains. As a result, they exhibit extensive cleavage and subsequent rearrangement, making the identification of these compounds more difficult. Although a library of electron ionization mass spectrometry (EIMS) is available, most such compounds have very similar fragment patterns. Accordingly, it would be desirable to develop a technique for soft ionization, providing a molecular ion and large fragment ions as well. In this study, a molecular ion was clearly observed, in addition to large fragment ions, for a variety of psychoactive substances, based on multiphoton ionization mass spectrometry (MPIMS) using a tunable ultraviolet femtosecond laser as the ionization source (fs-LIMS) [1-3].

Figure 1 shows mass spectra measured for barbiturates at the optimal wavelengths (see the caption). Extensive fragmentation was observed due to efficient α-cleavage and subsequent McLafferty rearrangement. However, a molecular ion was clearly observed in addition to large fragment ions for all of the barbiturates that were examined in fs-LIMS. In contrast, no molecular ions are observed for barbiturates in the NIST EIMS data, except for secobarbital and phenobarbital. This favorable result in fs-LIMS was achieved when the optimal laser wavelength for minimizing the excess energy remaining in the ionic state was used. All of the barbiturates studied provided unique mass spectral patterns in fs-LIMS, which was useful for the reliable identification of these compounds in practical trace analysis.

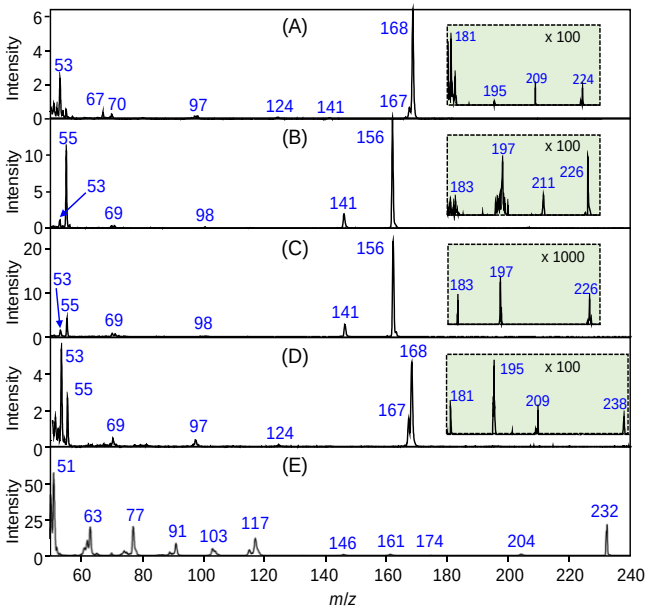

Fig. 1 Mass spectra observed for (A) butalbital (B) amobarbital (C) pentobarbital (D) secobarbital (E) phenobarbital at (A) - (D) 245 nm (E) 255 nm.

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A-02

TWO-DIMENSIONAL NONLINEAR SPECTROSCOPY IN THE EXTREME ULTRAVIOLET

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Abstract. In the optical region, high-frequency electronic transitions are excited in atoms and molecules, but the interesting information on nuclear vibrations and phonons is obtained at lower frequencies in multi-dimensional spectroscopy. Similarly, extreme ultraviolet (EUV) pulses in combination with optical pulses can be used to probe the coherence of multi-electron states. Here, we report a two-dimensional nonlinear four-wave mixing scheme in the EUV region for studying ultrafast electron wave-packet dynamics. Using two multiple-cycle optical pulses with incommensurate frequencies (e.g., at wavelengths 1400 nm and 800 nm) in a collinear configuration, a cascaded background-free four-wave mixing EUV field can be realized [1] because the EUV pulse produced by phase-matched high order harmonic generation in combination with the other two optical pulses creates a third-order nonlinear polarization which drives a phase-matched four-wave mixing process along the propagating direction. The four-wave mixing emission can be manipulated by varying the delay of the second optical pulse.

The phase-matching of the four-wave mixing process together with the relatively long interaction path combine to produce a strong output signal which leads to an enhanced signal-noise ratio of the Fourier-transformed signal used to obtain the two-dimensional cross correlation spectrum [2]. Some key features of this two-dimensional spectroscopy, such as the on-axis and off-axis peaks, can lead to the determination of interaction pathways of real dipole-allowed transitions and virtual transitions in the EUV. In addition, this scheme allows the extraction of amplitude and phase modifications of the atomic dipole moments of the coupled states interacting with the intense pulsed laser light.

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A-03

ARTIFICIAL INTELLIGENCE FOR CHARACTERIZING BIOFUELS BASED ON FEMTOSECOND LASER IONIZATION MASS SPECTROMETRY

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Abstract. Global warming has now become a serious environmental issue. One of the approaches for overcoming this is the use of a biofuel, which is produced by a reaction of vegetable oil with methanol to produce fatty acid methyl esters (FAMEs). The physicochemical properties of such the fuel, e.g., cloud point, cetane number, oxidative stability, which depend on the chemical structure of the FAMEs and their distribution, should be measured before its use although it requires a lengthy time for the measurement.

A mixture of 14 standard FAMEs was separated by GC and measured by femtosecond laser ionization mass spectrometry (fsLIMS). The fifth (206 nm) and fourth harmonic (257 nm) emissions of a femtosecond Yb laser (1030 nm) were used for excitation and subsequent ionization, respectively, since this ionization scheme was useful for observing the molecular ions [1-3]. The FAMEs contained in a real sample such as B100 (100% biofuel) were separated by GC and were be clearly identified by fsLIMS, as shown in Fig. 1 [4]. This approach provided the information concerning the molecular weight and the number of double bonds in a molecule and then was useful for characterizing the biofuel.

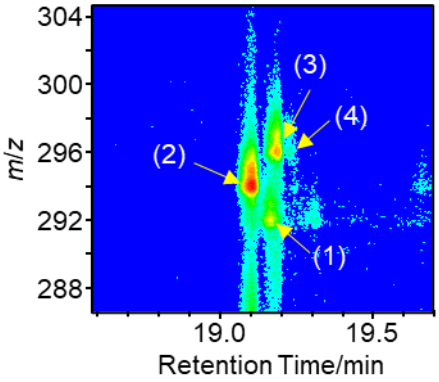

Fig.1 Two-dimensional display obtained for a real sample of B100. Assignment: (1) methyl linolenate (C18:3), (2) methyl linoleate (C18:2), (3) methyl oleate (C18:1), and (4) methyl elaidate (C18:1).

The mass spectral data of several biofuels were used as explanatory variables and the physicochemical properties of the biofuels were used as objective variables in artificial intelligence (AI) [4]. After machine learning, we predicted the physicochemical properties for unknown biofuels by AI. As a result, this technique was found to be useful for characterizing the biofuels. In fact, the errors in the evaluation of the physicochemical properties were a few percent when the distribution of the FAMEs in the unknown biofuel was similar to those of the biofuels used for machine learning. Accordingly, the present approach, involving a combination of fsLIMS and AI, has a potential for use in evaluating the properties of a biofuel and then in solving of environmental issue associated with global warming.

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A-04

ELECTROCHEMICAL PERFORMANCE OF POLYVINYL ALCOHOL (PVA) AND POLYACRYLONITRILE (PAN) BASED COMPOSITE CARBON NANOFIBERS FOR ENERGY STORAGE APPLICATIONS

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Abstract. Composite carbon nanofibers (CNFs) were created by combining polyvinyl alcohol (PVA) and polyacrylonitrile (PAN), with graphene oxide and silver nitrate serving as additional components. These polymer-based nanofibers were produced through electrospinning, followed by carbonization at high temperatures in a nitrogen environment. The resulting CNFs were characterized using scanning electron microscopy (SEM), X-ray diffraction (XRD), Raman spectroscopy, and X-ray fluorescence (XRF) spectrometry to investigate their morphological and structural properties. Binder-free electrodes were fabricated from these CNFs to evaluate their electrochemical performance. Specific capacitances of the electrodes were measured using cyclic voltammetry (CV), and their electrochemical impedance was analyzed through electrochemical impedance spectroscopy (EIS). The PAN/Ag/GO-based CNF electrode confirmed improved charge transfer kinetics and ion diffusion properties due to the composite materials used. Silver (Ag) nanoparticles enhanced electrical conductivity, thus improving charge transfer. Graphene oxide (GO) introduced structural disorder and high porosity, offering numerous active sites for ion adsorption and facilitating efficient ion diffusion. Nitrogen doping during carbonization further improved the electrochemical performance by increasing conductivity and providing additional active sites for charge storage. A high I_D/I_G ratio indicated beneficial defects and disorder within the carbon structure, leading to greater specific capacitance and overall improved electrochemical performance.

Keywords: Carbon nanofiber, electrospinning, electrochemical performance

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A-05

HIGH-POWER FIBER LASER FABRICATION - FACTORS AFFECTING THE QUALITY OF FIBER SPLICING JOINTS

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Abstract. High-power fiber lasers have been widely used in industrial material processing[1-3]. The laser includes of optical components that are interconnected by the optical fibers. The high-power output laser beam is also transmitted through optical fibers before reaching the processing head[4]. The quality and stability of the laser are highly dependent on the quality of the fiber splicing joints that connects the components, especially in high-power ranges. Due to the operation at very high laser power levels (ranging from tens to hundreds of Watts in optical pumping and possibly generating up to tens of kilowatts of laser output) [5-6], the fiber splicing joints require an extremely low attenuation to minimize a heat generation that causing the laser damages. This paper presents an analysis of the factors affecting the attenuation in fiber splicing joints, and proposes a method to improve the splicing quality in high-power fiber laser fabrications. A multimode fiber with core size of 200 µm, cladding of 220 µm, and jacket of 380 µm from a 300W diode laser pump [7] is used to illustrate the impact of fiber splicing parameters on the splicing quality. We also present the results of splicing the high-power optical components to fabricate high-power fiber laser. Additionally, analyzing the parameters affecting the quality of fiber splices will enable the active control and the repair of optical faults in existing high-power commercial fiber lasers in Vietnam, reducing the dependence on manufacturers as well as opening up other useful applications.

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A-06

SPECTROSCOPIC CHARACTERIZATION AND SCINTILLATION PROPERTIES OF POTENTIAL GLASS SCINTILLATORS FOR LASER FUSION EXPERIMENTS

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Abstract. Lithium fluorophosphate glasses with a composition of $20Al(PO_3)_3$-80LiF are promising scintillator host materials for laser fusion experiments [1]. Their high lithium (Li) content of 31.6 mmol cm^{-3} [2] enhances detector sensitivity to 270 keV down-scattered neutrons, crucial for analyzing imploded plasma areal density and gaining insights into fusion plasma dynamics. Building on our previous study [3], we present a comprehensive spectroscopic characterization of Ce^{3+}-doped lithium fluorophosphate glasses, focusing on their luminescence properties and scintillation mechanisms. The glasses were synthesized via the melt-quenching method with a composition of $20Al(PO_3)_3$-80LiF-$x$$CeF_3$. Fourier transform infrared (FTIR) spectroscopy revealed that Ce^{3+}-doping does not significantly alter the glass matrix structure. X-ray absorption spectroscopy at the Ce K-edge (40443 eV) confirmed the presence of stable Ce^{3+} centers, offering a more direct measurement of oxidation states compared to the commonly used Ce L-edge energies (5723.4 to 6548.8 eV). Spectroscopic analysis of ~ 2.0-mm-thick samples revealed distinct absorption and excitation edges, along with intense emission peaks corresponding to the interconfigurational Ce^{3+} 5d→4f transition. Increasing Ce^{3+} concentration leads to enhanced self-absorption and a red-shift in the emission band. The glasses also exhibit strong UV emissions with fast average lifetimes of less than 30 ns, a quantum yield of ~ 80 % under UV excitation, and a scintillation light yield of up to 620 photons/neutron for a 1.0 MeV neutron (^{252}Cf) source. A comparative study with a commercial scintillator will also be presented. Understanding these properties will facilitate the advancement of Ce^{3+}-doped lithium fluorophosphate glasses as potential neutron scintillator materials for laser fusion experiments.

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A-07

NOVEL OPTICAL MATERIALS AS SOLID-STATE LIGHT EMITTERS AND LASER MEDIA

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Abstract. Light sources in the ultraviolet (UV, λ = 400 nm to 250 nm), deep ultraviolet (DUV, λ = 250 nm to 190 nm) and vacuum ultraviolet (VUV, λ = 190 nm to 100 nm) wavelength regions have numerous technologically important applications, including lithography, sterilization, and surface modification. Solid-state lasers in these short wavelength regions offer the promise of being more robust, easier to maintain, and more cost-efficient light sources compared to conventional excimer lasers, synchrotron radiation, and free electron lasers (FEL). Towards UV, DUV and VUV laser development, we have explored fluoride crystals such as lithium calcium aluminum fluoride (LiCaAlF) and lanthanum fluoride (LaF) as excellent solid-state laser host materials because of their extremely wide band gaps which make them transparent down to about 100 nm. Fluoride crystals have been successfully doped with trivalent rare-earth ions such as cerium (Ce^{3+}) and neodymium (Nd^{3+}), whose dipole-allowed interconfigurational 5d to 4f transitions result in broad fluorescence bandwidths that enable the development of short-pulse tunable solid-state UV lasers. Interconfigurational transitions also result in fast luminescence emission. We leverage these fast emissions to develop fast-response scintillators that detect high-energy radiation. In addition to rare-earth ion doped fluorides, we also explored zinc oxide (ZnO) as a fast-response scintillator for the detection of extreme ultraviolet (EUV, λ = 10 nm to 100 nm) radiation. Undoped ZnO exhibits fast, nanosecond UV luminescence at room temperature. By intentional doping with impurities such as iron and indium, the luminescence decay time of ZnO increases by over two orders of magnitude, bringing its luminescence decay time in the picosecond range. Using indium-doped ZnO, we have demonstrated the synchronization of EUV-FEL and femtosecond Ti:sapphire laser pulses with about 3-picosecond accuracy. In this talk, I will present our work on rare-earth ion-doped fluoride crystals for solid-state UV, DUV and VUV laser and scintillator development and our work on undoped and impurity-doped ZnO scintillators.

A-08

BROADBAND TERAHERTZ METASURFACES FOR 6G AND BEYOND - DESIGN CHALLENGES AND APPLICATIONS

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Abstract. Terahertz (THz) metasurfaces, adept at manipulating electromagnetic waves at subwavelength scales, are poised to revolutionize photonics in the next generation [1]. Through smart design processes, one can achieve broadband response, holding immense potential to revolutionize various fields, including communication systems, imaging technologies, and sensing platforms, ushering in a new era of terahertz-enabled photonics innovations.

I will delve into the intricacies of designing planar and stacked metasurfaces in my talk, examining the challenges inherent in their fabrication and implementation for broadband applications. While planar metasurfaces offer simplicity in fabrication and integration, achieving broadband performance remains a significant hurdle [2]. Stacked metasurfaces, on the other hand, provide enhanced bandwidth and functionality but face challenges in precise alignment and layer control [3]. Addressing these design considerations is pivotal for realizing metasurfaces capable of operating across a broad range of terahertz frequencies. Moreover, active tunability emerges as a promising solution for overcoming the limitations of passive metasurfaces. Incorporating phase-change materials enables metasurfaces to dynamically modulate terahertz signals across a broad frequency spectrum. My talk will also spotlight the design challenges in creating active broadband modulators and their applications in next-generation photonics.

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A-09

HIGH-SENSITIVITY NON-ENZYME OPTICAL BIOSENSORS FOR GLUCOSE DETECTION BASED ON ZnO NANOSTRUCTURES

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Abstract. In recent years, our research group has studied susceptible optical biosensors using ZnO nanostructures and ZnO nanostructures decorated with Au nanoparticles (NPs) for non-enzymatic glucose sensing applications. The ZnO nanostructures were synthesized using a one-step hydrothermal method without using a seed layer with a galvanic cell. The glucose detection mechanism relies on the photoluminescence (PL) quenching of the ZnO NTs under UV excitation at 325 nm, with an emission peak at 384 nm. This sensor demonstrates a sensitivity of 3.5%.mM^{-1}, a detection limit of 70 µM, and a detection range of 0.1-15 mM, making it suitable for practical glucose sensing. The glucose detection is based on PL quenching of the ZnO NRs/Au NPs, with an emission peak at 382 nm. This sensor exhibits a significantly higher sensitivity of (22 ± 2)%.mM^{-1} and an ultra-low detection limit of 0.01 mM, with a rapid response time of less than 5 seconds. The addition of Au NPs enhances both PL intensity and the photo-oxidation properties of the ZnO NRs, making this sensor highly efficient for glucose detection in human blood serum. The third sensor integrates ZnO nanorods with the ferrous oxidation-xylenol orange (FOX) assay for absorption-based glucose detection. ZnO nanorods were synthesized on a copper wire mesh, providing high crystallinity and surface area. This sensor achieves a sensitivity of 0.394 mM^{-1}, a detection limit of 0.25 mM, and a wide linear range of 0-6 mM. The FOX-based sensor also shows excellent selectivity towards glucose compared to other sugars and provides accurate glucose measurements in human blood serum, aligning with clinical analysis results. These findings underscore the versatility and efficiency of ZnO-based nanostructures for non-enzymatic glucose sensing, with each sensor offering distinct advantages in sensitivity, detection range, and response time.

A-10

DOWNSTREAMING OF NATURAL MATERIALS HUTA GINJANG QUARTZ SAND DOPED WITH ND_2O_3 FOR LASER MEDIUM APPLICATION

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Abstract. Quartz sand is a type of material that is formed from volcanic eruptions and is rich in silicon dioxide (SiO_2) compounds. Quartz sand is also commonly referred to as silica sand, as it serves as the primary raw material for producing high-transparency glass. In this research, the preparation and characterization the structure of quartz sand from Huta Ginjang, Taput Regency, North Sumatera, were conducted and composited with several modifying compounds to serve as a potential host matrix for various rare earth ions. In this work, an exploratory investigation on the effects of the substitute of SiO_2 to quartz sand in Nd_2O_3 was executed, focusing on the physical, optical, luminescence and scintillation properties. Quartz sand was combined with some important compound so the following formula been: 10 Quartz sand + (50-x) B_2O_3 + 10 BaO + 30 Na^2O + xNd_2O_3 (x = 0; 0.5 mol%; 1 mol%; 1.5 mol%; 2 mol%). Neodymium ion (Nd^{3+}) as a part of rare earth (RE^{3+}) doped to get luminescence spectra at near infrared (NIR) wavelength range. The transition for the luminescence spectra are followed transition $^4F_{3/2} \rightarrow {}^4I_{9/2}$; $^4F_{3/2} \rightarrow {}^4I_{11/2}$ and $^4F_{3/2} \rightarrow {}^4I_{13/2}$ respectively. The melt-quenching method with melting at a temperature of 1200 ^oC will be applied to obtain a homogeneous, highly transparent and strong glass medium.

Keywords: Neodymium (Nd_2O_3); Huta Hinjang; Quartz Sand; Laser Medium

A-11

DEVELOPMENT OF THE FUNCTIONAL COMPOSITE SCINTILLATORS WITH CONSIDERATION OF THE REFRACTIVE INDEXES

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Abstract. In this talk, I will present our research on functional composites with considering refractive indexes for radiation imaging and thermal neutron detection applications.

1. Light guiding scintillator using large refractive index difference

The eutectic scintillators have a structure in which scintillator fibers core of several μm diameter are arranged in a clad matrix and have excellent position-resolving performance against x-rays and charged particles due to their optical waveguide function similar to optical fibers[1]. However, it was extremely difficult to grow the eutectic enough large size. Most recently, we proposed a novel optical-guiding crystal scintillator (OCS)[2]. It consists of halide single crystal scintillator core and glass clad. The refractive index of the halide single crystals is higher than the glass in this system. Generated scintillation light above the critical angle is totally reflected at the interface with the glass and optically waveguided like optical fibers and the scintillating fivers (fig.1-right). OCS is expected to be a material that has the same positional resolution as eutectic, but is superior in mass production and cost.

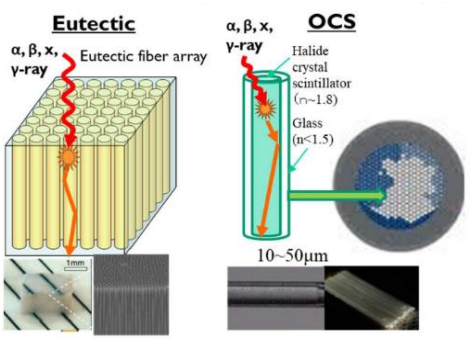

Fig.1 Schematics of the structure of eutectic scintillators (left) and developed OCS(right)

2. Transparent eutectic scintillator using a small refractive index difference

In the past decade, thermal neutron (n) scintillators containing ^{6}Li, such as Ce,Eu:LiCaAlF$_6$ and Ce:Cs$_2$LiYCl$_6$ single crystals, have been developed. To improve the n sensitivity, it is necessary to increase ^{6}Li concentration in this appllication. In single crystals, the Li content is limited by the chemical composition. In contrast, eutectic scintillators containing a high concentration of Li, such as LiBr/CeBr$_3$, Ce:LiBr/LaBr$_3$, Eu:LiSrI$_3$/LiI and Tl: LiBr/CsI etc. have been reported[3,4]. The eutectic scintillator is composed of a ^{6}Li-containing phase and a scintillator phase with a high n-capture cross-section. Its detection principle is to convert n rays into α rays and ^{3}H in the ^{6}Li-containing phase using the n-capture reaction of ^{6}Li, and convert the α rays and ^{3}H into light in the scintillator phase. In this study, we propose a new material design guideline to develop eutectics with excellent n/γ-ray discrimination performance and thermal neutron sensitivity by combining a scintillator phase with excellent α/γ discrimination performance and a ^{6}Li-containing phase

Tab.1 Example of scintillation properties of the developed scintillators

	Light yield (ph/neutron)	Decay time (ns)	PSD performance (FOM)	^{6}Li concentration (mol/cm^3)	1mm wafer
Target value	30,000<	<Several 100	○	0.028<	-
Tl:CsI/^{6}LiBr	110,000	580 (62.8%), 1793 (37.2%)	○ (2.916)	0.024	
Tl:NaI/^{6}LiBr	Not measurable			-	
Ce,Sr: LaBr$_3$/^{6}LiBr	~25,000	18.0	× (0.451)	0.036	
LaBr$_3$/^{6}LiBr	8,500	1724	○ (1.491)	0.036	
Ce:LaCl$_3$/^{6}LiCl	35,000	19.1(9.2%) , 66.7(18.2%), 407.3(72.6%)	× (0.377)	0.038	
LaCl$_3$/^{6}LiCl	25,000	1916	○ (1.089)	0.038	

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A-12

TRITIUM DETECTION: CHALLENGES AND PHOTONIC APPROACHES

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Abstract. Operation of nuclear reactors generates tritium (T), a radioisotope of hydrogen, through various nuclear reactions including ternary fission of fuels and neutron capture of deuterium (D) in water. Nuclear fusion power plants will use T as a fuel together with D. Accurate measurements and tight confinement of T are essential for safe operations of these nuclear facilities. However, special techniques are required for T measurements because T emits solely low energy β-rays and electron antineutrinos. The maximum energy of β-rays from T is just 18.6 keV, and the practical range of β-rays is a few mm in air and a few μm in liquids and solids. The objective of this presentation is to give an overview of challenges in T measurements and photonic approaches in T detection.

Liquid scintillation counting (LSC) is widely used for measurements of tritiated liquids [1]. T contents in biological samples are also measured using LSC after combustion. Difficulties in sample preparation and generation of organic liquid wastes are challenges. Solid scintillators including CaF_2(Eu) and plastics are considered to be alternatives of liquid scintillators [2-4] but the sensitivity is still lower than that of LSC. Photo-stimulated-phosphor imaging provides 2-dimensional distributions of T on surfaces and in bulk of solid samples and has been used for measurements of T distributions in fusion reactor materials [5-7]. Accurate quantification is an issue for this technique and it can be realized via computer simulation on interactions of radiations with matters. For a gas phase, Raman spectroscopy and infrared spectroscopy are capable of detecting isotopologues of hydrogen (H_2, HD, HT, D_2, DT, T_2) [8] and water (H_2O, HDO, HTO, D_2O, DTO, T_2O) [9], respectively, due to large isotope effects on vibrational energies in these molecules. These techniques allow identification of chemical state of T though sensitivity is lower than radiation measurements. More detailed information on each technique will be provided in the presentation.

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A-13

APPLICATION OF MICROSOLITON COMB TO 560 GHZ WIRELESS COMMUNICATION

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Abstract. Use of terahertz (THz) wave as a wireless carrier is considered for next-generation mobile communications (6G, expected carrier frequency > 300 GHz) [1]. Although wireless electronics have been widely used for the present wireless communications, it may face technical limitations in 6G due to higher frequency than millimeter wave; for example, decreased quality of electric signal source and/or increased transmission loss in electric signal line. The use of photonic THz generation is one potential way to break through the technical limit in THz communication.

One promising approach for the photonic generation of low-phase-noise THz wave ($f_{rep} = f_{THz}$) is the use of an optical frequency comb (OFC, frequency spacing = f_{rep}); two OFC modes with THz frequency spacing ($m\ f_{rep} = f_{THz}$) are used for photomixing with the help of a uni-travelling carrier photodiode (UTC-PD). Two OFC modes are generated from single optical cavity, thus, the relative phase noise of two modes is significantly low which generates ultra-low phase noise THz-wave by photomixing.

In particular, the on-chip Kerr micro-resonator soliton comb, namely the soliton microcomb [2], has attracted attention for photonic generation of THz-wave. Due to the sub-millimeter cavity size, it has a considerably large f_{rep} up to THz frequency and two adjacent microcomb modes can be directly used for photomixing to demonstrate ultralow-phase-noise THz wave generation at 300 GHz [3] and 560 GHz [4]. The method does not the need the optical frequency multiplication ($f_{rep} = f_{THz}$) also benefiting the low-phase-noise advantage of OFC. Furthermore, we have applied such photonic-generated THz wave for the wireless communication in 560 GHz band and demonstrate the data transfer in free space using modulation format of the on-off keying [5] and advanced modulation format [6].

In the presentation, we present methods to generate ultra-low noise THz-wave using micro soliton comb and photomixing and application to THz wireless communication. We also discuss issues in the application and our approach.

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A-14

GENERATION OF THE UNIDIRECTIONAL π-ELECTRON ROTATION IN AN AROMATIC RING MOLECULE USING THE PHOTO-DRESSED STATES

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Abstract. In this study we present the results of theoretical study on the generation of the π-electrons unidirectional rotation in aromatic ring molecules that properly considers the helical-photon-state within the semi-classical treatment of light-molecule interactions. The π-electron angular momenta of the two helical-photon-dressed states represent the intuitive rotational direction, and that of the remaining state represents the opposite, that is, counter-intuitive rotation. Intuitive rotation means that π electrons have the same rotational direction as that of a given helical electric field vector and obeys the classical equations of motion. Counter-intuitive rotation indicates that the rotational direction is opposite to that of the helical electric field vector. Counter-intuitive rotation is forbidden in an aromatic ring with high symmetry formed by a circularly polarized laser but is allowed in an aromatic ring with low symmetry (see Fig. 1). The angular momenta of the three dressed states are conserved and zero.

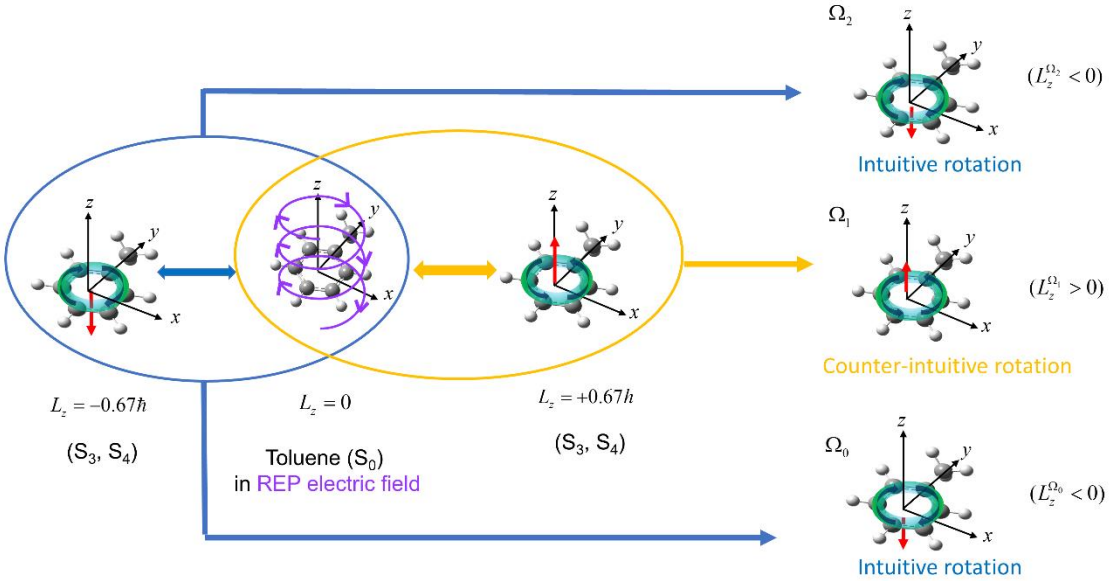

Fig. 1. Intuitive and counter-intuitive induction paths for inducing π-electron rotations of toluene in the three photon-dressed states formed by the REP laser.

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A-15

DEVELOPMENT OF Nd_2O_3 DOPED Ca-Na-Al BORATE GLASS AS CALIBRATING MATERIAL FOR LUMINESCENCE SPECTROMETER

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Abstract. Nd_2O_3-doped glass has emerged as a promising material for calibrating luminescence measurement instruments due to its unique optical properties. The incorporation of neodymium ions (Nd^{3+}) into glass matrices enables efficient light absorption and emission, making it highly suitable for precise wavelength calibration across a broad spectral range. This work used aluminum calcium sodium borate doped with Nd^{3+} ions and prepared using the melt-quenching technique. The intense emission around 1070 nm through the $^4F_{3/2} \rightarrow {}^4I_{11/2}$ transition was a prominent peak by stimulating with 581 and 808 nm, verifying consistent peak positions [1-2]. The NIR emission exhibited the best intensity at 0.50 mol% of Nd^{3+}. The results demonstrate the material's stability, reproducibility, and strong luminescent response, confirming its efficacy in ensuring the accuracy and consistency of luminescence-based analytical devices.

Keywords: *Borate glass, Calibrating, Neodymium, and NIR emission spectra.*

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A-16

IMPACT OF LASER PARAMETERS ON THE FORMATION AND FUNCTIONALITY OF LASER INDUCED GRAPHENE

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Abstract. Laser-Induced Graphene (LIG) was synthesized on polyimide film using a 455 nm blue laser, with laser parameters such as power, spot size, scan rate, and beam overlap systematically varied. The electrical conductivity of the LIG was assessed using the 4-probe method, providing insights into the effects of laser conditions on the material's conductive properties. Surface morphologies were characterized by Scanning Electron Microscopy (SEM), and the structural properties were further analyzed using X-Ray Diffraction (XRD), revealing the crystallographic changes induced by different irradiation parameters. Raman 2D mapping was utilized to analyze the formation and quality of the graphene. Additionally, contact angle measurements were performed to evaluate the wettability of the LIG surfaces. Electrochemical and impedance analyses were employed to investigate the porosity and electrochemical properties, emphasizing the material's potential for energy storage and sensor applications.

Keywords: LIG, Raman 2D mapping, Impedance analysis, Laser irradiation parameters, sheet reisitance.

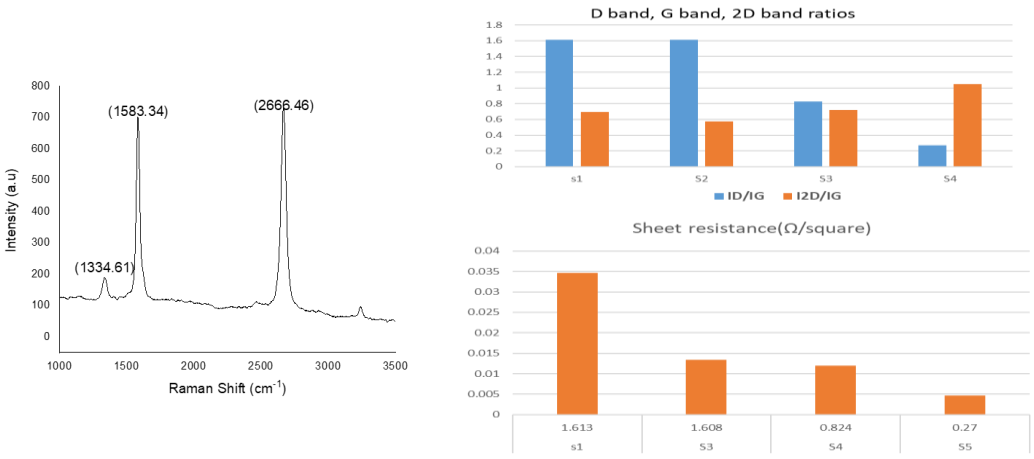

Fig.1 Raman spectrum of one of LIG sample and D,G and 2D bands ratios and their sheet resistances for LIG samples

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A-17

ENHANCING ANGULAR GOOS-HÄNCHEN SHIFT AT SURFACE PLASMON RESONANCE FOR SENSING APPLICATIONS

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Abstract. We demonstrate for the first time the enhancement of angular Goos-Hänchen shift at surface plasmon resonance to track small refractive index changes with high sensitivity. Goos-Hänchen (GH) shift is the displacement of real optical beams along the plane of incidence upon reflection from a planar interface [1]. The shift could either be spatial (Δ_{GH}) which depends on the angular derivative of the phase change after reflection, or angular (Θ_{GH}) which depends on the angular derivative of reflectivity [2,3]. Owing to the sharp phase change and reflectivity dip at the resonance angle, excitations of surface plasmons at resonance has been shown to enhance the GH shift. Our group has demonstrated that this shift can be further enhanced by focusing the incident beam to a small beam waist which renders Δ_{GH} negligible while significantly enhancing Θ_{GH} [4,5].

Fig. 1a shows sub-millimeter beam displacements at the vicinity of the SPR angle for a Au (t = 47.5 nm)/ Ti (t = 2.5 nm) film at varying sucrose concentrations. We show that the significant enhancement of GH shift makes the scheme a good potential towards sensing application. Small changes in the refractive index would induce a measurable change in GH shift as shown in Fig. 1b where dynamic GH measurements are performed to track small refractive index measurements in real-time [6]. The large GH shift measured translates to higher sensitivity as a sensor.

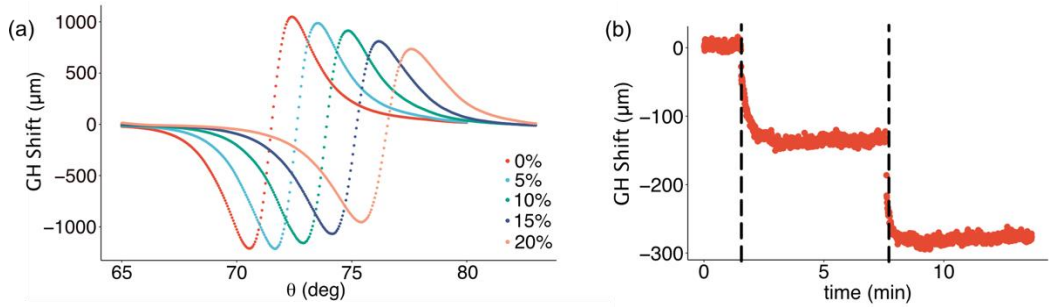

Fig. 1 ***(a) GH shift measurement for varying sucrose solutions, and (b) dynamic measurement of GH shift upon serial addition of sucrose solution. Measurements in milli-Q were used as baseline. Dashed lines indicate the injection times when sucrose solutions were added to the cuvette system.***

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A-18

METAMATERIALS AND NANOPHOTONICS OPEN UP NEW POSSIBILITIES FOR CONTROLLING LIGHT AND TERAHERTZ WAVES

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Abstract. Micro/nano processing technology is one of the important elements for achieving the academic progress and industrialization of metamaterials and nanophotonics. There are strong expectations for the establishment of micro/nano fabrication technology to produce metamaterials and nanophotonic devices that meet needs. Here, the metamaterials and nanophotonic devices, such as dielectric *Mie* scattering sphere metamaterials for visible light, micro-electromechanical-systems (MEMS)-driven silicon waveguides for optical communication systems, MEMS-driven electromagnetically induced transparency metamaterials for 6G communications, MEMS-driven ladder-type metamaterials, force sensors using gap-variable metal-insulator-metal metamaterials, and heat-shielding metamaterials, developed in my research group and their microfabrication technologies are discussed [1-6].

Acknowledgements
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A-19

RAPID IDENTIFICATION OF WAVE NUMBER FROM UNFOCUSED IMAGES BY DEEP NEURAL NETWORK

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Abstract. Plasma imaging plays a pivotal role in experimental plasma physics. Sub-microwave and microwave diagnostic techniques, such as reflectometry, offer the advantage of straightforward-identification of measured points [1]. However, achieving high resolution imaging with a limited number of antennas presents a significant challenge, necessitating the development of methods for image reconstruction from sparse measurements. In our previous work, we demonstrated the feasibility of reconstructing simple images from complex-amplitude microwave data using Tikhonov-Phillips regularization techniques [2]. However, generating videos from numerous images remains impractical due to the extended computation time required for each image reconstruction. To address this limitation, we propose a rapid image identification method using machine learning techniques. In this approach, a deep neural network is employed to extract information from image data obtained through a lens-less planar array detection system. We conducted numerical simulations to calculate the distributions of reflected microwaves across a wide range of patterns, and this extensive dataset of cutoff surface pattern-reflected microwave distribution pairs was used for training. Remarkably, we achieved the direct extraction of key features from observed data, particularly the wave number of the cutoff surface pattern. Notably, this was accomplished using a basic deep neural network with either one or two layers, each containing a relatively small number of perceptrons. Our findings suggest the potential of employing a lens-less imaging reflectometer in conjunction with deep neural networks.

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A-20

INTINS CO. LTD INTRODUCTION

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Abstract. INTINS Vietnam is a branch of INTINS Corp, a global spectroscopy company and the official distributor of Ocean Optics (formerly known as Ocean Insight). Established in 2021, INTINS Vietnam focuses on providing a wide range of optical measurement equipment.

The company leverages its expertise in developing products tailored to customer specifications, ensuring that each solution meets the unique needs of its clients. In addition to its local capabilities, INTINS Vietnam can coordinate with the headquarters of Ocean Insight in the United States to offer comprehensive solutions, including detailed application descriptions and product documentation in PDF format.

Leveraging INTINS Co. Ltd.'s experience in supplying to numerous companies, we are committed to delivering prompt and tailored solutions to meet your specific requirements. The firm collaborates closely with its headquarters in Seoul, Korea, to enhance local interactions and drive technological advancements. Our team is committed to providing cost-effective solutions and superior services that effectively address the technical needs of our valued customers, ensuring quality and satisfaction in every engagement.

The products provided by Intins include spectrometer series, wideband light sources, various fiber optic options, and diverse optical accessories. Additionally, Intins offers comprehensive optical solution systems suitable for various research and industrial applications. Lastly, Intins provides consulting services, installation, technical documentation, research and development of customized solution systems as per customer requirements, supports equipment calibration with specialized lab facilities, and after-sales services.

A-21

A REVIEW ON SPIN ROTATIONAL EXCITATIONS IN HEXAGONAL *R*MNO$_3$ (*R*=Y, RARE-EARTHS) STUDIED BY RESONANCE RAMAN SPECTROSCOPY

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Abstract. We have observed spin rotational excitations in RMnO3 (R=Y, rare-earths) below the Neel ordering temperatures through resonance Raman scattering. Figure 1 shows temperature-dependent Raman spectra of the hexagonal LuMnO3 single crystal in cross polarization scattering geometry. The broad Raman peaks near 197, 580, and 805 cm-1 get stronger at lower temperatures below the Neel ordering temperature and thus they aseem to be non-phononic in origin. Similar peaks, but at different wavenumbers were observed in singlecrystal YMnO3. These broad peaks below TN are found to be excited through the resonance with the Mn d-d transition by the incident red laser (~1.85 eV).

Along with theoretical analyses of the spin-spin interaction Hamiltonian and the Raman selection rules, we conclude that these broad peaks are due to simultaneous rotation of all three Mn spins in one Mn-trimer in hexagonal RMnO3 at the antiferromagnetic state. We could assign all the spin excitation peaks in terms of Heisenberg spin interaction, and found that the spin rotational angles are predominantly 60, 120, 180 degrees commensurate with the triangular lattice of the Mn-ion spins. Unlike usual spin-wave excitations, this spin rotational excitations are limited to one triangular unit cell, thus costing relatively high excitation energy (~ 0.1 eV).

The triangular symmetry with the antiferromagnetic ordering of the Mn-ion planes allows the rotations of the three Mn-ion spins in special angles only.[1] Thus the spin rotation angles are quantized due to the triangular symmetry of the hexagonal RMnO3. Optically pumped and optically detected spin rotational excitations confined in a triangular cell can be a good candidate for future spin logic/memory devices.

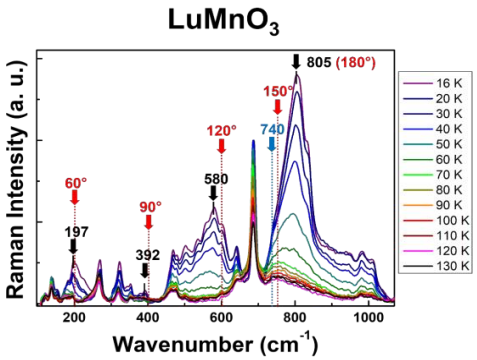

Figure 1. Spin rotational excitation peaks are observed in hexagonal LuMnO3 below TN. The angles denoted are for the spin rotations of all three Mn-ion spins in one trimer with respect to the neighboring spins.

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A-22

EMISSION LIGHTS DEPENDENCE OF EXCITATIONS AND ENERGY TRANSFER OF Eu^{3+}/ Tb^{3+} CO-DOPED OXYFLUORO-PHOSPHOSILICATE GLASS FOR RED AND GREEN LIGHT EMITTING DEVICES

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Abstract. The co-doping of terbium (Tb^{3+}) with europium (Eu^{3+}) ions in phosposilicate glasses by the addition of fluorides composition were fabricated to know their capability for photonic applications. The emission lights of glasses have been tuned under light down conversion, with excitation at 218, 377 and 394 nm. The corresponding down conversion emission spectra of dual doped glasses exhibits a wide color production spectral range (450-750 nm), mainly covering of RGB colors at 614 nm (red), 544 nm (green), and 488 nm (blue). To determine the influence of surrounding Eu3+ ions in color tuning of co-activated glasses, the asymmetric ratio was evaluated from the integrated intensities of the red ($^5D_0 \rightarrow {}^7F_2$) and orange ($^5D_0 \rightarrow {}^7F_1$) emission bands of Eu^{3+}. Under the stimulation of 218 nm wavelength, the area of the integrated intensity under the green (Tb^{3+}: 544 nm) band reaches a maximum of 71%, while it falls under the red (Eu^{3+}: 614 nm) peak at about 29%. Dexter and Reisfeld's energy transfer mechanism proved a decrease in Eu^{3+} emission and its decay times as well as a rise in Tb^{3+} emission through multipolar interactions in the present dual doped glasses. The CIE color coordinates under light excitations reveal the vital performance of Tb^{3+} with Eu^{3+} concentration in spectral tuning from the red to green region, especially the color purity, relative color temperatures, and color coordinates, were also discussed and compared to distinguish the potentiality of the present dual doped glasses for use in both red and green light emitting devices.

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A-23

ELECTROMAGNETICALLY INDUCED GRATING IN A THREE-LEVEL V-TYPE ATOMIC MEDIUM VIA AMPLITUDE AND PHASE MODULATIONS

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Abstract. Electromagnetically Induced Grating (EIG) is formed when a traveling wave field of a strong coupling field is replaced by a standing wave field to create diffractions in the propagation direction [1-2]. This diffraction causes a weak probe field to modulate periodically in space due to the change in the absorption and dispersion properties of the medium [3]. Based on amplitude or phase modulation of transmission function, the absorption grating or the phase grating can be formed, respectively. The tunable periodic structure itself will have more applications than traditional gratings. Therefore, theoretical and experimental studies of EIG have attracted great attentions due to its potential applications in many fields, such as atoms velocimetry, realizing optical bistability, all-optical switching and routing, light storage, beam splitting and fanning, shaping a biphoton spectrum, and modern photonic devices [4-6].
In this work, based on controllable absorption and dispersion properties of a three-level V-type atomic system, we study the control of the absorption grating and the phase grating with respect to the intensity and the frequency of the laser fields. The absorption diffraction pattern at the two-photon resonance is obtained, while the phase diffraction pattern appears when there is a frequency shift of either the coupling frequency or the probe frequency compared to the corresponding atomic resonance frequency. By adjusting the coupling or/and probe laser frequency, the absorption grating can be converted into the phase grating and the high-order diffraction efficiency can also be improved.

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A-24

DIRECT LIGHT PATTERNING OF METALLIC NANOSTRUCTURES AND DEMONSTRATION OF ITS NONLINEAR OPTICAL EFFECT

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Abstract: We demonstrate a simple and cost-effective technique, namely one-photon absorption based direct laser writing (DLW), for direct fabrication of desired gold nanostructures (NSs) and nanoparticles (NPs) and investigate their nonlinear optical properties. Au NSs or NPs can be patterned in air or in polymeric medium, depending on the application target. The fabrication technique relies on the optically induced local thermal effect [1,2] at the focusing spot of a DLW system using a continuous-wave laser at 532 nm-wavelength. First, using a high laser power, it induces the evaporation of the Au thin film in air and thereby creating air nanoholes (NHs). By controlling the exposure doses, including laser powers and writing velocities, Au NHs with small sizes around 300 nm and a periodicity of 500 nm were successfully demonstrated [1]. Moreover, due to the non-uniform heat transfer in an imperfectly flat Au film, the formed NHs show roughness and asymmetry, resulting in strong second-harmonic generation (SHG) signal [3]. Second, by focusing a laser with only a few milliwatts to a hybrid metal complex/photoresist material, we achieve a direct creation of Au NPs inside a polymerized SU-8 resist. The Au NP size is in the range of 10–50 nm and the density is about 100 NPs per polymerized SU-8 resist voxel. By moving the focusing laser beam, various polymeric structures containing Au NPs are patterned on demand, with the smallest feature size of about 500 nm. Thanks to the nonlinear properties of the as-formed Au NPs, the hybrid structure also exhibits a strong SHG signal when excited by a pulsed infrared laser [4]. In both cases, Au NSs in air or Au NPs in polymeric structures, it is demonstrated that SHG is strong, thanks to the plasmonic effect of Au NSs and NPs and their coupling, which strongly enhances the fundamental light intensity. We then explored their nonlinear responses for applications in optical data storage and nonlinear imaging.

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A-25

CHARACTERISATION OF PHOTONIC MATERIALS USING XAFS AT PHOTON FACTORY

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Abstract. Institute of Materials Structure Science (IMSS) belongs to High Energy Accelerator Research Organization (KEK) located in Tsukuba, Japan. IMSS operates two synchrotron rings, Photon Factory (PF) and Photon Factory Advanced Ring (PF-AR). PF is operated with the beam energy of 2.5 GeV. PF-AR with 6.5 or 5.0 GeV provides higher energy regions. There are 6 x-ray absorption fine structure (XAFS) beamlines: 9A, 9C, 12C, 15A1, NW2A and NW10A out of about 50 beamlines.

XAFS is one of the most popular methods at synchrotrons and is applied to study a wide variety of materials such as catalysts, batteries, magnetic materials, functional oxides, semiconductors, minerals and environmental samples. XAFS is usually divided into characteristic two regions, x-ray absorption near edge structure (XANES) and extended x-ray absorption fine structure (EXAFS). XANES is the region of the spectrum from just below the absorption edge to ~50-70 eV above the edge and is used to study chemical/valence states. EXAFS includes the higher energy region above XANES and analysed to investigate local structures such as bond lengths and coordination numbers.

We would like to share a couple of XAFS studies performed at our facility. One topic is Ce doped CaF_2. This is a laser material fabricated long before, but the dopant properties were unveiled. We performed XAFS experiments revealing that Ce dopants were characterised as its Ce(III) state and substituted for the Ca site [1]. In addition, I would suggest potential topics to be studied further. We definitely welcome you to perform joint research projects.

Keywords. Synchrotron Radiation, X-ray Absorption Spectroscopy, Chemical State, Local Structure, Bond Length

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A-26

MATERIAL SCIENCE ON THE IBR-2 REACTOR

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A-27

NEAR-INFRARED PLASMONIC METASURFACES FOR BIOIMAGING AND BIOSENSING: SIMULATION AND FABRICATION

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Abstract. In this work we review a part of the achieved results on the design, simulation, and fabrication of plasmonic metasurfaces toward the realization of the fluorescent bioimaging and refractive index biosensing devices. The plasmonic metasurfaces working in the near-infrared region are formed by stacking up the silver (Ag) subwavelength pillar/disk arrays combined with Ag films on the glass substrate. The devices were calibrated with various structural parameters, which were fabricated using the 3D direct laser writing method and sputtering technique and their characteristics were analyzed with a finite-difference time-domain (FDTD) method. Thus making plasmonic metasurfaces the impressive approach for near-infrared fluorescent bioimaging and refractive index biosensing devices.

Keywords. *Plasmonic metasurfaces, surface plasmon resonances, array directivity, near-infrared fluorescent bioimaging and biosensing devices.*

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A-28

LENSLESS FOURIER HOLOGRAPHIC FIBER BUNDLE ENDOSCOPE FOR REFLECTANCE IMAGING OF UNSTAINED TISSUES

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Abstract. We have developed a lensless Fourier holographic endoscopy system, a fully flexible, ultrathin fiber endoscope capable of capturing 3D holographic images of unstained tissues with sub-micron spatial resolution. Using a bare fiber bundle with a diameter as thin as 200 μm, we have designed a lensless Fourier holographic imaging configuration that selectively detects weak reflections from biological tissues, enabling label-free endoscopic reflectance imaging. We developed a unique wave correlation algorithm for calibration-free holographic image reconstruction, which allows imaging through narrow and curved passages, regardless of fiber bending. Furthermore, our model-driven optimization algorithm, designed to retrieve object functions based on the light propagation model, expands the working depths and field of view beyond what is achievable with the wave correlation algorithm. We demonstrate endoscopic reflectance imaging of unstained rat intestine tissues that are completely invisible to conventional endoscopes.

A-29

ZERO-POINT VIBRATIONS OF SOLID HYDROGEN STUDIED BY STATISTICAL MOMENT METHOD

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Abstract. Zero-point vibrations of solid hydrogen are investigated by analyzing the molecular mean-squared displacement (MSD) and mean-squared relative displacement corresponding to extended X-ray absorption fine structure (EXAFS) Debye-Waller factor within the statistical moment method (SMM) approach in statistical mechanics. Numerical computations of these thermodynamic properties were conducted for solid hydrogen from 0 K to its phase transition temperature using the Wigner-Kirkwood mean-field potential derived from the Buckingham exp-6 potential. We have shown that the quantum-mechanical zero-point vibrations play an important role at low temperature. And these thermodynamic quantities increase with temperature, suggesting that both thermal and quantum effects play a significant role near the liquid-solid phase transition. The favorable consistency between our findings and the recent experimental inelastic neutron scattering measurements of MSD attests to the potential of SMM as a novel approach for determining the atomic vibrations of solid hydrogen. This approach allows us to study these effects including the anharmonicity of lattice vibrations.

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A-30

EXPLOITING MULTIPLE SCATTERING FOR DEEP-TISSUE IMAGING AND ALL-OPTICAL MACHINE LEARNING

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Abstract. Over the past decade, my group has developed deep-tissue optical imaging methods to achieve imaging depths beyond the conventional limit. Specifically, we have proposed experimental systems that measure the reflection matrix of the scattering medium to quantify the input-output response across all possible degrees of freedom1. Unique theoretical frameworks and image reconstruction algorithms have been developed to solve the inverse scattering problem by exploiting multiple scattering within the measured reflection matrix2,3. In this talk, I will introduce our recent noteworthy breakthroughs, including a method to track multiple light scattering trajectories within the scattering medium4 and the experimental demonstration of *in vivo* through-skull imaging of a mouse brain5,6. I will also introduce ways to exploit multiple scattering in a nonlinear scattering medium for all-optical machine learning7. All these developments will serve as essential tools for biology, medicine, and photonics.

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SESSION B

OPTICS AND SPECTROSCOPY

B-01

BLUE LASER APPLICATION FOR WHITE LIGHT CONVERSION

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Abstract. LED is well developed technology for many applications for luminaire, automotive illumination and even marine signal. However, LED has limitation of etendue which drive the development of new technology for etendue squeezing optics. The blue laser with white light conversion can provide a solution for this limitation. We can minimize volume of optics while we maintain etendue of optical system. In this reason, white light conversed with blue laser illuminators, due to their high intensity, low power consumption, compact size, and lightweight design, can be applied to the narrow beam lighting or illumination. In this paper, we have studied about optical performance of phosphor plate focused on blue laser for white light illumination. Phosphor In Glass (PIG) and Phosphor Ceramic (PC) has been tested for high optical efficiency, color stability, luminous flux with respect to radiometric power density by varying beam diameter. We also have demonstrated used case of such a light source for anti-bio fouling, drone lighting, and automotive headlamp (1,2). In optical design of these cases, we simplified laser phosphorescence model for realizing white light by using focused Gaussian cross-sectional beam. We simulated various cases in the relative position of PC/PIG and focused LD beam, and finally found the optimized beam position through Monte-Carlo simulation. Thes blue laser applications were highly effective in terms of brightness over mechanical weight and illuminated field up to twice as far as LED lighting, providing excellent visibility.

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B-02

ALL-OPTICAL MAGNETIZATION SWITCHING IN $NiCo_2O_4$ THIN FILMS

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Abstract. Ultrafast magnetization switching by pulsed lasers has been actively studied due to its potential for next-generation magnetic recording devices. A phenomenon where magnetization is switched by laser irradiation without applying a magnetic field is called all-optical switching (AOS). We are searching for AOS in oxide thin films to realize future device applications. By performing magneto-optical Kerr effect (MOKE) microscopy measurements of laser-irradiated magnetic domains, we revealed both helicity-dependent and -independent AOS in $NiCo_2O_4$ thin films with a property of perpendicular magnetic anisotropy [1-3]. Here, the sample was irradiated with linearly horizontal ultrafast laser pulses generated by Yb: KGW laser PHAROS (1030 nm, 1 kHz, pulse width ~200 fs). Figure 1 presents the schematics of the laser-pulse-accumulation effect of laser-induced magnetization switching in the $NiCo_2O_4$ thin film. AOS emerged at the perimeter of the laser spot after irradiating 10^3 - 10^5 pulses. Furthermore, the AOS area increased by accumulating laser pulses.

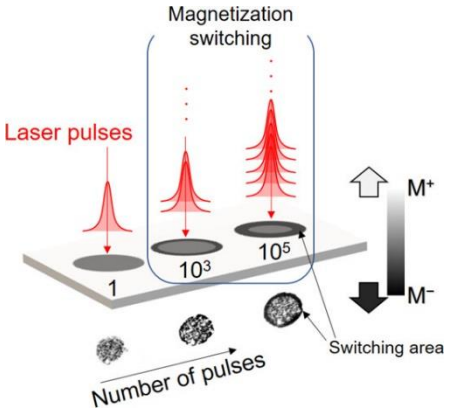

Fig. 1: Schematics of the laser-induced magnetization switching in the $NiCo_2O_4$ thin film.

Recently, we succeeded in building a low-cost and portable MOKE microscope device using a 3D printer [4]. This device costs approximately 20,000 yen, much cheaper than standard commercial ones.

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B-03

PRE-CALIBRATION OF PHASE ERRORS IN PROGRAMMABLE PHOTONIC INTEGRATED CIRCUITS

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Abstract. Photonic integrated circuits (PICs) are pivotal platform technologies in advanced applications such as optical communication, sensing, metrology, and information processing [1-2]. Traditionally, PICs are application-specific, which leads to lengthy and costly R&D cycles. The emergence of programmable PICs [3], inspired by the reconfigurability of FPGAs and CPLDs, offers a flexible alternative by allowing lightwave circuits to be dynamically defined and programmed by software. Fundamental to these programmable PICs are tunable 2×2 beam splitters, typically realized through either a variable directional coupler or a tunable Mach-Zehnder Interferometer (MZI) by configuring the waveguide phases in alignment with the PIC's intended function. However, due to inevitable manufacturing imperfections, phase pre-calibration of each splitter is imperative before the programmable PIC operates. This talk presents several approaches to pre-calibrate waveguide meshes in programmable PICs, including a progressive phase calibration algorithm for reconfigurable universal meshes and the use of embedded local waveguide monitors for non-universal meshes. We introduce two non-invasive waveguide monitoring techniques: an AC-coupled Wheatstone-bridge circuit [4] for sensing power splitting ratios and a microelectromechanical-system optical probe combined with image analysis [5] for dynamic phase error diagnosis.

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B-04

ULTRASENSITIVE DETECTION OF ORGANIC DYES USING SURFACE-ENHANCED RAMAN SCATTERING ON AU - AG HYBRID MATERIAL

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Abstract. Organic pigment pollution has become a threat to aquatic ecosystems. Developing the dyeing industry leads to a large amount of industrial waste containing toxic pigments such as rhodamine B (RhB), crystal violet (CV), methyl orange (MO), etc., which directly affect the environment and human health. Solutions for testing minimal concentrations of these substances in the aquatic environment have still not completely met the requirements of convenience, response time, and cost. Surface-enhanced Raman scattering (SERS) is one of the methods attracting much attention from researchers around the world. In this study, Au - Ag hybrid material was used as a substrate to enhance Raman signals in SERS. The chemical reduction method was chosen as an optimal solution for synthesizing Au - Ag materials thanks to its advantages in sample volume, time, and cost. The spherical Au - Ag with a size of about 40 nm was coated on a glass substrate by the self-assembled monolayer method and showed high effectiveness in enhancing the Raman signal of organic dyes, specifically RhB and CV. Besides, the FDTD simulation results show that the interaction between nanoparticles on the glass substrate contributes to explaining and proving the effectiveness of the Au - Ag material in enhancing Raman signals. In addition, testing on real water samples to evaluate the level of interference of impurities in water to the signal of the analyte is also an important factor. Han River water samples were measured with single and mixed analytes to help determine interference and the ability to distinguish their signals. Regarding peak intensity, a large decrease was observed for the sample tested in Han River water compared to the sample in DI water. Compared to samples analyzed with a single dye, mixed dye samples showed drop tendencies not only in the typical peak intensity but also in the number of peaks. The intensity of the peaks is estimated to decrease by over 50% at the characteristic peaks of MO, CV, and rhB corresponding to the wave numbers 1197, 1619, and 1648 cm^{-1}. These results lay the foundation for the development of SERS technology not only in the environmental field but also in many other fields such as food and health.

B-05

STUDY OF HIGH HARMONIC GENERATION IN ARGON-NEON GAS MIXTURES

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Abstract. High Harmonic Generation (HHG) is a highly nonlinear optical process that produces coherent extreme ultraviolet (XUV) pulses on ultrashort time scales [1, 2]. The high-order harmonics, emitted as a series of attosecond bursts with excellent spatial and temporal coherence, are particularly valuable for probing electron dynamics on an attosecond time scale [3] and for coherent diffractive imaging [4]. To achieve high-intensity harmonic radiation, it is essential to consider the effects of propagation and phase matching conditions between the harmonic field and the fundamental field within a macroscopic medium [5, 6]. This study explores how the phase matching condition in the HHG process varies when using an argon-neon gas mixture. Phase-matched HHG is produced near the absorption edge of argon gas, with neon gas added to the argon. The study also studies how the intensity of the harmonics generated by this gas mixture depends on pressure. The findings show that as more neon gas is added, the phase matching for higher-order harmonics becomes less favorable compared to lower-order harmonics. In addition, the total phase mismatch at different gas mixture pressures is investigated. The experimental results align with theoretical calculations.

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B-06

IMPACT OF ANNEALING TIME ON THE PROPERTIES OF SM_2O_3-DOPED BOROTELLURITE GLASSES FOR PHOTONIC APPLICATIONS

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Abstract. This study presents the effects of annealing time on the physical, structural, optical, and luminescence properties of Sm^{3+}-doped ZnO-BaO-B_2O_3-TeO_2 borotellurite glasses prepared using the melt-quenching technique [1-5]. The glasses were annealed at 350 °C for varying durations of 2, 4, 6, 8, and 10 hrs. The investigation revealed that density and refractive index decreased with increasing annealing time up to 8 hrs but increased after 10 hrs, inversely correlating with molar volume. Structural analysis using X-ray diffraction confirmed an amorphous phase, while FTIR spectroscopy identified characteristic vibrations of TeO_4, BO_4, and BO_3 units, which diminished with longer annealing times. Optical properties, assessed via UV-Vis-NIR absorption spectroscopy, displayed transitions from the ground state $^6H_{5/2}$ to various excited states. Luminescence studies indicated that the sample annealed for 8 hrs exhibited the highest luminescence [6], emitting orange light. Chromaticity coordinates were determined using the CIE 1931 color space. The shortest luminescence decay time was 0.863 ms for the 10 hrs annealed sample, while the longest was 0.873 ms for the 6 hrs sample. These findings elucidate the impact of annealing time on the material properties of Sm^{3+}-doped borotellurite glasses, underscoring their potential for photonic applications.

Keywords: Borotellurite, Sm^{3+} ion, Annealing times, Luminescence

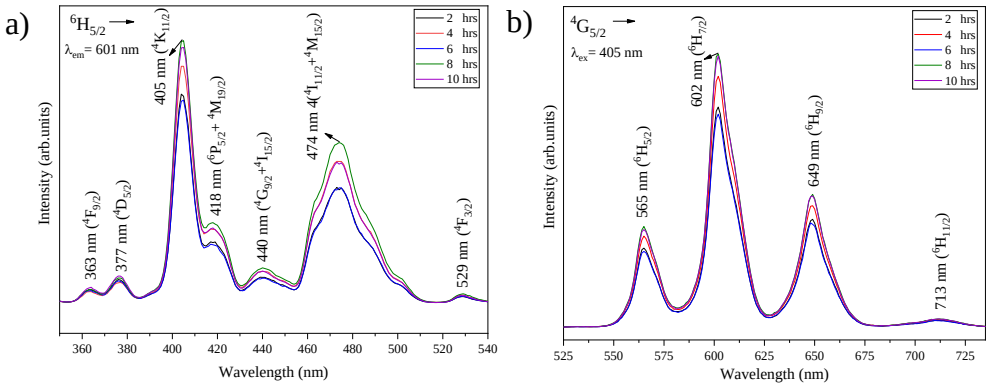

Figure 1. Luminescence properties, where a) the excitation spectra, and b) the emission spectrum.

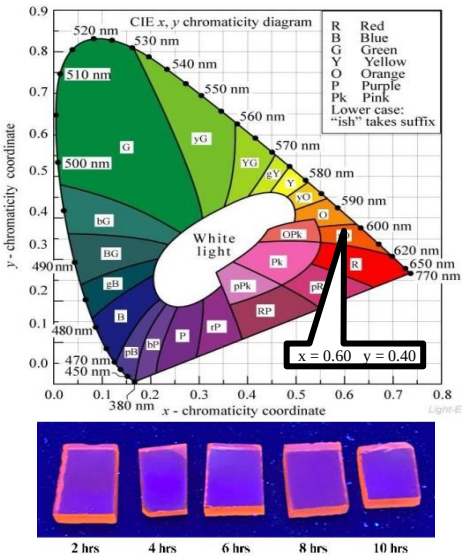

Figure 2. CIE 1931 Standard Colorimetric Diagram indicating the Color Coordinates of Light Emitted from Sm^{3+} ions Doped Glass.

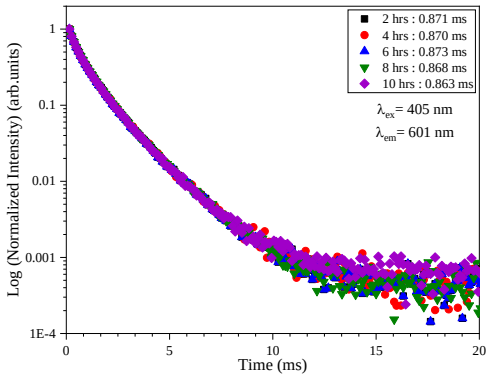

Figure 3. The decay time curves of Sm^{3+}-doped ZnO-BaO-B_2O_3-TeO_2 glass sample.

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B-07

DEVELOPMENT OF MELT GROWTH METHOD FOR B-GA_2O_3 SINGLE CRYSTALS UNDER PRECIOUS METAL CRUCIBLE FREE CONDITION

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Abstract: Compared with conventional wide bandgap materials, such as SiC or GaN, β-Ga_2O_3 is expected to help realize energy-saving power devices with higher performance thanks to its wider bandgap (4.5–4.9 eV). The development of β-Ga_2O_3-based Schottky barrier diodes and field-effect transistors for power electronics is progressing rapidly. Similar to Si, β-Ga_2O_3 can be grown from the melt. Thus, β-Ga_2O_3 is expected to have comparable low-cost and high-quality properties. However, the most widely used growth method for bulk oxide single crystals currently requires the use of precious metal crucibles. For high-melting-point oxides, the use of expensive iridium crucibles is a bottleneck, resulting in high production costs for single-crystal substrates. Technoeconomic modelling results published in 2019 showed that the cost of iridium (Ir: used as crucible material) is the main factor determining the total cost of Ga_2O_3 wafers [1]. Since the publication of this analysis, the price of Ir has more than tripled. Therefore, Reese et al [1] suggest that technological innovations, such as the development of alternative crucible materials that can significantly reduce the cost of gallium oxide substrates, will facilitate the widespread use Ga_2O_3 semiconductor devices.

In this study, we report on the growth of β-Ga_2O_3 bulk crystals (Fig. 1) based on crystal pulling from melt using a cold container without the use of a precious metal crucible. Our new approach is a fusion between the skull-melting [2-5] and Czochralski (CZ) methods and is named the oxide crystal growth from cold crucible (OCCC) method [6]. The results have the potential to meet the requirements suggested by Reese et al. [1]. Furthermore, Ce: GAGG**Error! Reference source not found.**, Ce: La-GPS and $LiTaO_3$.were also grown by this method. The first two crystals showed scintillation properties comparable to crystals grown from Ir crucibles using the CZ method.

These R&D were carried out jointly with C&A Corp., an academic start-up and spin-off star-up FOX Corporation. " In the talk, as an introduction of the situation surrounding university-launched start-ups in Japan, the business models of our laboratory's start-ups will be mentioned.

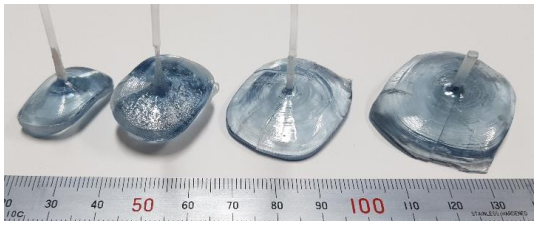

Fig.1.β-Ga_2O_3 crystals grown by OCCC method.

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B-08

LIGHT SCATTERING DEPOLARIZATION FOR MEASUREMENT OF TURBIDITY

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Abstract. The suspended insoluble particles reduce the transmitted light by scattering. The measurement of turbidity is a key optical technique to characterize the concentration or size of suspended particles. The turbidimetry and nephelometry are two complementary ways of measuring turbidity, each of which has its own limitation. Here, the light scattering depolarization ratio (DR) is suggested as another alternative measure of turbidity overcoming the limits of both the turbidimetry and nephelometry. The DR shows almost linear dependence on the scattering extinction for high concentration up to 4 OD (optical density), while exploiting the advantage of the high signal-to-noise ratio of the scattered light intensity for low concentration. The advantages and limitations of this new measure of turbidity will be discussed in this presentation.

B-09

STUDY ON THE ENCHANCED PERFORMANCE OF INFRARED PHOTODETECTOR BASED ON HYBRID STRUCTURE BETWEEN REDUCED GRAPHENE OXIDE AND LEAD SULFIDE NANOPARTICLES

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Abstract. The infrared photodetectors based on the hybrid structure between lead (II) sulfide nanoparticles (PbS NPs) and reduced graphene oxide (rGO) are studied. In this structure, PbS NPs work as an "antenna" for absorbing infrared light to generate electron-hole pairs, while rGO acts as a transport layer to drive carrier charge toward the electrodes for enhancement the photocurrent. The PbS NPs/rGO hybrid photodetector demonstrates exceptional capability in detecting IR light with the wavelength of 980 nm. The maximum responsivity is calculated with the value of 10^{-5} A/W at a power of 50 mW and biased at 5 V. More interestingly, the photodetectors are developed on a patterened PDMS substrate that provides both flexibility and transparency for optical applications, as well as improving the light absorption of the devices. The mechanical stability and durability of the IR sensor are evaluated, indicating the stable detecting capacity of the device under stretching conditions. Furthermore, sensing mechanism is clearly clarified to deeply understand this report. We do believe that our development is high potential for wearable and stretchable IR sensors used for human-machine interfacing.

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B-10

EXPANDING LASER APPLICATIONS IN INTERDISCIPLINARY FIELDS: FROM CULTURAL HERITAGE ANALYSIS TO AGRICULTURAL PRODUCT PROTECTION

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Abstract. Lasers, being coherent light sources, already play a crucial role in various fields such as science, medicine, communications, and industry, utilizing their characteristics for high-precision optical devices, optical communication, and laser processing. With the development of new laser sources and control methods, further advancements are anticipated. Our group is engaged in laser system applications, including cultural heritage analysis through spectroscopic techniques, and agricultural applications such as developing technologies for pest and weed control using semiconductor blue lasers. In this presentation, we will review the resent achievement on these studies.

Among cultural heritage artifacts, ceramics are particularly well-suited for laser imaging spectroscopy. Specifically, by measuring ceramics using spectrally resolved imaging in infrared and ultraviolet wavelengths, spatially resolved X-ray absorption spectroscopy, and fluorescence imaging, it becomes possible to elucidate mechanisms such as the coloration process of glazes or to identify cultural artifacts with unknown provenance based on their characteristics. Figure 1 shows an example of multispectral imaging spectroscopy, illustrating how the strength of laser imaging spectroscopy lies in its ability to make "the unseen visible" by selecting appropriate wavelength conditions. The figure clearly shows that the presence or absence of impurities in the glaze is clarified through the processing of ultraviolet images.

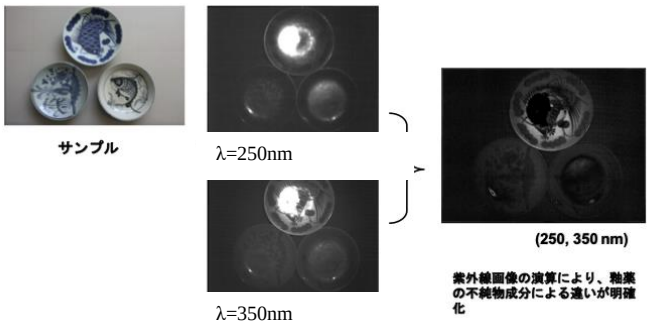

Figure 1. Example of Multispectral Imaging Spectroscopy Analysis of Ceramics

On the other hand, in agricultural applications, traditional pest control has relied on chemical pesticides. However, in recent years, pests have developed resistance to these chemicals, diminishing their effectiveness. Out of the global agricultural production value of 165 trillion yen, 26 trillion yen is lost due to damage caused by pests and harmful animals. In response, a new pest control method using laser light is gaining attention. This method has successfully targeted the cotton bollworm moth by tracking its flight position using image detection technology and shooting it down with a blue semiconductor laser. It is expected to effectively eliminate pesticide-resistant pests without the use of chemicals, thus having no environmental impact.

B-11

FLUORESCENCE CHARACTERISTIC OF ANTHOCYANIN IN PURPLE SWEET POTATO USING PHOTOLUMINESCENCE TECHNOLOGY

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Abstract. Anthocyanins are compounds with high antioxidant properties, giving colors that range from red to purple [1]. They are found in foods with purple hues or flowers that are red. This study focuses on the presence of anthocyanins in purple sweet potatoes. Purple sweet potatoes contain a significant amount of anthocyanins, mostly concentrated near the skin. The concentration decreases as you move toward the center of the potato. The research employed an extraction method using hydrochloric acid, ethanol, and ethyl acetate. For measurement and analysis, a photoluminescence (PL) spectrometer with time-resolved capability was used, with excitation at 375 nm [2]. Fluorescence spectral studies were carried out to determine the existing of fluorescent anthocyanin in water extract of purple sweet potato [3]. The anthocyanin extract clearly displayed intense excitation-dependent fluorescent emission. The presence of different fluorescent anthocyanin structures in our sample and common regions of excitation of different species is the reason for excitation-dependent fluorescent emission and the overlapping of fluorescence spectra [4]. The results show a direct correlation between the increasing of pH, first, with a shift of excitation wavelengths to higher values, and, second, with an increment of the fluorescence intensity with a concomitant bathochromic effect for emission wavelength maxima, which may be related with the presence of the neutral and anionic quinoidal bases present in solution at higher pH values. Anthocyanin fluorescence lifetime is sensitive to pH. Anthocyanin fluorescence lifetime tends to become shorter at lower pH, with the shortest value at pH 4.5 [5].

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B-12

SIMULATIONS OF RELATIVISTIC QUANTUM EFFECTS WITH BINARY WAVEGUIDE ARRAYS

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Abstract. Binary waveguide arrays (BWAs) – a special class of waveguide arrays created by periodically arranging two different types of waveguides – are a wonderful photonic system to simulate basic relativistic quantum effects described by the Dirac equation.
In this talk we present the results of simulations of several fundamental relativistic quantum effects with the help of BWAs [1]. These effects include Zitterbewegung (or trembling motion of free electrons) [2], Dirac solitons [3], the electron–positron pair production and annihilation under the action of the external electric field [4-6], topological Jackiw-Rebbi states [7-10], Klein tunneling [11-12] and the Sauter effect [13] which is the inhibition of the Klein tunneling when fermions go through a transition region with finite width in the potential fields. We also discuss the so-called beyond-band discrete solitons [14] which are a completely new class of discrete solitons discovered just recently by our group.

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B-13

SYNTHESIS OF SILVER NANODECAHEDRA FOR DETECTING CYPERMETHRIN BY USING SURFACE- ENHANCED RAMAN SCATTERING TECHNIQUE

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Abstract. Pesticides play an important role in contemporary agricultural practices. The detection of pesticides is an essential step in monitoring and assessing pesticide concentrations within the ecosystem. Cypermethrin is one of the most commonly used household broad-spectrum insecticides. Surface-enhanced Raman scattering (SERS) is known as a potential technique for non-destructive detection and quantitative analysis. In this report, silver nanodecahedra was synthesized under blue light-emitting diode (LED) irradiation of silver seed, which was prepared by the chemical reduction route. The SERS method based on AgND surface has been implemented to detect cypermethrin. The SERS performance of AgND was studied on a range of concentrations of cypermethrin from 20 ÷ 184 ppm. This is an acceptable initial result for the further investigation of pesticide detection.

B-14

NEW RAMAN LASERS: EFFICIENCY INCREASE AND LASER THRESHOLD REDUCTION

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Abstract. It is known that since the creation of high-power lasers, it has become possible to expand the spectral range (from UV to IR) of coherent radiation sources using nonlinear optical frequency converters - harmonic generators and lasers based on stimulated Raman scattering (SRS, Raman lasers). Raman lasers discovered an unlimited number of coherent sources based on a set of frequency shifts in different media, as well as new possibilities for nonlinear SRS spectroscopy. However, the optical breakdown in the sample limited the generation of Raman laser. Therefore, the main aim of this report is presentation of our results on searching new media and methods to increase the efficiency of Raman lasers and reduce the SRS threshold. Recently [1] we have discovered a new phenomenon in Raman lasers - stimulated low-frequency Raman scattering (SLFRS) on acoustic modes of nano- and submicron particles in suspensions and photonic crystals. It is significant that the size variations of nanoparticles provide a tunable GHz shift of the Stokes component of SRS. The tunable shift is extremely important for resonant biharmonic effects, for example, on nanosized viruses, in order to suppress their activity. For the first time to our knowledge, we have measured [2] the natural frequencies of viruses in the GHz range using SLFRS at the GHz oscillations of viruses. Note that in these new nonlinear optical media, a record (up to 70 %) SRS efficiency was achieved. On the other hand, using Bessel beams, we have obtained SRS efficiency of about 30 % and the divergence of SRS radiation less than 1 mrad in ordinary water. Also, the efficiency of the pumping Nd^{3+}:YAG laser has been increased by 200 % (2-fold) with a 3-fold reduction in the lasing threshold when high-frequency power is supplied to its flash lamp. An important result is also a record (up to 30 times) reduction in the threshold of new Raman laser on water [3] when the pumping beam is focused at the water surface. Of particular interest is recently discovered [4] by us optical breakdown in water by picosecond pulses with 20 times lower energy (~ 2 mJ) instead of 40 mJ to achieve the breakdown threshold (40 TW/cm^2) at the lens focus. In this case, the generation of a shock wave forms a fountain of drops towards the pump pulse with the suppression of the Stokes component in backward SRS. The intriguing reduction in the pulse energy for breakdown is undoubtedly of interest for ensuring the “fast ignition” mode in laser thermonuclear fusion experiments. These results have been obtained as a part of joint Belarusian-Russian research under the project F23RNF-040 of the Belarusian Republican Foundation for Fundamental Research and the grant No. 23-42-10019 of the Russian Science Foundation.

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B-15

GROWTH OF LARGE $CSLIB_6O_{10}$ CRYSTALS FOR DUV LIGHT SOURCE APPLICATION

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Abstract. $CsLiB_6O_{10}$ (CLBO) is one of the nonlinear optical crystals suitable for the generation of deep-ultraviolet (DUV) output at wavelengths below 300 nm. For the next generation of advanced laser processing applications, the output degradation that occurs within the crystal is a critical issue related to power scaling and long-term operation. In this research, we developed large CLBO crystals for fabricating large aperture frequency converters.

CLBO crystals were grown through the Kyropoulos method using a resistance heating furnace and a platinum crucible with a diameter of 200 mm and a height of 185 mm. Cs_2CO_3, Li_2CO_3, and H_3BO_3 powders were used to synthesize the raw material with a Li-poor self-flux composition [1]. A transparent CLBO crystal with a weight of 1020 g was successfully grown for a period of 23 days. The weight is about three times heavier than that of conventional crystal. After tuning the temperature distribution in the crucible, a transparent CLBO crystal with a weight of 1519.3 g was also grown for a period of 27 days. A 15 mm-long CLBO was cut along the phase-matching direction for type-1 second harmonic generation of 532 nm laser light.

We also developed a picosecond pulsed 1064 nm laser source with an average power of 261 W, a repetition rate of 1 MHz, and a pulse duration of 14 ps, using a gain-switched DFB laser diode as a seed laser and a 914 nm laser-diode-pumped Nd-doped YVO_4 power amplifier. Using a LiB_3O_5 (LBO) crystal with 241 W at 1064 nm, we obtained 165 W at 532 nm with a conversion efficiency of 68%. Then we launched a 164 W 532 nm pulse into a CLBO crystal, obtaining an average power of 53 W at 266 nm with a conversion efficiency of 32% [2].

This work was supported by NEDO project “Research and Development of Next Generation Laser Processing Technology” (P16011) and ‘‘Research and Development Project of the Enhanced Infrastructures for Post 5G Information and Communication Systems” (JPNP20017). This work was also supported by JSPS Kakenhi JP22H01993.

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B-16

DESIGN AND FABRICATION OF SEMICONDUCTOR TERAHERTZ PHOTOCONDUCTIVE ANTENNA AND SPINTRONIC TERAHERTZ EMITTER DEVICES AT THE NATIONAL INSTITUTE OF PHYSICS UNIVERSITY OF THE PHILIPPINES

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Abstract. The most recent results of the research activities of the Condensed Matter Physics Laboratory (CMPL), National Institute of Physics at the University of the Philippines are presented. We work on the design and fabrication of photoconductive antenna (PCA) devices from GaAs-based films grown by molecular beam epitaxy (MBE). These PCA devices comprise the terahertz (THz) emitters and detectors in THz time-domain spectroscopy systems. Novel techniques for enhancing the performance characteristics of THz PCA's by utilizing THz plasmonic metal structures are also demonstrated. Improved THz emission from a THz PCA is shown, as well, achieved by embedding metal nanoparticles in the PCA photo conducting gap, due to increased plasmonics-enhanced photocarrier generation during ultrafast optical excitation. Very recently, we have successfully fabricated PCA devices from MBE low temperature-grown InGaAs films that are lattice-matched to InP substrate. These THz devices are used for telecom-wavelength (1.55um) laser excitation. In addition to novel THz PCA designs, we also work on spintronic THz emitters based on ferromagnetic/nonmagnetic metal heterostructure. Our interests include the optimization of the spintronic THz emission and the study of spin electron dynamics. The CMPL engages in and promotes collaborative research; both locally and internationally. We have active and productive linkages with the academic and research institutions in Japan, Vietnam, Taiwan, and Korea. It is hoped that this presentation will introduce our research field of interest to possible collaborators who are also working on the same area.

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B-17

RARE-EARTH DOPED $NaYF_4$ MATERIALS AND APPLICATIONS

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Abstract. Rare-earth-doped $NaYF_4$ powders are considered crucial up-conversion luminescent materials with many applications, including anti-counterfeiting printing, biological imaging, and optical information storage, etc [1-3]. In this work, $NaYF_4$ powders doped with different rare earth pairs were prepared by the hydrothermal method and their structural and optical properties were also investigated. The results indicate that the reaction temperature and time impact significantly on the morphology and luminescent intensity of the powders. These powders exhibit potential applications in anti-counterfeiting ink and bio-imaging.

Keywords. Rare earth doped $NaYF_4$ up-conversion, hydrothermal, energy transfer.

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B-18

STUDY ON THE INFLUENCE OF pH AND ANNEALING TIME ON THE STRUCTURE AND SIZE OF $CoAl_2O_4$ NANOCRYSTALS, APPLIED IN DIGITAL COLOR PRINTING

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Abstract. $CoAl_2O_4$ nanocrystals (NC) with a spinel structure have been successfully synthesized using the sol-gel method combined with solid-phase reaction. Differential Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TG) were used to determine the optimal temperature in the synthesis process of $CoAl_2O_4$ NCs. The effects of gel pH and annealing time on the structure and crystal size of $CoAl_2O_4$ NCs were studied in detail. The $CoAl_2O_4$ NCs exhibit color variations from blue to green and demonstrate high stability against light and harsh weather conditions, making them promising candidates in the field of digital color printing.

Keywords: Sol-Gel, $CoAl_2O_4$, structure, color printing, digital.

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B-19

DEVELOPMENT OF A RADIATION IMAGING DETECTOR USING AN OXIDE SINGLE-CRYSTAL SCINTILLATORS

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Abstract. The science and technology of detecting and imaging ionizing radiation, including X-rays, gamma-rays, alpha-rays, beta-rays, neutrons, molecules, and ions, play a pivotal role across a wide array of disciplines, spanning particle and nuclear physics, astrophysics, materials science, and the life sciences. In our laboratory, we have concentrated on advancing oxide scintillator single crystals for radiation imaging and have also constructed and evaluated the performance of radiation imaging detectors based on these materials.

X-ray imaging is employed in numerous sectors, including nondestructive testing of electronic components, pharmaceuticals, and food, medical X-ray CT, and airport baggage screening. Recently, substantial attention has been directed towards millisecond-scale 4D X-ray CT [1] using synchrotron radiation, necessitating scintillator materials with higher luminescence intensity to enable faster timing resolution. In high-resolution X-ray imaging with synchrotron radiation, single-crystal scintillators are frequently used to minimize light scattering within the scintillator. While single-crystal oxide scintillators are favored for their non-hygroscopic nature and ease of handling, there has been little significant progress in the last decade in developing these scintillators for X-ray imaging, aside from the well-established $Lu_3Al_5O_{12}$:Ce [2] and $Gd_3(Ga,Al)_5O_{12}$:Ce (GAGG:Ce) [3] scintillators, which was developed in our laboratory. In 2023, we reported that co-doping two luminescent center elements, Ce and Tb, into the host composition of $(Gd,YA)_3Ga_3Al_2O_{12}$ induces an efficient bidirectional energy transfer between Ce and Tb, resulting in a substantial increase in light yield [4]. Notably, the sample co-doped with Ce and Tb exhibited the highest light yield, outperforming samples doped solely with Ce or Tb. In this study, we synthesized 1-inch diameter GAGG:Ce,Tb single-crystal scintillators using the Czochralski method and developed an X-ray imaging detector integrated with magnifying optics and a CMOS sensor. X-ray imaging tests conducted at a synchrotron radiation facility achieved submicron resolution, with luminescence brightness 2.4 times higher than commercially available LuAG:Ce and 1.6 times higher than GAGG:Ce.

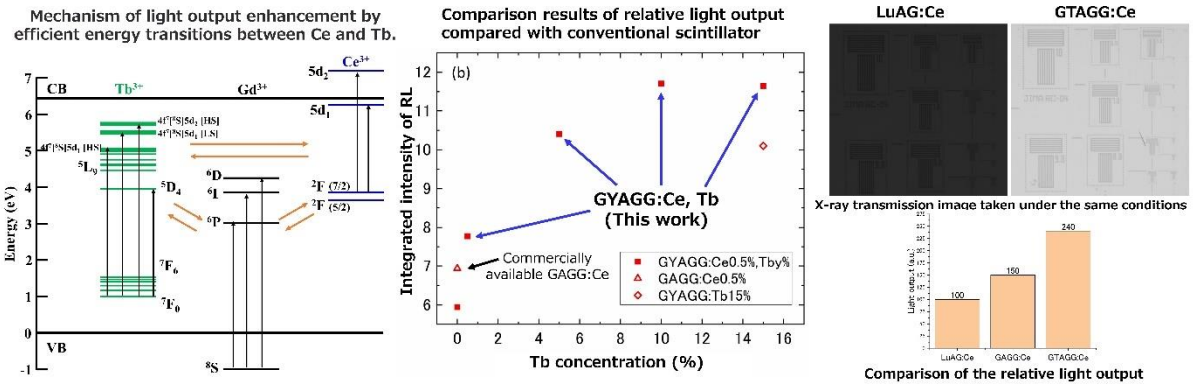

Figure 1. Mechanism of light output enhancement by co-doping Ce and Tb, X-ray images obtained, and evaluation results of relative light output

Alpha particle imaging has also gained prominence, driven by the increasing use of targeted alpha particle therapy. This therapy delivers radiation precisely to diseased tissues, such as cancer cells, while minimizing damage to adjacent healthy cells. High-resolution alpha-particle imaging techniques have become crucial for elucidating the distribution of alpha radionuclides within intracellular organelles during alpha-particle therapy development. We have developed an ultra-high resolution, real-time alpha particle imaging system by combining a GAGG:Ce single crystal scintillator with an magnifying optics system and a cooled qCMOS sensor [5, 6]. In this study, we successfully imaged the trajectory of alpha particles emitted from an Am-241 sealed source with submicron (0.48 μm) resolution, significantly surpassing the resolution of a previous study in 2022 (~20 μm).

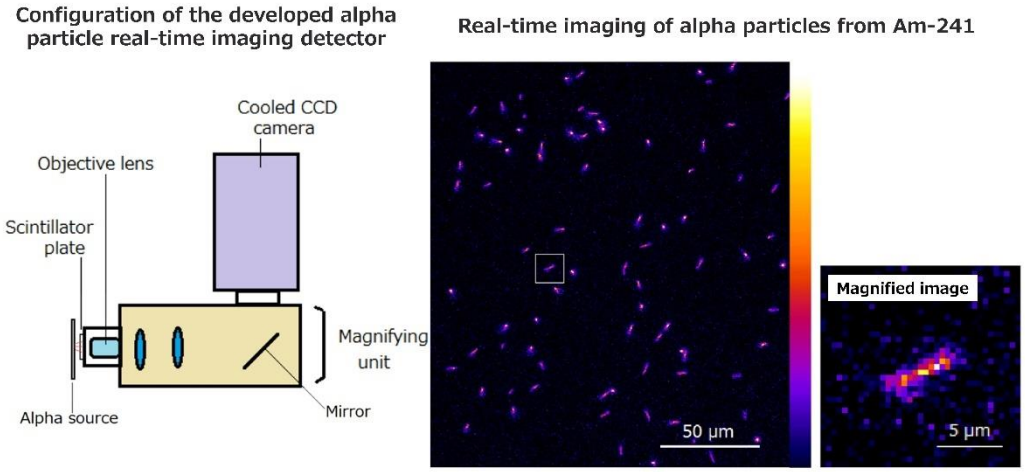

Figure 2. Schematic diagram of the alpha-particle imaging detector and obtained trajectory of alpha particles.

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B-20

INTRODUCTION OF HAMAMATSU PHOTONICS K.K. (HPK)

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Abstract. Introduction of products from Hamamatsu Photonics K.K.(HPK).
HPK's mission is to benefit society through the development of technologies that capture, measure, and generate various types of light. That's why HPK is re-invest of at least 9% of yearly revenue into research and development - to maintain cutting-edge quality across 90 types of image sensors, light sources, components, and systems with capabilities that span the spectrum from x-ray to infrared.
HPK is one of the only companies in the world that develops a wide range of both light sensors, such as photomultiplier tubes and photodiodes, and light sources such as lasers, LEDs, and measurement lamps.
Light sensor and light source components are also available as modules and units with dedicated circuits. These devices can be incorporated into systems. HPK develop, such as optical measurement systems, imaging systems, and image analysis systems and that support cutting-edge academic research.
The components HPK manufacture measure and generate not only visible light, but also ultra-low, ultraviolet, infrared, and x-ray light. HPK products are widely used in various applications such as medical, life science, industrial equipment, non-destructive testing, and analytical equipment.

B-21

SOLAR MODULATION ENABLED BY VO_2 NANOPARTICLES FOR THERMOCHROMIC SMART WINDOWS

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Abstract. A thermochromic layer coated on a glass window allows for passive control of solar radiation transmission. Vanadium dioxide (VO_2) is a thermochromic material that has attracted significant attention due to its unique property of undergoing a reversible semiconductor-to-metal phase transition at a temperature of 68°C (Tc). It is transparent to infrared light in the monoclinic phase below Tc and translucent in the tetragonal rutile phase above Tc. In our project, we aim to develop a smart solar greenhouse dryer capable of drying crops like rice and coffee by regulating the greenhouse temperature, achieved by lowering the transition temperature (Tc) of VO_2 to around 40°C. In this work, VO_2 nanoparticles (NPs) were successfully synthesized using the hydrothermal method and dispersed into a transparent polymer matrix before being coated onto glass. The thermochromic properties of the synthesized VO_2 film were examined, and the results demonstrated good thermochromic behavior in the infrared range. Notably, a pronounced localized surface plasmon resonance (LSPR) was clearly observed at 1200 nm.

B-22

STUDY ON BROADBAND OPTICAL VORTEX BEAMS FORMATION IN LIQUID USING NANOSTRUCTURED ALL-GLASS COMPONENTS

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Abstract. Optical vortex beams (OVBs) exhibit doughnut-shaped intensity profiles, and helical phases with the central singularities [1]. Due to such unique properties, they have become important in numerous scientific research and practical applications. For instance, particle manipulations, optical communications, high-resolution imaging processes, and micro-machining [2]. In the last couple of years, we have developed two new nanostructured gradient index phase components (NPCs) for converting Gaussian beams into vortex beams at designed wavelengths [3] and for working in a wide wavelength range in the air [4].

In this paper, we report the study on the performance of the developed NPC for the generation of broadband optical vortices in liquid. The theoretical calculations and numerical simulations show that our component allows the generation of fundamental optical vortices in water over 290 nm wavelength bandwidth from 1275 nm to 1565 nm. This has been verified experimentally using three diode laser sources operating at 1310, 1550, and 1565 nm. The formations of OVBs in water (Fig. 1(a'-c')) are confirmed using the corresponding setup in Fig. 1(a-c): doughnut intensity with a zero-intensity at the centre (Fig. 1(a')), topological charge value of l = 1 observed in an astigmatic transformation pattern (Fig. 1(b')) and Mach-Zehnder interferogram (Fig. 1(c')).

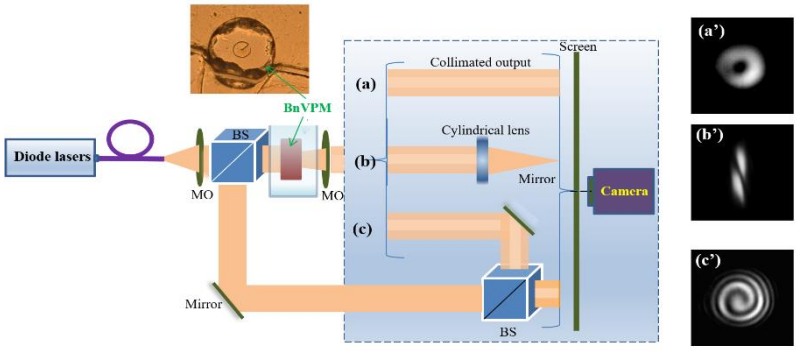

Fig. 1. Schematic for verification of the OVB generation in liquid and its obtained properties.

It is noticed that we obtained the same results as in the case of NPC in air [4]. That means the broadband NPC maintains its optical properties in both air and liquid media. This is important for optofluidic applications of vortex beams.

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B-23

EVOLUTION OF THE ELECTRONIC HEAT CAPACITY ACROSS LOW DIMENSIONS

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Abstract. The growing demand on low-dimensional devices necessitates simulations that would predict how the properties of materials evolve with lower dimensions. As these devices are subject to different temperatures (T), their responses to varying T must be understood. This study investigates the electronic heat capacity (C_V) as a function of temperature (T). A Gaussian-shaped density of states (DOS) and a size-varied quantum box model were used for to investigate the lower dimensions and imitate the fabrication of nanomaterials. The chemical potential μ was first obtained via a root-finding method. The result was then used to calculate for C_V.

Lowering the dimensional structure reveals a decreasing effect on the change of C_V over T, though the effect is minimal, and, for low T, C_V is still closely linear with T. The chemical potential as a function of temperature μ(T) exhibits a close transition between the 3D, 2D, & 1D solution of μ(T) – from a decreasing to a constant and finally to an increasing μ with respect to T. These results are observed on the structures from 3D to 1D, including the 0D - 1D crossover region closer with 1D. For structures leading closely into 0D, C_V(T) manifests the Schottky anomaly due to the DOS becoming more discrete, which is then also reflected in the behavior of μ(T).

B-24

INTEGRATED RF-MEMS TECHNOLOGY FOR RECONFIGURABLE SPOOF-SURFACE-PLASMON-POLARITON DELAY-LINE

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Abstract. The rapid development of the 5th and 6th generations (5G/6G) of global telecommunication has required the development of compact, integrated microwave circuit devices. Radio-Frequency Micro-Electro-Mechanical-Systems known as RF-MEMS devices are made to function between a few megahertz (MHz) and several gigahertz (GHz), that comprise various components [1], with capacitive switches, inductors, resonators, actuators, and switches serving as the main constituents in microscale with mechanical components fabricated by precise microfabrication processes. So far, we have been conducting research and development on metamaterials [2-3], MEMS [4], and SSPP waveguides [5]. In this report, we proposed and fabricated MEMS actuator arrays with a resonant frequency of 1.5 MHz designed in the gap of split-ring resonators (SRR) capacitively coupled to a delay-line based on a spoof-surface-plasmon-polariton (SSPP) waveguide. The static and dynamic resonant mechanical characteristics of the MEMS actuators have been investigated systematically, which affect the transmission characteristics of the SSPP waveguide. When applying voltage to the MEMS actuators in air and room temperature, a DC voltage of 160 V and an AC voltage of 15 V result in a phase difference of 3 degrees. The findings demonstrate the possibility of realizing the modulation of microwaves with MEMS actuators by perturbation of the confined electric field in the metamaterial structures. The proposed device can find applications in miniaturized and low-power microwave modulators, phase shifters, and microwave-based sensors.

Acknowledgments

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B-25

RESEARCH ON REFLECTION AND ABSORPTION CHARACTERISTICS OF METAL – DIELECTRIC – METAL STRUCTURES DEPENDING ON POLARIZATION AND ANGLE OF INCIDENT LIGHT

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Abstract. Plasmonic structures are widely used in the fields of chemistry, physics and biology. The study of the optical properties of the structure plays an important role in orienting the application as well as optimizing the structure before fabrication. In this study, we study the reflection and absorption properties of a metal-dielectric-metal (MDM) structure depending on the polarization and angle of the light incident on the structure. The structure consists of nanometer-sized gold discs, located on a special dielectric-metal substrate. The results obtained from the simulation software CST Studio Suite show that the structure creates plasmon resonance at a wavelength of λ~1500 nm, while the absorption and reflection of the structure do not depend on the polarization but depend on the angle of the incident light.

Keywords: *Surface plasmon resonance, ordered metallic nanostructures, plasmonic, metal – dielectric – metal .*

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B-26

CHARACTERIZATION OF Eu^{3+}-DOPED BORATE GLASSES SYNTHESIZED USING MICROWAVE AND CONVENTIONNAL MELTING METHODS FOR RED LIGHT-EMITTING APPLICATION

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Abstract. The research work emphasis on glasses with stoichiometry composition Eu^{3+}-doped B_2O_3-ZnO-Na_2O prepared using microwave technique (MW) and conventional melt-quench using electric furnace (EF) techniques. The effects of the rare-earth ion (Eu^{3+}) local environment and its effect on luminescence parameters of different synthesis techniques and compared. The photoluminescence properties of the glasses that were obtained were investigated and characterized. Additionally, the absorption and radiative properties of the glasses were assessed using the Judd-Ofelt (JO) theory. The emission spectra for all the glasses consistently show the characteristic emission peak of Eu^{3+}, with a prominent peak at 614 nm, corresponding to the $^5D_0$ to $^7F_2$ transition, observed when excited at a wavelength of 395 nm. According to XANES, the Eu ions in both glasses function as Eu^{3+} like the original Eu_2O_3 powder. The EXFAS result indicated that six oxygen atoms surrounded with Eu atom as a first neighbor shell, both in microwave (MW) and melt-quench (EF) techniques. The Eu-O distance fluctuates more in MW than it does in EF. The results on its structural orientation of Eu^{3+} ions show potential use for red light-emitting applications with various synthesis techniques employed

Keyword: Microwave techniques (MW), Electric furnace (EF), Judd-Ofelt (JO), XANES, EXFAS

B-27

RECENT ADVANCES IN TRANSILLUMINATION IMAGING TOWARD REALIZATION OF OPTICAL COMPUTED TOMOGRAPHY

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Abstract. Using light with 700-1200 nm wavelength, we can visualize the internal light-absorbing structure of an animal body or human body part by transillumination imaging. However, this technique faces a severe challenge with strong scattering in biological tissue. As a consequence, the observed image is severely blurred. We derived a depth-dependent point spread function for a fluorescent light source in a scattering medium to describe the scattering effect in the biological tissue. We developed techniques to suppress the scattering effect using the depth-dependent point spread function and verified their feasibility in experiments. With these techniques, we can visualize the macroscopic internal structure of an animal body. Further, we can quantify the physiological change that occurred in the body as the change in transillumination images. A fundamental study has been conducted to visualize the functional change inside a living animal body using near-infrared light. As a result, the changes in the tissue oxygenation and the blood volume could be detected noninvasively in the transillumination images.

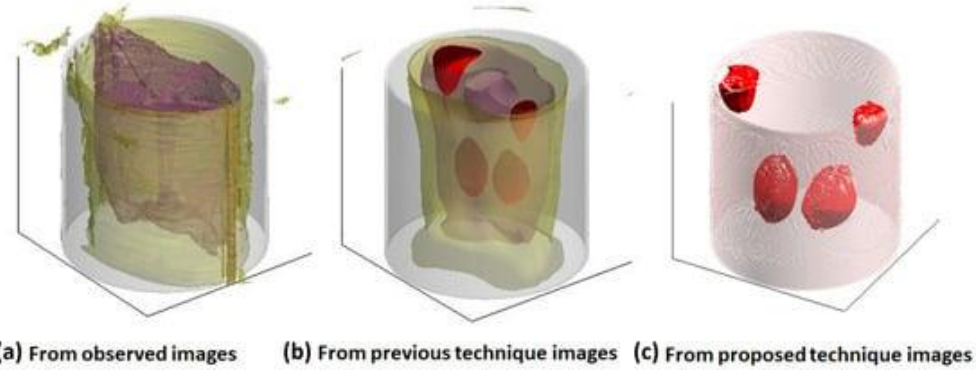

Figure 1. 3D reconstruction image of a small animal body from observed images and from improved images

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B-28

POLISHING OF OPTICAL LENSES WITH FAST PROCESSING TIME, HIGH ACCURACY AND HIGH REPRODUCIBILITY USING MODERN TECHNOLOGY

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Abstract. Polishing optical lenses with high precision and efficiency is crucial for advancing modern optical systems. This study presents an innovative polishing process using the Advanced Polishing System 3D (APS 3D) integrated into the APL 120 polishing machine from SCHNEIDER. We tested the process on two spherical lenses with diameters of 46 mm and 66 mm, and radii of 41.6 mm and 155.6 mm, respectively. In just 10-15 minutes, the polishing achieved a radius deviation accuracy of 0.05% and form errors characterized by a peak-to-valley (PV) of 0.2 wavelength. Compared to conventional techniques, this approach reduces processing time by approximately 400%. The method also ensures consistent performance across multiple production cycles, highlighting its suitability for large-scale manufacturing. Especially, the APS 3D method is effective not only for spherical lenses but also for aspherical lenses, which are currently unavailable in Vietnam. We successfully polished an aspherical lens with a PV accuracy of 0.25 wavelength. This study highlights how modern polishing technology can meet the increasing demand for high-precision optical fabrication, allowing for faster and more reliable production of advanced optical devices in the country.

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B-29

SYNTHESIS AND STUDY OF THE STRUCTURE AND OPTICAL PROPERTIES OF Tb^{3+}- DOPED ZnO SEMICONDUCTOR NANOSTRUCTURES

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Abstract. Tb^{3+} ions-doped ZnO semiconductor nanocrystals (NC) at concentrations of 0, 1, 3, and 5% have been successfully synthesized using the wet chemical method in a non-coordinating solvent, ODE. The ZnO and Tb^{3+}-doped ZnO NCs at various concentrations all exhibit a hexagonal structure, belonging to the space group *P63mc*. The presence and concentration of elements in the Tb^{3+}-doped ZnO NCs were determined through Energy Dispersive X-ray spectroscopy (EDX). The optical properties of the samples were investigated through absorbance (Abs), Photoluminescence excitation (PLE), and Photoluminescence (PL) measurements. The Tb^{3+}-doped ZnO NCs emit in the visible light region, making them promising candidates for applications in lighting and biosensing.

Keywords: nanocrystals, ZnO, rare earth, Tb^{3+}, optical properties.

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B-30

SPIN AND ORBITAL HALL EFFECT IN PARAXIAL LIGHT BEAMS

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Abstract. In optical trapping, structured light with phase or polarization singularities is often used. Therefore, light beams with a nonzero orbital and spin angular momentum (OAM and SAM) receive much attention. The SAM rotates particles around their centers of mass [1]. Thus, tailoring a distribution of the SAM density can allow simultaneous rotation of a set of particles. In some cases, light fields with specific nonzero SAM distribution can be generated simply by propagation of light with zero SAM, i.e. linear polarization, in the initial plane. This phenomenon, when photons with a different spin move along different paths and thus areas with nonzero SAM are generated from a linearly polarized beam, is the optical spin Hall effect. In addition to the spin Hall effect, the optical Hall effect can also be orbital or spin-orbital. At first, the Hall effect was discovered for metals by E. Hall in 1878. In 1971, it was observed for semiconductors [2]. In 2004, this effect was also demonstrated in photonics [3]. This effect can arise at a medium interface [4] or in an inhomogeneous medium or in microcavities [5], metamaterials, dielectric gratings, and in free space in the tight focusing conditions [6]. Here, we consider several cases, when the spin Hall effect arises even in paraxial light fields. We demonstrate that it arises in a light beam with multiple polarization singularities on a circle, in a light beam with an infinite number of polarization singularities, in light beams with two-index polarization singularities (different index for different transverse axes), in superpositions of beams with cylindrical and linear polarization, and in a cylindrical vector beam with spatial carrier frequency. For all these light fields we obtain analytically the expressions for their complex amplitudes and for the generated SAM distributions.

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POSTER SESSION I

PI-01

SPECTRAL CHARACTERISTICS OF POLYMETHINE DYE IN MODEL BACTERIAL ENVIRONMENTS UNDER PHOTOIRRADIATION

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Abstract. The problem of drug resistance of microorganisms to the action of a wide range of antibiotics is very relevant for modern medicine. This stimulates the development of research in the direction of finding alternative therapeutic methods. One of the promising methods that can speed up treatment is photodynamic antibacterial therapy (PDAT). This method involves the use of drugs or photosensitizers in combination with the effects of laser radiation sources.
The maximum permeability of biological tissues is in the range of 700–900 nm. For PDAT, it is advisable to use compounds with an absorption band in the region of maximum permeability of biological tissues and with good solubility in water. To increase the effectiveness of PDAT, it is necessary to know how the photosensitizer penetrates the cell [1]. The spectral and luminescent characteristics of a polymethine dye were studied in model bacterial environment under the influence of a light-emitting diode source with a wavelength of λ=684 nm, corresponding to the long-wave absorption band of the dye. The objects of the study were a water-soluble tricarbocyanine dye used as a photosensitizer [2] and a strain of gram-positive microorganisms *Staphylococcus aureus*. Peptone yeast broth (PYB) was used as a nutrient medium for culturing bacteria. It was found that polymethine dye molecules penetrate the cell wall of bacteria in PYB. For the dye to penetrate into the cell of gram-positive bacteria *S.aureus*, substances produced by the cells themselves are required. This confirms the hypothesis that substances formed during the vital activity of microorganisms can act as dye transporters into the bacterial cell.

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PI-02

CLASSUFICATION OF MOSAIC TESSERAE BY HIERARCHICAL CLUSTER ANALYSIS IN PRINCIPAL COMPONENT SPACE OF X-RAY FLUORESCENCE SPECTRA

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Abstract. During the archaeometric study of mosaic tesserae, much attention is paid to the analysis of their chemical composition [1], the results of which provide information about the probable date, place and technological features of the production of artifacts. Glass production began in the third millennium BC in Ancient Egypt and Mesopotamia. Later examples of Roman glass can be found throughout Europe. Ancient Russian glasses made in the XII-XIV centuries represent a special artistic and industrial phenomenon in European medieval culture. The traditional method of analysis of historical glasses is X-ray fluorescence (XRF). This non-destructive method allows identifing the main and trace elements in the studied samples. According to the chemical composition of ancient tesserae determined by the XRF spectrum, their classification can be carried out [2]. But the XRF spectra contain more information than is necessary to determine the chemical composition. Therefore, it is possible to omit this intermediate stage and classify historical mosaic tesserae directly by the XRF spectra using methods of multivariate data analysis. Principal component analysis (PCA) [3] and hierarchical cluster analysis (HCA) [4] are used here for classification of 337 samples of mosaic tesserae from the Tithe Church and St. Sophia Cathedral (Kyiv), St. Sophia Cathedral (Novgorod), the burial church of the Euphrosyne Monastery (Polotsk) and the Annunciation Church (Rurikovo Settlement). The measurements were carried out with portable XRF spectrometer Bruker Tensor 5. PCA is used to reduce the dimension of the feature space for classification. HCA satisfies any two of the three axioms of Kleinberg's impossibility theorem (there is no clustering algorithm that is simultaneously scale-invariant, consistent, and complete) [5]. The standard Euclidean metric of the principal component space and Ward method were used, in which the distance between clusters increases minimally. To determine the number of clusters, a silhouette measure was used, which simultaneously takes into account the cohesion and separation of clusters.
After removing 5 outlier samples and selecting 5 principal components in the XRF spectra, a dendrogram of the hierarchical structure of agglomerative clustering was constructed, with a maximum silhouette value for 4 clusters. This result shows that the studied historical mosaic tesserae found in the East Slavic lands are optimally grouped into 4 classes. This conclusion needs to be further confirmed by external measures of classification performance.

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PI-03

IMPROVING THE QUALITY OF FLUORESCENCE THERMOMETRY WITH HO-DOPED GLASSES BY MULTIVARIATE DATA ANALYSIS

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Abstract. The development of accurate non-contact temperature measurement methods is crucially important for many industrial and scientific applications. The fluorescence intensity ratio (FIR) [1] technology is already classical and has such advantages as simplicity of instrument implementation, real-time operation up to milliseconds, high spatial resolution, insensitivity to noise of the pumping radiation power, high sensitivity and low temperature uncertainty. In this paper we show that the use of multivariate data analysis can significantly improve the last two characteristics of fluorescent thermometry.

Fluorine aluminophosphate glasses doped by 0,1 % Ho^{3+} and 2,0 % Yb^{3+} was used in the work. Efficiency of the Yb^{3+}/Ho^{3+} couple is based on the fact that Yb^{3+} as a sensitizer be easily excited by commercial laser diodes (λ = 980 nm) and transfer energy to Ho^{3+} activator ions via energy transfer. The fluorescence spectra were recorded at temperatures from 298 to 473 K with a step of 5 K in the range of 500-700 nm.

For classical FIR the intensity is integrated over 5 nm windows near fluorescence peaks at wavelengths 549 nm and 642 nm. To improve sensitivity and temperature uncertainty the following multivariate methods were used: principal component analysis (PCA) [2], partial least squares (PLS) [3] and searching combination moving window interval PLS (scmwiPLS) [4].

FIR thermometry is preferable with spectral interval over wavelengths (548 nm and 644 nm) that correspond to the extrema of the first principal component loadings spectrum. The relative sensitivity S_r = 0,6 $\%K^{-1}$ of this models is the same as for classical FIR with 549 nm and 642 nm and the temperature uncertainty δT=1,4 K of the first mentioned model is two times less than that of the second (2.8 K). For temperature calibration by scores in the first principal component S_r= >6,1 $\%K^{-1}$ and δT=0.7 K.

In turn, the multivariate temperature calibration by PLS is slightly inferior in quality to the PCA model (δT=0,8 K). When applying the selection of spectral variables to the PLS (scmwiPLS method), the δT value can be reduced by half from 0.8 K to 0.4 K.

Thus, the application of principal component analysis in fluorescent thermometry makes it possible for increase the sensitivity of the FIR method by optimizing the wavelength used and reduce the temperature uncertainty by almost 5 times be partial least squares with an interval selective of spectral variables.

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PI-04

INVESTIGATION OF SIZE-DEPENDENT BAND GAP AND SPECTRA OF SPHERICAL AND TETRAGONAL I-III-VI_2 QUANTUM DOTS

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Abstract. Nanomaterials are emerging instruments for biological applications. However, examining their properties becomes increasingly challenging as they reach dimensionless scales. These dimensionless structures are known as quantum dots (QDs). The QDs have been extensively studied for their optical properties through both experimental and computational methods. Prior studies predominantly focus on heavy metal materials [1]. To mitigate the toxicity of QDs, strategies such as capping the QD core with non-toxic materials or using inherently non-toxic materials have been proposed [2][3]. In this study, non-toxic alternatives were investigated in spherical (SQD) and tetragonal (TQD) cell structures using MATLAB simulations. The study focuses on the band gap and spectra of I-III-VI2 bare QDs. The QD energy band gap is determined by the sum of the bulk semiconductor band gap and QD confinement energy using the Brus equation. Spectral range were obtained using the photon energy equation, incorporating the QD energy band gap. The results indicate that spherical structures (SQD) exhibit higher confinement energies compared to tetragonal structures (TQD) due to their lower volume. Additionally, confinement energies increase significantly as QD size decreases. The band gap exhibits substantial variation at smaller QD sizes and approaches a specific value as size increases. In both models, $AgGaS_2$ exhibited the narrowest range in band gap, varying from 2.76 – 3.27 eV for SQDs and 2.76 – 3.19 eV for TQDs. Whereas, $CuInSe_2$ had the broadest range in band gap, varying from 1.14 – 2.24 eV for SQDs and 1.13 – 2.06 eV for TQDs. As for the QD spectral range, wherein it strongly depends on the QD band gaps, the $AgGaS_2$ had the narrowest spectrum ranging from 380 – 449 nm for SQDs and 390 – 450 nm for TQDs. Meanwhile, $CuInSe_2$ had the broadest spectrum ranging from 553 – 1085 nm for SQDs and 602 – 1096 nm for TQDs. In conclusion, the heavy metal-free QDs studied exhibit significant potential for suitability in biological applications due to their spectral range in visible light and near-infrared lights.

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PI-05

SIMULATING THE GROWTH TEMPERATURE EFFECTS ON THE PHOTOCARRIER DENSITY OF LOW-TEMPERATURE GROWN GALLIUM ARSENIDE PHOTOCONDUCTIVE ANTENNA

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Abstract. Gallium arsenide (GaAs) is a direct bandgap semiconductor used as a substrate in photoconductive antennas (PCAs) which are utilized as terahertz (THz) radiation sources and detectors in THz time domain spectroscopy systems. Thin film GaAs grown at temperatures 200-480 °C are classified as low-temperature GaAs (LT-GaAs). Growth temperature (T_g) is a parameter altered in the epitaxial growth process that affects the carrier lifetime and the defect concentration of the substrate. Using the Drude-Lorentz model, we simulated the LT-GaAs PCA carrier density and its temporal change for varying substrate T_g. Increasing T_g enhances crystalline quality, leading to higher carrier densities, ranging from 1.51×10^{24} m^{-3} at 200°C to 2.50×10^{24} m^{-3} at 320°C. However, at around 260°C, a saturation of carrier density was observed, indicating optimal performance within a T_g range of 200°C to 260°C. Furthermore, decreased carrier lifetime results from increased defect concentration consequently reducing carrier densities from 2.55×10^{24} m^{-3} at 1.17×10^{17} m^{-3} to 1.50×10^{24} m^{-3} at 1.57×10^{17} m^{-3} defect concentrations, respectively. The results from this study provide insights in optimizing growth temperature parameters in LT-GaAs growth in PCA fabrication for viable THz technology industrial applications.

(a) (b)

Figure 1: Dependence of charge carrier density with (a) growth temperature and (b) defect concentration.

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PI-06

NEAR-INFRARED FLUORESCENCE ENHANCEMENT BY PLASMONIC METASURFACES

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Abstract. Fluorescence is an important phenomenon in optical research which occurs at time scale of nanosecond where electrons at mostly outer layer of fluorophores relax after being excited. Fluorescence is a potential candidate for emerging applications in biosensing, bioimaging. However, the lifetime of fluorescence is short with not strong intensity, thus, the fluorescence enhancement attracts the researchers a lot. In this context, this work presents the methods of fluorescence enhancement with the preliminary results focus on excitation process of fluorophores by applying the property of localizing Electric field of surface plasmon resonance in near infrared generated by plasmonic metasurfaces.

Keywords: *Fluorescence enhancement, near-infrared, plasmonic metasurfaces.*

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PI-07

DUAL-MODE GREEN EMISSION PROPERTIES OF RARE-EARTH-ELEMENT-DOPED $CAZRO_3$ PEROVSKITE PHOSPHOR

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Abstract. In this work, we report the optical properties of rare-earth doped $CaZrO_3$ perovskite phosphor synthesized using a solution combustion method. The crystal structure, morphology, and optical properties of resulting phosphors were investigated by XRD, FE-SEM, and PL analysis. XRD result confirmes that the single-phase orthorhombic $CaZrO_3$ was obtained. Under 975 and 379 nm, the phosphors emitted a strong green region at 520/550 nm and a weak red region at 660 nm, corresponding to the $^2H_{11/2}$–$^4I_{15/2}$/$^4S_{3/2}$–$^4I_{15/2}$ and $^4F_{9/2}$–$^4I_{15/2}$ transitions of Er^{3+} in host lattice. Dependence-emission intensity on power laser excitation indicated that the two-photon absorption produces a green and red upconversion emission. In addition, the obtained phosphor exhibits intense green UC and DC emissions and high color purity. The energy transfer diagram of the system was proposed to explain the UC and DC emission mechanism. These results indicate that the intense UC and DC emission phosphor with high color purity makes it suitable for optoelectronic devices and solid-state lighting applications.

Keywords: Combustion method; Dual-mode emission; $CaZrO_3$ perovskite.

PI-08

FLUORESCENCE EXCITATION ENHANCEMENT BY PLASMONIC SILVER-COATED POLYMER PILLAR METASURFACE

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Abstract. Fluorescence is one of the interesting emission phenomena of molecules in nano-optics with emerging applications in biosensing. However, the lifetime and emission intensity of fluorescence is low. Therefore, fluorescence enhancement is essential in optical application efforts. Fluorescence can be enhanced by excitation enhancement, quantum yield, and collection efficiency. In this work, we present initial results of fluorescence enhancement related to the excitation process of the fluorophores. Considering the surface plasmon resonance enabled by a metal nanostructure consisting of silver (Ag) layers covering the outside of the 2D polymer array on a glass substrate, the simulation performed by the Finite-Difference Time-Domain (FDTD) method shows that this structure supports surface plasmon resonance in the near-infrared region (1442.9 nm) which provides an increase of E-field of 39.78 folds. Accordingly, the excitation enhancement of ~1582.45 folds is achieved. This study will be an initial step of deep research on fluorescence enhancement.

Keywords: Fluorescence enhancement, surface plasmon resonance, nanostructure, FDTD.

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PI-09

INTENSITY-DEPENDENT REFRACTIVE INDEX IN RESONANT PHOTONIC STRUCTURES

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Abstract. In this work, we study theoretically and numerically the dependence of refractive index on intensity of light in the resonant photonic structures which designed/fabricated in the third-order nonlinear optical materials with nonlinear susceptibilities $\chi^{(3)}$. The refractive index depends on the light intensity determined by $n = n_0 + n_2(\tilde{E})^2$, which *n* is the real refractive index of the medium, n_2 called the third-order index of refraction, $n_2 = \frac{3\chi^{(3)}}{4}$, and *E* is the electric field intensity of incident light. For enhancing the performance of nonlinear optical devices, the light confinement (photon lifetime) in photonic structures is a prerequisite which can be provided by the resonant photonic structures with a high quality-factor (*Q*-factor). The one-dimensional (1D) and two-dimensional (2D) photonic crystal structures, and other photonic resonant structures will be discussed in this work.

Keywords: Intensity-dependent refractive index, photonic structures, nonlinear optics.

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PI-10

ANALYSIS OF DISPERSION CHARACTERISTICS OF POLARIZATION MODES IN DUAL-PBG08 CORE PHOTONIC CRYSTAL FIBERS WITH UV710 SUBSTRATE AND HEXAGONAL LATTICE

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Abstract. A novel type of symmetric dual-core photonic crystal fiber (PCF) is proposed, and its dispersion characteristics are numerically studied. The fiber has a hexagonal lattice, using nonlinear glasses UV710 and PBG08 as the substrate and core materials. The investigation shows that the choice of structural parameters can control the dispersion profile of the fiber in terms of magnitude, flatness, and zero-dispersion wavelength (ZDW). When comparing two cores (A and B), the dispersion curves have very similar shapes in the range of 1.0-1.8 μm. However, the fiber exhibits a lower dispersion value and a flatter dispersion curve in the case of core A in the longer wavelength region. We also compare the polarization modes of the two cores for the optimized fiber structure. The results show that at a wavelength of 1.5 μm, the positive dispersion value is quite small (from 5.3 to 9.1 ps/nm/km). The suggested dual-core PCF structure can provide the desired dispersion at various frequency ranges, making it a good candidate for many optical applications, especially supercontinuum generation.

Keywords: Dual-core, photonic crystal fiber, dispersion, UV710 glass.

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PI-11

A DESIGN OF MAGNETO-INDUCTIVE WAVEGUIDE SWITCHABLE BY LASER DIODE

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Abstract. Magneto-inductive waves (MIW) have recently gained a lot of attention due to their potential in both industrial and medical devices. However, existing methods for manipulating MIW remain complex and limited, which is a challenge because MIW applications require a high tunability of physical structures. In this paper, we present a MIW waveguide that operates at two distinct frequencies, 13.56 MHz and 14.2 MHz, based on two states of a visible laser beam. This proposed design exhibits high light sensitivity due to an integrated photodiode sensor and a voltage-driven circuit in each resonance unit cell. The investigations on the effects, such as *S*-parameters and magnetic field distribution, are carried out to confirm the light-controllable, which brings a huge potential for both near-field communications and wireless power transfer systems.

Key word: *Magneto-inductive waveguide, High light sensitivity, light-controllable.*

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PI-12

CHARACTERISTIC CONTROLLED FABRICATION OF FLEXIBLE SERS SUBSTRATES BY MODIFICATION OF GLASS FIBER FILTER SURFACE

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Abstract. Surface enhanced Raman spectroscopy (SERS) is an an extremely sensitive and unique fingerprint method for molecule identification. Flexible SERS substrates and handheld Raman spectrometers offer significant potential for field-work applications [1, 2]. In the present study, the silver nanoparticles were fabricated on the glass fiber filter substrates by the chemical reduction method and used as flexible SERS substrates. The glass fiber filter was pre-treated to form -OH functional groups on the surface. Due to multiple -OH functional groups, the number of silver nanoparticles on the glass fibers increased significantly and was distributed more evenly. This affects the characteristics of the SERS substrates, the enhancement factor (EF), and signal uniformity. The SERS substrates obtained from -OH group functionalized glass fiber substrates showed higher EF of Melamine. The average relative standard deviation for ten repeated measurements was also lower than without -OH group functionalization on the glass fiber filter surface.

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PI-13

SYNTHESIS OF A COUNTER ELECTRODE (CE) BASED ON REDUCED GRAPHENE OXIDE (RGO)-CU_2S BY A ONE-STEP ELECTROCHEMICAL METHOD APPLIED TO QUANTUM DOT PHOTOSENSITIZED PHOTOVOLTAIC CELLS (QDSSC)

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Abstract. A counter electrode (CE) comprising reduced graphene oxide and copper(I) sulfide (rGO-Cu2S) was created on a fluorine-doped SnO_2 (FTO) substrate through a one-step electrochemical co-reduction process using a cyclic voltage, followed by sulfurization. The rGO-Cu2S counter electrode with six cycles demonstrated greater electrocatalytic activity and lower charge transfer resistance (Rct) than the rGO and Cu_2S CE. This improvement is attributed to the increased surface area, charge transfer, and enhanced electrical contact between the CE and electrolyte owing to the introduction of rGO and Cu_2S. A power conversion efficiency (η) of 4.16% was achieved for rGO-Cu_2S (6) in TiO2/CdS/CdSe: Cu/ZnS quantum dot solar cells (QDSSCs) with a polysulfide electrolyte. The QDSSC featuring the rGO-Cu_2S (6) counter electrode exhibited the highest short-circuit current density (Jsc) of 17.2 mA cm^{-2}, open-circuit voltage (Voc) of 0.52 V, and fill factor of 41%. These results surpassed those of the counter electrodes composed of Cu_2S (3.34%) and rGO (3.24%). Notably, the fabrication method of the rGO-Cu_2S counter electrode is more scientific, time-efficient, cost-effective, and straightforward.

Keywords: rGO-Cu_2S, QDSSC, electrochemical deposition

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PI-14

APPLICATION OF FRACTAL GEOMETRY IN EVALUATING THE EFFECTIVENESS OF CAMOUFLAGE NETS IN THE VISIBLE LIGHT SPECTRUM

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Abstract. Camouflage is an integral part of the art of military deception [1]. Consequently, accurately identifying camouflaged targets in the shortest time possible has become a focal point of research for military experts worldwide. Among various camouflage devices, camouflage nets are of particular importance, often referred to as the "umbrella" for military targets, including weapons and military facilities. Evaluating the effectiveness of camouflage nets is crucial for improving the shortcomings of current models in modern operations, and an objective and efficient evaluation standard would be beneficial in overcoming the limitations of human observation in assessing camouflage capabilities [2]. This paper presents the theoretical and experimental basis for applying Fractal geometry in evaluating the effectiveness of camouflage nets by comparing them against different backgrounds [3]. The results indicate that background images and camouflage nets can be quantitatively assessed using fractal dimension, providing a measure of similarity between the images.

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PI-15

FABRICATION AND CHARACTERISTICS PHOTOCATALYS OF TiO_2/N-GQDs

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Abstract. This work carries out the study and fabrication of TiO2/Nitrogen-Graphene Quantum Dots (N-GQDs) as a photocatalytic degradation methylene blue (MB). N-GQD was synthesized by hydrothermal method from citric acid and urea. TiO2/N-GQDs was synthesized by added N-GQD to TiO2 by the spreading method. The material were investigated for their structural and morphological characteristics by X-ray diffraction spectroscopy; Raman spectra and Scanning Electron Microscopy (SEM) imaging. The optical properties were investigated through absorption and fluorescence spectroscopy. TiO2 and TiO2/N-GQD photocatalys properties was compared by characterizing the degradation of MB under ultraviolet light irradiation.

PI-16

MICROMETER-SIZED RANDOM LASERS BASED ON POROUS POLYMER MICROSPHERES

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Abstract. Random lasers have attracted considerable research interest due to their unique physical properties and promising applications, such as photonic barcoding, speckle-free bioimaging, and biosensing [1]. Particularly interesting are micrometer-sized random lasers, which hold significant potential for on-chip optical communications and data processing [2]. However, the fabrication of these micrometer-sized random lasers is still a challenging issue. In this study, we demonstrate random lasers with diameters ranging from 30 to 120 μm, utilizing a straightforward emulsion process followed by selective chemical etching [3]. These laser sources are composed of dye-doped polyvinyl alcohol (PVA) porous microspheres. The pore structure enhances light scattering, which is essential for random lasing. Upon optical excitation above the lasing threshold, approximately 100 μJ mm^{-2}, these microporous structures exhibit clear lasing behavior with an emission wavelength centered around 595 nm. Our investigation into size-dependent lasing characteristics reveals that the lasing threshold increases as the microsphere size decreases. Furthermore, a redshift of 10 nm in the lasing wavelength is observed as the sphere diameter increases from 34 to 160 μm.

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PI-17

INVESTIGATION ON THE FABRICATION AND SPECTRAL PROPERTIES OF DOPED GRAPHENE QUANTUM DOTS WITH CHANGING EMISSION COLORS IN THE VISIBLE REGION

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Abstract. In this study, we present the change in color of the fluorescence emission of doped graphene quantum dots (GQDs) when they are fabricated with different precursors and try to determine the cause of the change from blue to red. The atoms used for doping in to the quantum dot graphene lattice are nitrogene (N), sulfur (S), and zinc (Zn). Based on the molecular structure of the precursors in the reaction to form doped-GQDs and the appearance of important functional groups in the Fourier transform infrared (FTIR) spectra, we assume that the emission color change is related to functional groups that bond with atoms in GQDs at edge or defect locations, creating different energy levels deep within the Cπ* - Cπ bandgap of GQD (Fig.1). Research on optical properties such as absorption, photoluminescence excitation (PLE), photoluminescence (PL) spectra, and PL decays of these doped-GQDs has been conducted.

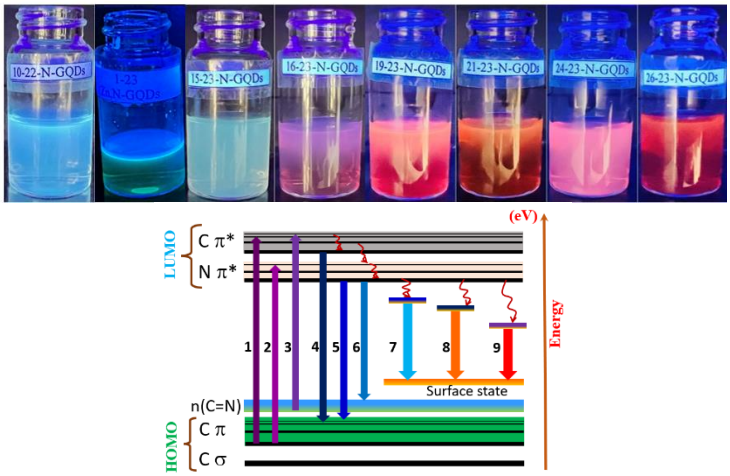

Fig.1. Digital photograph of the doped GQDs samples (photo above), proposed energy level diagram, electron transitions of doped-GQDs and the possible emission mechanism.

PI-18

FABRICATION OF SILICON WIRES BASED ON NANO IMPRINTING TECHNOLIOGY FOR APPLICATION IN OPTIC WAVEGUIDES

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Abstract. In recent years, silicon nanowires (SiNWs) have emerged under intensive research due to their emerging physical properties and potential as key materials in optoelectronic and optical applications. This research focuses on the fabrication of silicon wires using nano imprinting technology for application in optical waveguides [6][7]. This technique used a template with nanostructures to shape a polymer layer on silicon substrate. The RF sputtering was used to form Cr wires as protective masks for the wet - etching process. Anisotropic etching of crystal silicon was applied to form the SiNWs. The dimensions and shapes of the silicon wires are investigated by optical and SEM images.

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PI-19

TAMM PLASMON RESONANCE IN METAL-COATED POROUS SILICON PHOTONIC STRUCTURES

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Abstract. The Tamm plasmon (TP) resonance is a surface state or surface wave that occurs at boundary between a metallic film and the photonic crystal (PC) substrate [1, 2]. Contrary to a surface plasmon resonance, a TP resonance can be excited at any angles of incidence for both polarizations without using additional coupling optics. In this work, we design a structure of photonic crystal coated with a metal film. The existence conditions of TP resonance have been demonstrated using Bloch's theorem for periodic structures and the transfer matrix method. The results show that TP resonance depend on the metal thickness and the number of periods in the PC.

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PI-20

DESIGN AND SIMULATION OF SURFACE RESONANCE IN TWO-DIMENTIONAL Ag ARRAY FOR NEAR-INFRARED REFRACTIVE INDEX SENSING

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Abstract. The report presents a numerical study of a refractive index sensor structure based on a metal-dielectric-metal (MDM) plasmonic metasurface, which creates a high-sensitivity plasmonic resonance effect in the near-infrared region. The MDM plasmonic metasurface is formed by periodically stacking silver (Ag) disks on a thin silica (SiO_2) buffer layer and an Ag film (acting as a reflective surface) on a glass substrate. The optical properties of the MDM plasmonic metasurface, influenced by the periodicity and shape, as well as the diameter of the Ag disks, are investigated using the finite-difference time-domain (FDTD) method integrated into the Lumerical simulation software. As the results show, the optical properties of the structure depend on the shape, size of the Ag disks, and the periodicity of the structure. By examining the electric field distribution at the resonance wavelength, a strong concentration of incident light is localized at the interface between the Ag disks and the SiO_2 layer, leading to a low reflection intensity (nearly 0%).

Key word: *Metal-dielectric-metal structure, surface plasmon resonance, refractive index sensor, plasmonic metasurface.*

PI-21

EXPERIMENTAL STUDY ON THE PHOTOTHERMAL PROPERTIES OF NANOFLUID CONTAINING GRAPHENE OXIDE-SILVER NANOPARTICLE HYBRID MATERIALS

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Abstract. In this study, the optical and photothermal properties of nanofluids containing graphene oxide- silver nanoparticle (GO-AgNP) hybrid materials were investigated. The GO-AgNPs hybrid material was prepared by chemical reduction method. Morphology and structure of hybrid material were investigated. The results indicated that GO-AgNPs hybrid material was successfully fabricated with uniformly sized AgNPs of 18nm attached to the surface of GO. The nanofluid containing hybrid materials was prepared by a two-step method. The transmittance of the nanofluid is reduced in comparison to DI water due to the involvement of nanoadditives, such as AgNPs, GO, and GO-AgNPs. These nanoadditives participated in the absorption and scattering of light. The photothermal conversion efficiency of the nanofluids containing AgNPs, GO, and GO-AgNPs was dramatically increased to 34%, 25%, and 42%, respectively. The photothermal conversion efficiency of the GO-AgNPs hybrid nanofluid was over 2.5 times greater than that of DI water. These findings indicated the significant application potential of the produced nanofluid containing GO-AgNPs hybrid nanomaterials in solar energy harvesting systems.

PI-22

NANO-ZNO-MODIFIED LOTUS FIBERS: A NOVEL APPROACH FOR NONVOLATILE MEMRISTORS

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Abstract. In recent years, there has been a significant increase in the study of biopolymers as sustainable alternatives to traditional materials due to the growing environmental awareness in society. Cellulose, a natural and environmentally friendly material, has demonstrated potential for various applications. However, it has limitations in electronic applications due to poor electrical and thermal conductivity. To address this issue, our study explores the development of an eco-friendly electronic memory device using ZnO@Cellulose (ZC) nanocomposites, synthesized by decorating cellulose fibers extracted from lotus petioles with zinc oxide nanoparticles (ZnO NPs). The synergistic combination of cellulose and ZnO NPs offers a unique platform for improving the functionalities of electronic materials while maintaining sustainable and biocompatible characteristics. The influence of ZnO NPs on the performance of the nanocomposite in electronic memory devices will be explored. The ZC-based device demonstrated non-volatile bipolar resistive switching behavior with significant enhancements, including a low operating voltage of 2.0 V, a high ON/OFF resistance ratio of 10^3, endurance of 10^2 cycles, and excellent retention time of 10^4 seconds. The presence of oxygen vacancies in ZnO particles, as confirmed by PL and XPS analyses, was identified as a key factor contributing to the device's performance. This study highlights the potential of ZC nanocomposites as sustainable, biocompatible, and cost-effective materials for next-generation memory devices, addressing both technological and environmental challenges.

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PI-23

CLASSIFICATION OF MOTOR IMAGERY USING MACHINE LEARNING ON EEG DATA AND BRAIN MAPPING

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Abstract. There is significant interest in understanding how the brain functions during motor imagery, especially for its potential applications in brain-computer interface (BCI) technology. This study focuses on classifying motor imagery tasks (imagining left-hand and right-hand movements) using machine learning models applied to EEG data, and creating brain maps to visualize and analyze the brain regions involved in motor imagery. The EEG data were taken from the EEG Motor Movement/Imagery Dataset on PhysioNet. The signals were filtered between 1-40 Hz to remove noise and keep the frequency bands related to motor functions (alpha, beta, gamma). Features like Power Spectral Density (PSD) and Phase Locking Value (PLV) were extracted to analyze differences between imagining left-hand and right-hand movements. Machine learning models like K-Nearest Neighbors (KNN) and Support Vector Machine (SVM) were used to classify the EEG signals, and the data were split into training and testing sets to check the performance of the models. Additionally, brain maps were created to show the distribution of brain activity over time during the motor imagery tasks. The results showed that both KNN and SVM models performed well, with classification accuracy of 85% and 88%, respectively. The brain maps revealed clear differences in activity within the motor cortex between the two tasks, with increased beta-band activity seen during right-hand imagery. PLV values indicated stronger phase synchronization between brain regions during left-hand imagery. This study demonstrates that motor imagery tasks can be accurately classified using machine learning models and feature extraction from EEG data. The brain mapping also provides a clear view of brain activity distribution, offering useful insights into how the brain works during motor imagery. These findings could be applied in the development of Brain-Computer Interface (BCI) systems.

Keyword: KNN, SVM, Power Spectral Density, Phase Locking Value, brain mapping.

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PI-24

NUMERICAL SIMULATION OF NONLINEAR PROPERTIES OF HOLLOW-CORE CIRCULAR LATTICE PHOTONIC CRYSTAL FIBERS FILLED WITH $C_2H_4Br_2$

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Abstract. In this study, a circular lattice photonic crystal fiber filled with $C_2H_4Br_2$ is designed to improve the nonlinear properties of fibers. By numerically solving the Maxwell wave equation, the effective mode area and nonlinear coefficient are investigated in detail with the variation of the filling factor d_1/Λ and the lattice constant Λ. The effective mode area as small as 1.822 μm^2 corresponding to the nonlinear coefficient as high as 780.456 $W^{-1}.km^{-1}$ at 1.55 μm with the structure d_1/Λ = 0.65, Λ = 0.9 μm are obtained. The results further demonstrate that the filling of the hollow core with $C_2H_4Br_2$ combined with the difference in diameter and lattice constant of the air hole rings in the cladding can precisely control the nonlinear properties of fibers and open up great application possibilities for broadband supercontinuum generation in the specified wavelength region.

Keywords: $C_2H_4Br_2$, photonic crystal fiber, nonlinear properties, supercontinuum generation

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PI-25

ADVANCES IN SYNTHESIS OF DOPED GRAPHENE QUATUMS DOTS FROM INDIGO EXTRACTED FROM INDIGO LEAVES IN THE MOUNTAIN REGIONS OF NORTHERN VIETNAM

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Abstract. As a new carbon material, graphene quantum dots (GQDs) show attractive properties due to their small size, quantum confinement effect and edge effect, which have brought potential applications in chemical catalysis, biomedicine, optpelectronis, energy, photocatalysis and many new fields that are being targeted. From the published references, it is shown that the differences in starting materials, synthesis methods, fabrication conditions... affect the size, functional groups, doping, and optical properties of GQDs. The factors of green, friendly, simple, easy to fabricate, low cost... in which the source of the starting materials is an important factor, the completely natural origin is especially focused. In this paper, we propose a new direction for the fabrication of nitrogen-doped graphene quantum dots from the active ingredient Indigo extracted from Cham leaves which is taken form Bao Lam, Cao Bang provice. This is a fairly common active ingredient, used for a long time by ethnic minorities in the mountainous areas of Northern Vietnam in dyeing fabrics. We developed a method to synthesize and extracted Indigo from natural Indigo leaves, from which we initially fabricated N-GQDs from this raw powder by hydrothermal method. Through measurements such as UV-Vis absorption spectrum, FTIR infrared spectrum, Raman spectrum, EDX, fluorescence emission measurement... to evaluate the activity of Indigo active ingredient and the fabricated N-GQDs, to compare the results previously published by related research groups.

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PI-26

OPTICAL PROPERTIES AND ANNEALING EFFECTS OF CE^{3+}-DOPED $LU_3AL_5O_{12}$ SINGLE CRYSTAL GROWN BY MICRO-PULLING-DOWN METHOD WITH W CRUCIBLE

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Abstract. The micro-pulling-down (μ-PD) method is a melt-growth method and is suitable for materials research of functional single crystals due to its high growth speed compared to conventional melt-growth methods such as Bridgman–Stockbarger and Czochralski methods [1]. In general, single crystals are grown using the μ-PD method using Ir (melting point: 2466 °C) and Pt (melting point: 1768 °C) crucibles. However, the use of these crucible for crystal growth with high melting temperatures is restricted. In addition, the rising price of Ir metals has also been a problem. Since W metal has a higher melting point (~3422°C) and is cheaper than Ir, it is expected to replace Ir crucibles for growing functional single crystals [2]. In order to suppress oxidation of the W crucible, crystal growth is performed in a reducing atmosphere, resulting in the formation of oxygen defects in the crystals. Especially in scintillator materials, luminescence is disturbed and the characteristics are degraded. Therefore, in this study, we decided to compare different annealing conditions in order to evaluate oxygen defects formed during crystal growth.

$(Ce_{0.005}Lu_{0.995})_3Al_5O_{12}$ single crystal was grown by μ-PD method using a W crucible with the die of 3 mm in diameter under an Ar + 2% H_2 atmosphere. Deoxygenated ZrO_2 insulators were used, and to suppress oxidation of the W crucible. After cutting and mirror polishing, optical and scintillation properties were evaluated, and the results of characterization after annealing in air atmosphere with different conditions were compared.

The grown $(Ce_{0.005}Lu_{0.995})_3Al_5O_{12}$ single crystal is shown in Fig. 1. The obtained samples exhibited a typical broad photoluminescence emission in the wavelength ranges from 450 to 650 nm owing to 5d-4f transitions of Ce^{3+}. Among those samples, sample 1 had a transparency exceeding 80% in wavelengths ranging from 480 to 800 nm and showed the highest scintillation light yield of 14,700 photons/MeV when excited by a ^{137}Cs gamma-rays source. Details of the crystal growth, the optical characteristics and annealing effects will be presented.

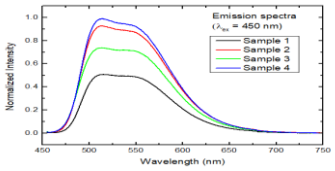

Fig.2. Photoluminescence emission spectrum (excitation wavelength: 450 nm).

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PI-27

EFFECT OF FREQUENCY DETUNING ON ELECTROMAGNETICALLY INDUCED TRANSPARENCY IN A SEMICONDUCTOR QUANTUM WELL WITH A THREE LEVEL LAMDA CONFIGURATION

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Abstract. In the framework of the semi-classical theory, we have used the density matrix equation for the semiconductor quantum well in the Lamda configuration under the simultaneous effects of two laser probe and coupling beams. The Lamda configuration includes two lower levels in the valence band, an upper level in the conduction band. We calculate the absorption coefficient in the GaAs/InAs/GaAs semiconductor quantum well with frequency of probe laser and coupling laser. We study the change of absorption coefficient in a semiconductor and frequency of probe laser and coupling laser. The results show that a Lamda configuration appears a transparent window for the probe laser beam. The depth and width or position of these windows can be altered by frequency detuning of the coupling laser fields.

Keywords: semiconductor quantum well, absorption coefficient, electromagnetically induced transparency, frequency detuning.

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PI-28

FABRICATION OF MEMRISTOR CROSSBAR ARRAY BY STENCIL LITHOGRAPHY

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Abstract. Stencil lithography offers a cutting-edge approach to high-resolution surface structuring at the micro and nanometer scales. Unlike conventional lithography, this innovative shadow-mask technique streamlines the fabrication process by eliminating resist-related steps, making it a powerful tool for advanced device manufacturing. In our study, we harnessed the benefits of stencil lithography to prevent electrode oxidation in memristor devices, ensuring low resistance crucial for optimal performance. Using a micro-scale stencil, we successfully fabricated a high-density crossbar array of memristors, achieving cell sizes as small as 50 µm x 50 µm and integrating 256 cells within a 10 mm² area. These memristive cells were created through a sequential sputtering process, depositing Cr_xO_y/TiO_2 layers on a Ti lower electrode, followed by Cr top electrodes on the TiO_2 layer. The resulting memristor cells demonstrated stable analogue switching behaviour, showcasing the significant potential for applications in neural networks.

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PI-29

IMPROVEMENT OF ABSORPTION FIGURE OF MERIT ON CUO THIN FILMS FABRICATED BY SOLUTION PROCESSING AND OXYGEN-ATMOSPHERE ANNEALING

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Abstract. Copper oxide (CuO) thin films were prepared by a solution-processed combining with spin-coated technique. The thin films deposited were crystallized by incubating in oxygen atmosphere at various temperatures from 400, 425, 450, 475 to 500^{o}C. Scanning Electron Microscope (SEM) images showed a markedly improved surface structure and uniform arrangement of particles. As a result, the absorption figure of merit (*a-FOM*) behave an absorption improvement when the thin films were treated in an oxygen-rich atmosphere. X-ray diffraction (XRD) results indicated an increase in the peak intensity when the annealing temperature was increased, but up to 450^{o}C, the intensity decreased due to oxygen separation in the crystal network. The particle size increased from 18.09 to 21.07 nm with the enhancement of the incubation temperature. The optical band-gap energy of the films was changed in a range of 2.82 to 2.89 eV for the temperature increased from 400 - 450^{o}C, but slightly decreased for the temperature increased further to 500^{o}C.

Keywords: *Thin film, CuO, Sol-gel, P-type semiconductor.*

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PI-30

A COMPARATIVE STUDY OF CONFINEMENT LOSS AND EFFECTIVE REFRACTIVE INDEX OF PCFs INFILTRATED WITH 1,2-DIBROMOETHANE AND NITROBENZENE

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Abstract. A comparison of effective refractive index and confinement loss characteristics of photonic crystal fibers (PCFs) infiltrated with 1,2-dibromoethane and nitrobenzene is carried out in this study. The introduced fibers are designed using commercial Lumerical Mode Solution software based on the full-vector finite element method. These PCFs include five rings of air holes forming a hexagonal lattice in the cladding. Interestingly, the size of the two air holes near the center on the horizontal axis differs from that of the remaining holes. This contributes to reducing fiber loss. After analysis, it can be seen that the confinement loss of PCFs with nitrobenzene-core is smaller than that of 1,2-dibromoethane-PCFs. At 1.55 µm wavelength, the lowest loss value is recorded with the smallest filling factor in the case of a large lattice constant. Such PCFs open up good application opportunities for supercontinuum generation and high-sensitivity sensors.

Keywords: Nitrobenzene, 1,2-dibromoethane, Photonic crystal fiber, Effective refraction index, Confinement loss, Five air-hole rings.

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PI-31

ANALYSIS OF DISPERSION AND NONLINEAR COEFFICIENT CHARACTERISTICS OF PHOTONIC CRYSTAL FIBERS INFILTRATED WITH CARBON TETRACHLORIDE

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Abstract. In this paper, a study of the dispersion and nonlinear coefficient characteristics is carried out on photonic crystal fibers (PCFs) infiltrated with carbon tetrachloride. The photonic crystal fibers were designed using Lumerical Mode Solution software. In our analysis, the structure introduced is a novel structure consisting of five rings of air holes arranged in a hexagonal lattice. The difference between the diameters of the two air holes near the center located on the horizontal axis compared to the remaining air holes is a new point in our work. The change of structural parameters such as filling factor (d/Λ) and lattice constant (Λ) strongly affects the dispersion and nonlinear coefficient of the PCFs. A structure with a filling factor of 0.6 and a lattice constant of 1.5 μm with a flat dispersion and high nonlinear coefficient is proposed for supercontinuum generation. Our results are important in the development of fiber optic technology, especially for supercontinuum generation applications.

Keywords: Photonic crystal fibers (PCFs), dispersion, high nonlinear coefficient, hexagonal lattices.

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PI-32

THE SUPERCONTINUUM GENERATION IN SQUARE LATTICE PHOTONIC CRYSTAL FIBER WITH CHALCOGENIDE FOR INVISIBLE BROADBAND

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Abstract. A numerical model for a photonic crystal fiber composed of aquare lattice As2S3 chalcogenide glass is presented, focusing on its application in generating highly coherent supercontinuum (SC) in the mid-infrared region. The simulations utilize the finite element method, applying an optical dispersion engineering technique to reduce dispersion effects at the pump wavelength by adjusting the fiber's geometric parameters. Two optimized fiber structures are identified for further analysis of their nonlinear characteristics and SC generation. The two fibers F1 and F2, with a lattice constant of 1.0 and 2.5 μm, a filling factor of 0.3 and 0.3, operates in dispersion regime. The F1 undergoes a normal dispersion, producing an SC spectrum ranging in invisible wavelength of over 2- 8.0 μm, using a pump wavelength of 5.0 μm, 90 fs pulse duration, and peak power of 6 kW. The F2, exhibits anomalous dispersion and generates a much more broader SC spectrum of 2.0 - 39 μm with a lower peak power of 7 kW.

Keywords: Supercontinuum; As2S3; zero-dispersion wavelength, invisible mid-frared dispersion.

PI-33

DETERMINATION OF OPTIMAL WAVELENGTH OF RADIATION FOR EFFICIENT EXCITATION OF CURCUMIN FOR SENSITIZED INHIBITION OF CANCER CELLS

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Abstract. It is well known that the anticancer and antimicrobial action of curcumin, a natural herbal preparation of the polyphenol group from the root of Curcuma longa, can be significantly enhanced by the sensitizing properties of the drug, since upon absorption of light, curcumin is able to generate active oxygen species (and, above all, singlet oxygen), which have an inhibitory effect on cancer and microbial cells. However, the wavelength of radiation optimal for curcumin-sensitized cell inhibition has not been determined. This is due to the strong dependence of absorption properties of curcumin on the microenvironment (the type of solvent or the type of biological macromolecules that form a complex with it). For example, the long-wavelength maximum of absorption spectrum of curcumin in dimethyl sulfoxide is located at λ_{max} = 460 nm, and in isopropanol at λ_{max} = 429 nm. In water, the absorption spectrum of curcumin strongly depends on the pH of the medium and in the region of neutral pH values is at λ_{max} = 424 nm. When binding to protein, a long-wavelength shift ($\triangle\lambda_{max}$ = 20 nm) of the maximum of the absorption spectrum of curcumin occurs.

Using confocal microscopy we have shown that curcumin is able to penetrate through the membranes of HeLa cells. A significant proportion of the preparation is localized near the cell membrane, while some of the fluorescent curcumin is concentrated in the cytoplasm and intracellular compartments. Since the fluorescence excitation spectrum of the dye generally corresponds well to its absorption spectrum, we studied the fluorescence excitation spectra of curcumin localized in the cells. For this purpose, after 2-hour incubation of the cells with curcumin, they were washed three times from excess dye unbound to the cells and localized in the nutrient medium by centrifugation. It was found that upon excitation in the region of λ_{ex} = 445 nm, the fluorescence of curcumin localized in cells is characterized by a broad band in the region of 460-700 nm with a maximum at λ_{max} = 503 nm. In the fluorescence excitation spectrum of curcumin associated with cells, a band with a maximum at λ_{max} = 424 nm and a less intense (by 15%) maximum in the region of λ_{max} = 445 nm is registered. This position of the extreme points in the fluorescence spectra of curcumin bound to cells suggests that it is embedded both in lipid structures and in protein macromolecules (membrane-bound proteins), since curcumin in a complex with albumin (BSA) is characterized by the presence of a maximum in the fluorescence spectrum at λ_{max} = 507 nm, and in the excitation spectrum - at λ_{max} = 429 nm, whereas for the curcumin complex with phosphatidylcholine liposomes, the maximum in the absorption spectrum is located at λ_{max} = 420 nm, and fluorescence - at λ_{max} = 498 nm. The studies of the dependence of light-induced chemiluminescence of cells on the wavelength of the exposed radiation also allow us to conclude that the spectral range of 420-445 nm is optimal for inhibiting the growth of cancer cells.

PI-34

PHOTOPHYSICAL AND SENSITIZING PROPERTIES, PHOTOCHEMICAL STABILITY OF NITROFURAN DERIVATIVE DRUGS

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Abstract. Interest in the study of spectral-fluorescent and sensitizing properties, as well as photochemical stability of drugs - nitrofuran derivatives is due to their ability to act as photosensitizers for antimicrobial photodynamic therapy, established in recent years. The aim of this work is to study the above characteristics for furacilin (active ingredient - nitrofural) and furasol (furazidin), widely used in modern medicine as antiseptics. The long-wavelength absorption bands of the studied antiseptics are located at the edge of the long-wave UV and visible regions of the spectrum, with a maximum in the region of λ = 374 nm for furacilin and λ = 396 nm for furasol. A characteristic feature of the fluorescence spectra of furacilin and furasol is a significant Stokes shift relative to the absorption band ($\Delta\lambda \approx$ 170-210 nm), an extremely low fluorescence quantum yield (φ_{fl}), and a very short fluorescence decay time (τ_{fl}) at room temperature. According to our estimates, for furacilin in water at room temperature φ_{fl} = 0.0002, τ_{fl} = 10 ps, for furasol φ_{fl} = 0.0008, τ_{fl} = 10 ps. The most likely reason for such low values of φ_{fl} and τ_{fl} is the presence of alternative pathways for the dissipation of the excited state energy, primarily such as the processes of configurational *cis-trans* photoisomerization of nitrofuran molecules at the double –C=N– bond. This conclusion is supported by a sharp increase in the fluorescence intensity and its decay time when the solution temperature is reduced to 6°C and when switching to viscous media using Triton X-100 as a solvent. It is characteristic that due to the very short lifetime of the S_1 state, above compounds show fairly high values of the degree of fluorescence polarization (p) in aqueous media even at room temperature (p ≈ 0.35–0.40). When switching to viscous media based on Triton X-100, the degree of fluorescence polarization of furasol practically reaches the limiting value of p = 0.50; for furacilin, p = 0.40. Measurements of singlet oxygen phosphorescence in D_2O in the 1270 nm region upon photoexcitation of preparations by laser radiation with a wavelength of λ = 405 nm (continuous-wave mode) showed that the quantum yields of singlet oxygen generation (φ_Δ) by nitrofurans are not high: for furacilin φ_Δ = 0.004; for furasol φ_Δ = 0.0145. One of the disadvantages of the studied preparations when used as photosensitizers is their low photochemical stability, which must be taken into account when developing methods of antimicrobial photodynamic therapy. Moreover, photolysis of the indicated nitrofurans is sharply accelerated when sodium azide, a singlet oxygen quencher, is added to their solutions. It has been shown that despite the indicated shortcomings, furacilin and furasol, due to their effective interaction with microbial cells, cause their pronounced photodestruction when exposed to light corresponding to the absorption spectrum of the drugs.

PI-35

THE EFFECT OF BLUE LIGHT ON CELL CYCLE PARAMETERS, VIABILITY, INDUCTION OF APOPTOSIS AND NECROSIS IN CANCER CELLS

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Abstract. Many aspects of mechanism of photophysical and photochemical processes underlying inhibitory effect of blue light have been studied quite well. However, a number of issues require further study and analysis. In this work, we studied the effect of radiation from LED sources peaking at λ_{max} = 405 and λ_{max} = 445 nm on the parameters of the cell cycle and the survival of human cervical cancer cell line HeLa. The above parameters, as well as apoptosis and necrosis, were assessed by flow cytometry with propidium iodide staining 21 hours after the cessation of light exposure on the cells. The irradiance was I = 25 mW/cm^2. The studies have shown that the effect of blue light on HeLa cells leads to a dose-dependent decrease in their viability, inducing necrosis and late apoptosis in the cell population. In addition, cell irradiation with blue light is accompanied by changes in cell cycle: a decrease in the relative number of cells in the G0/G1 phase, an increase in the relative number of cells in the G2/M phase, and an insignificant increase in the S phase. At the same time, for all the parameters studied, at the same energy doses, more significant changes are induced by exposure to light with λ_{max} = 405 nm. Thus, after exposure to radiation with λ_{max} = 405 nm at D = 7.5 J/cm^2, the relative number of cells in the late apoptosis phase (sub-G1 phase) increased by approximately 3.5% compared to the control non-irradiated cells, and by 4% at D = 15 J/cm^2, whereas after exposure to radiation with λ_{max} = 445 nm, the corresponding increase in the relative number of cells in the sub-G1 phase is only 1.5% and 2.5%. The increase in the relative number of cells in the necrosis phase after exposure to blue light with λ_{max} = 405 nm compared to the control is 6% at D = 7.5 J/cm^2 and 15.5% at D = 15 J/cm^2. The corresponding increase in the number of cells in the necrosis phase after exposure to light with λ_{max} = 445 nm is 3.5% and 11%. At the same energy dose, a more pronounced decrease in the relative number of cells in the G0/G1 phase is also observed after exposure to radiation with λ_{max} = 405 nm: at D = 7.5 J/cm^2, this indicator decreases in comparison with the control non-irradiated cells by approximately 10%, and at D = 15 J/cm^2 – by 14.5%, whereas after exposure to radiation with λ_{max} = 445 nm, the corresponding decrease in the relative number of cells in the G0/G1 phase is 4.5% and 11%. The number of cells in the G2/M phase after exposure to radiation with λ_{max} = 405 nm at D = 7.5 J/cm^2 increased compared to the control non-irradiated samples by approximately 3%, and at D = 15 J/cm^2 - by 9%, whereas after exposure to radiation with λ_{max} = 445 nm, the corresponding increase in the relative number of cells in the G2/M phase is 2.5% and 8%. It is shown that the change in the parameters of the cell cycle, as well as cell death by the mechanism of necrosis and apoptosis when exposed to blue light, are due to the generation of active oxygen forms by endogenous photosensitizers.

PI-36

PHASE TRANSFORMATIONS OF LIGHT BEAMS IN PHOTOREFRACTIVE CRYSTALS OF BISMUTH SILICATE

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Abstract. Photorefractive crystals of bismuth silicate $Bi_{12}SiO_{20}$ are semiconductors with a broad forbidden band, which still are highly sensitive to radiation in the visible spectral region due to numerous impurity and defect centers in sillenites [1]. Crystals of the sillenite family enable fast recording and erasure of information, dynamic gratings including. These crystals are extensively used in systems of real-time optical processing of the light fields, in systems for data storage and transmission in the process of designing the controlled elements of adaptive and wave-guide optics, in holographic interferometry inclusive of the vibrational amplitude measurements in the subnanometer range [2, 3].

This paper presents realization of a pulsed recording of singular dynamic holograms [4] with the use of Gaussian and singular beams in photorefractive crystals of bismuth silicate. At the first stage volume holograms have been recorded in a photopolymer characterized by high resistance to radiation damage to enable the formation of singular beams (optical vortices). On reconstruction of the holograms recorded in the photorefractive crystal, the Gaussian beam propagation was in zero diffraction order and a singular beam was propagating in the first diffraction order. This scheme is distinguished by the use of the transmitted and of the diffracted beams for interference analysis of the topological charge of an optical vortex. Owing to two transmitted beams, one can compensate for the effect of optical activity and obtain a high-quality interference pattern with high visibility.

Moreover, the use of four-wave interaction scheme to record dynamic holograms has permitted realization of the wavefront conjugation effect. In this case the recorded hologram is read out by the laser pulse counterpropagating to the reference wave. The diffracted wave is counterpropagating to the signal wave, with the same spatial distribution of the amplitude and phase. Compensation for the phase distortions on return propagation of the diffracted wave has been demonstrated.

As shown by analysis of dynamic recording and relaxation of dynamic gratings in crystals of bismuth silicate, the formed gratings of two types were different as to the formation mechanisms and recording or relaxation times. The conditions of recording the short-lived (a few hundreds of microseconds) and long-lived (several seconds) dynamic gratings effective in systems of adaptive interferometry have been determined.

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PI-37

PHOTODAMAGE TO ERYTHROCYTES INITIATED BY EXCITATION OF ENDOGENOUS PHOTOSENSITIZERS

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Abstract. The radiation of blue and green spectral regions is widely used in modern neonatology for the treatment of hyperbilirubinemia (jaundice) in newborn children by exposing of child's body surface to light. Another area of application of this physical factor in medical practice is antimicrobial phototherapy and therapeutic technologies based on intravenous light irradiation of blood. At the same time, the effect of blue-green light on blood cells has hardly been studied.

In the present work, the photodamage of human (adult donors) red blood cells was investigated when exposed to their suspension by radiation from LED sources with the wavelengths of the emission spectra maxima λ_{max} = 463 nm and λ_{max} = 517 nm, forming a uniform light spot with irradiance at the surface level of the samples I_{LED} = 12 mW/cm^2. The tests indicating photodamage of the erythrocyte membrane were data on the concentrations of potassium K^+ ions and hemoglobin molecules in the solution surrounding the erythrocytes, which was extracted by centrifugation of the suspension as a supernatant. The magnitude of the photobiological effect was characterized by the ratio of optical densities at the Soret band maximum (λ_{max} = 416 nm) in the supernatant of experimental and control samples, as well as by the ratio of K^+ ion concentrations in the supernatant of experimental and control samples.

The performed studies have shown that the effect of radiation from LED sources of blue (λ_{max} = 463 nm) or green (λ_{max} = 517 nm) spectral regions at irradiance of I_{LED} = 12 mW/cm^2 for 20 minutes (energy dose D = 14.4 J/cm^2) on the human erythrocyte suspension in the phosphate buffered saline leads to erythrocyte membrane damages, which is confirmed by an increase in the optical density of supernatant in the Soret band of hemoglobin. The values of photohemolytic effects are approximately equal when exposed to radiation from blue and green spectral regions.

Molecular-structural changes in erythrocyte membranes when exposed to light of the mentioned above parameters are most likely stipulated by the excitation of endogenous porphyrin (protoporphyrin IX, zinc-protoporphyrin) and flavin (flavin mononucleotide, flavinadenindinucleotide) photosensitizers contained in the erythrocytes in low concentrations, but characterized by high efficiency of generation of reactive oxygen species. The leading role of porphyrin compounds in the effects of sensitization is substantiated.

The effect of radiation of the same parameters on the erythrocyte suspension almost does not influence the permeability of cell membranes for potassium ions. The difference in the effect of blue-green radiation on the release of hemoglobin molecules from erythrocytes and ion transport through the membrane is consistent with the known information about the spatial separation of these processes in the membrane and the difference in the mechanisms mediating them.

PI-38

TWO-COLOR PICOSECOND RAMAN LASER ON WATER WITH MULTIPLE TEMPORAL COMPRESSION OF THE STOKES PULSE AND PUMP PULSE RETARDATION IN A COLLIMATED BEAM

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Abstract. For the first time to our knowledge, we report the multiple temporal compression of a pulse of the laser based on the stimulated Raman scattering (SRS, Raman laser) when water (H_2O) in a 30-cm long cuvette is pumped by the collimated beam of picosecond laser (60 ps, 532 nm). Earlier, we have studied several sets of SRS generation when pumping H_2O samples by the collimated beam of picosecond pulses. However, it remained unclear if the output SRS pulse duration depends on the sample length, and studying this question was the main goal of the present work. In the experiments, the laser system has been used consisting of a master oscillator (1064 nm) and cascade of 4 amplifiers allowing the generation of the trains of 1 to ~ 120 pulses long. The pulses were then frequency doubled in a KDP crystal providing single pulse energy up to 2 mJ (35 MW) at 532 nm. Using Hamamatsu C8484-05G02 CCD camera, SRS beam track images were acquired in 90° scattering geometry.

Raman lasing threshold and SRS pulse duration in double distilled H_2O have been measured (~ 0.8 mJ/pulse (80 MW), and ~10 ps respectively). The SRS track profiles have demonstrated the monotonous SRS intensity growth from the input to the output windows of the sample cuvette. Also, pump and SRS pulse durations have been measured utilizing a PS-1 S1 streak camera (manufactured in Prokhorov General Physics Institute of Russian Academy of Sciences, Moscow, Russia). The 6-fold SRS pulse temporal compression (power also) has been revealed compared to the pump pulse. The observed compression is due to the exponential law of the SRS intensity generation: $I_{SRS} = I_0 \cdot \exp(I_p \cdot g \cdot L)$, where I_{SRS} is the SRS Stokes intensity, I_0 is the noise intensity at Stokes frequency, g is the SRS gain coefficient, and L is the interaction length. The calculations of the group velocity mismatch between the SRS Stokes (650 nm) and pump (532 nm) pulses give an ~11 ps retardation of the pump pulse at 30 cm of the sample cuvette relative to the SRS pulse. Such a result makes it possible to carry out pump-probe experiments on studying the hydrogen bond dynamics in water [1] if one uses sub-picosecond pump pulse durations. Knowing that Raman laser can be pumped by femtosecond laser pulses [2], the chirped SRS pulses generation could be achieved with controllable chirp sign and subsequent compression to even shorter durations.

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PI-39

NEW UP-CONVERSION MATERIAL FOR THERMOMETRY: FLUOROALUMOPHOSPATE GLASSES DOPPED Ho^{3+} AND Yb^{3+} IONS

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Abstract. Materials activated by Ho^{3+} ions are widely used in the development of sensors, both as luminescence sources [1] and sensitive elements [2]. For fluorescent temperature sensors, glasses are in particular used [3, 4]. Recently, a low-phosphate alumofluoride glass has been developed that combines the best characteristics of phosphate and fluoride glasses, exhibits high up-conversion properties with Tm-Yb [5] and is promising for use in fluorescence thermometry with Er-Yb [6].

In this work, we studied up-conversion (UC) properties and temperature sensitivity of such glasses, doped by Ho^{3+} and Yb^{3+} ions, depending on CW IR (960 nm) pump power and ions concentration for the purpose of their application for biology, aviculture, pipeline and sewerage as sensors sensitive elements. Measurement of UC spectra for log-log intensity dependence on pump power was carried out at the room temperature by the pump power changing from 0.1 to 2 W. The temperature sensitivity was defined by fluorescence intensity ratio (FIR) technique in the temperature range from + 25 °C to + 200 °C at pump power of 0.4 – 1 W. UC spectra and slope *n* point to different channels of energy levels population of excited Ho^{3+} ions due to energy transfer from Yb^{3+} ions as (ETU) mechanisms for different ions concentration. More sensitive to temperature changes are FIR of sub-bands near the wavelengths of 543 nm/657 nm and for integral intensities within the wavelengths of green and red fluorescence bands. The FIR-dependence is well approximated by a linear function with a correlation coefficient close to 1. The sample containing 0.5 mol.% Ho^{3+} and 5 mol.% Yb^{3+} gave the largest UC intensity. For this glass, at the pump power of 0.4 W, the maximum relative thermal sensitivity S_r (0.49 % K^{-1} at 298 K) was obtained, and the temperature resolution (δT) was 0.5 K. The obtained results show that this glass is comparable in S_r to TZBYH3 glass [3], is better than fluoroborate glass [4] and surpasses these materials in δT.

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PI-40

UP-CONVERSION OF TRACE THULIUM IONS IN YVO_4 CRYSTAL EXCITED BY NONRESONANT IR RADIATION: MECHANISM AND NONLINEAR EFFECTS

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Abstract. The yttrium orthovanadate crystal (YVO_4) continues to be widely used for the conversion of laser radiation by the method of stimulated Raman scattering (SRS) [1] and to enhance the contrast of femtosecond pulses with a wavelength of 1 μm [2]. Relatively recently, it was discovered that SRS conversion of continuous-wave radiation (1064 nm) in YVO_4 is accompanied by the up-conversion of trace Tm^{3+} ions (10^{-5}–10^{-6} %) in the 475 nm range, characterized by an anomalous process involving two absorbed photons [3]. It is in contrast to the classical excitation schemes of blue up-conversion fluorescence of Tm^{3+} ions with the participation of three to four photons, depending on their concentration. For the first time, the report substantiates the mechanism of such up-conversion based on experimental data obtained by the adapted Z-scan method with simultaneous registration of up-conversion radiation. The shape of the transmission curve measured in a closed-aperture scheme reflects the contribution of nonlinearity due to free charge carriers [5, 6]. The data obtained in the open-aperture scheme showed that the excitation of the up-conversion fluorescence of trace Tm^{3+} ions in YVO_4 was accompanied by a complex change in its transmission with the manifestation of the saturation effect of the population of $^3F_4$ and $^3H_4$ multiplets of Tm^{3+} ions and the appearance of nonlinear absorption and photo-darkening in the sample. The effects of nonlinear absorption [7], photo-darkening [8] and the formation of free charge carriers [9] are associated with the excitation of the crystal lattice due to the transfer of energy to it during photon absorption. In our case, the absorption of two photons of continuous-wave IR radiation by Tm^{3+} ions is sufficient to populate the $^3F_2$ and $^3F_3$ levels and emit 671 nm radiation from them. This radiation is absorbed by other excited Tm^{3+} ions, transferring them from the $^3H_4$ level to the $^1D_2$ state with emission of 453 nm radiation and relaxation to the $^1G_4$ level. Further, the absorption of photons of visible radiation will lead to the excitation of the crystal matrix and the transfer of energy during the exchange interaction to Tm^{3+} ions, maintaining the population of $^1D_2$ and $^1G_4$ multiplets. The work was partially sponsored by the SPSR "Photonics and Electronics for Innovations" (tasks 1.2).

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PI-41

BEHAVIOR OF C_{60} FULLERENE IN A BINARY MIXTURE OF XYLENE AND ETHANOL

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Abstract. The study of molecular and colloidal solutions of pure fullerenes is of both practical and fundamental interest in connection with the emergence of new controllable properties of fullerenes in solutions [1]. On the other hand, understanding the self-organization of fullerene molecules in solutions is necessary for the synthesis on their basis of nanostructured materials with well-controlled properties [2]. Determining the onset time and duration of clustering of fullerene molecules (C_{60}) in solutions has also not been fully studied. These issues represent a very complex experimental problem and require systematic study, since the phenomena governing self-organization occur at subnanometer sizes. The study of physical processes that occur especially in binary solvents at low concentrations of C_{60} fullerene is of particular interest from a practical point of view. The purpose of this work is to experimentally study the formation and stability of C_{60} colloidal dispersions in C_{60}/xylene/ethanol solutions using optical absorption, Raman spectroscopy, refractometry and dynamic light scattering (DLS). Various combinations of solvents and fullerene concentrations were investigated. A correlation has been established between the change in the refractive index of the C_{60}/xylene/ethanol solution and the degree of self-organization of C_{60} molecules in the medium at various concentrations and storage periods of the solution. It is shown that the features of the optical absorption spectrum of C_{60}/xylene/ethanol at a fixed low concentration of the fullerene are sensitive to its storage time. It was determined that the beginning time of the formation of C_{60} nanoclusters and their final size depend on the degree of concentration of fullerene and the time of keeping the solution. The observed nature of the C_{60} fullerene solution in a binary mixture may help to elucidate the mechanism of self-organization in the future. Studying the self-assembly properties of C_{60} fullerene in binary solvents will help in analyzing the formation of other organic nanoclusters with similar growth and morphology. The specific parameters of C_{60} nanoclusters (stability inside and outside solution, electron transport, photovoltaic properties, energy storage, photovoltaic and other properties) are still not fully understood and thus represent an excellent area for future research.

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PI-42

DEVELOPMENT OF A SHORT-GUN TRAINING DEVICE USING INFRARED POSITION SENSORS

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Abstract. The short gun is a commonly used weapon in the armed forces, and regular shooting training is a critical task. However, traditional training methods have limitations regarding accuracy and effectiveness when checking the sightline. We have developed a training device for gun shooting that utilizes infrared positioning sensors. It acts as a simplified camera system mounted on the gun. The infrared sensors determine the aiming direction of the weapon in real time by tracking the coordinates of an infrared light source mounted on the training target. This system allows for analyzing the aiming spot path, scoring of each shot, and evaluation of key movements during training. The device is lightweight, low-cost, easy to deploy, and provides advantages such as time control, precise determination of the aiming path, gun balance, vibration measurement, and shot result evaluation.

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PI-43

PHOTOLUMINESCENCE TEMPERATURE DEPENDENCE STUDY OF CdSe QUANTUM DOTS

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Abstract. Colloidal semiconductor nanocrystals, so-called quantum dots (QDs), have generated tremendous interest both for fundamental research and technical applications such as light emitting diodes (LEDs), P. O. Anikeeva et al [1], bioimaging, H. Tada et al [2], and solar cells, B. Farrow et al [3]. Because of their size-dependent photoluminescence (PL) related to quantum-size effect tunable across the wide visible spectrum, CdSe QDs have become the most extensively investigated QDs, M. G. Bawendi et al [4].

In this study, CdSe quantum dots (QDs) were successfully prepared. Synthesized CdSe QDs were characterized by field-emission transmission electron microscope (FE-TEM - Titan G2 ChemiSTEM Cs Probe from FEI Co.). Then, the CdSe QDs were used for spin coating on glass substrate and the CdSe QDs thin film on glass was used to study the temperature dependence of photoluminescence (PL). The PL of the samples was measured under excitation by an iHR320 imaging spectrometer (Horiba Jobin Yvon).

In detail, the CdSe QDs were prepared by TOPO-TOP based organometallic synthesis, H. W. Park et al [5]. 2 M stock solution of trioctylphosphine selenide (TOP : Se) was prepared by dissolving 15.8 g of Se into 100 mL of TOP. The stock solution was filled in 100 mL three-neck round-bottomed flask and fitted with a thermocouple temperature sensor and condenser, with TOPO (10 g), HDA (10 g) and TOP (2.5 mL), and heat to 170^0C under vacuum for 1-2h and raise the temperature to 340–350^0C. In a separate vial, mix $Cd(acac)_2$ (620 mg), HDDO (1 g), and TOP (5 mL) and heat under vacuum to 100^0C; the solution should become homogeneous. Cool the mixture to approximately 80^0C and add 5 mL of a 2 M TOP : Se. The solution mixture of cadmium and selenium precursors was rapidly injected into the hot flask containing the coordinating solvent, and then cooled using each solvent. The QDs extracted from same hot batch were divided into different cooling solvents. The TEM images of the CdSe QDs are shown in Figure 1. The black scale bar in the image indicate the lengths of 20nm. The images display the shape and size distribution of the synthesized QDs. Spherical nanostructures are observed, which have an average diameter of about 5 nm. The synthesized CdSe QDs were used for coating on glass substrate.

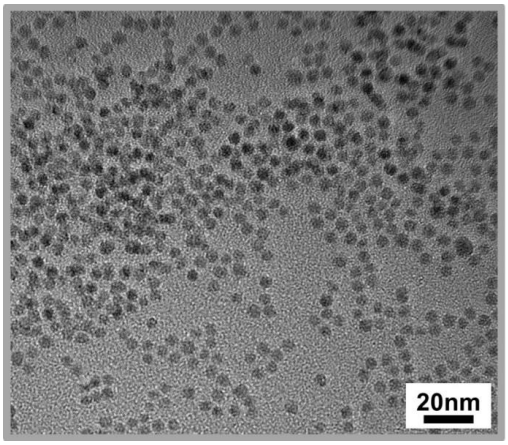

Figure 1. TEM images of the CdSe QDs. The black scale bar in the image indicate the lengths of 20nm.

Temperature dependent PL spectroscopy is often used to study the radiative and non-radiative relaxation processes, as well as exciton-phonon coupling in colloidal core and core/monoshell QDs. So, the coated CdSe QDs samples on glass were used to study the temperature dependence of PL the range 170-270 K in order to investigate thermal quenching

behavior of CdSe QDs. The image of measure system is shown in figure 2a. The measured results (figure 2b) indicate clear changes in the PL intensity, peak position, and FWHM. With increasing temperature, the PL intensity decreases, the emission spectra slightly red shifted, with line broadening.

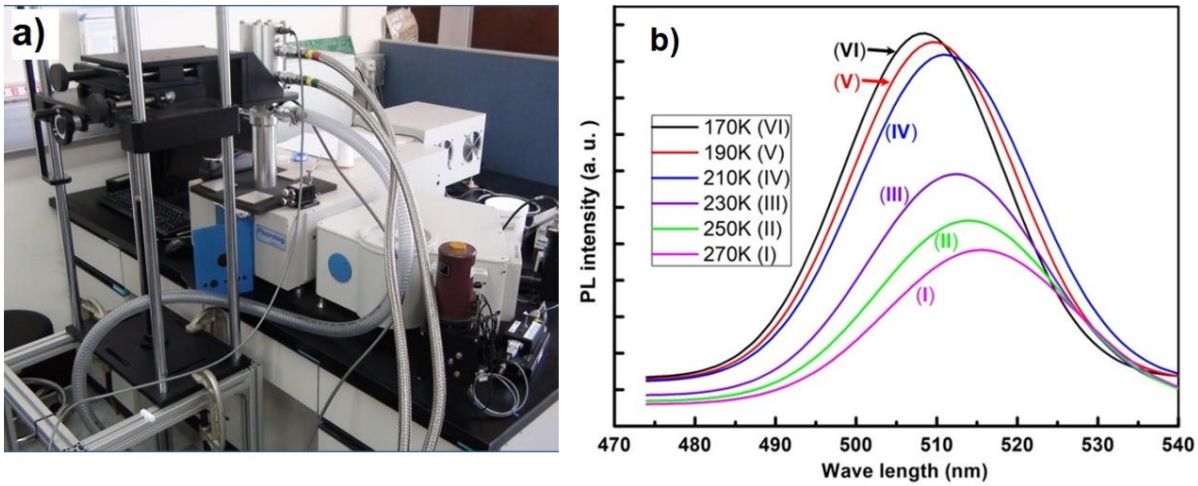

Figure 2. Image of measure system (a); Temperature dependence of CdSe QDs PL (b)

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PI-44

DECTECTION OF CHLORAMPHENICOL AT LOW CONCENTRATION BY SERS METHOD

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Abstract. Chloramphenicol (CAP) is a broad-spectrum antibiotic widely used in livestock farming, medicine and aquaculture. However, high consumtion rate of CAP poses significant risks to human health. Despite being banned in many countries worldwide, illegal usage of CAP is still being continued due to the economic incentives and some difficulties of rapid detection of CAP residual. Our research focuses on using surface-enhanced Raman scattering (SERS) to detect CAP. These SERS sensors have been fabricated using metal nanoparticles synthesized via PLA techniques. Thanks to their high sensitivity, we have successfully detected the SERS spectrum of CAP at low concentrations. The result are presented in this report.

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PI-45

SPECTROSCOPIC PARAMETERS AT HIGHT TEMPERATURE OF SELF BROADENED CO USING THE CLASSICAL MOLECULAR DYNAMICS SIMULATIONS

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Abstract. In this work, using the requantized Classical Molecular Dynamics Simulations (rCMDS), the spectroscopic parameters for lines with rotational quantum number from 1 to 50 of self-broadened CO including the collisional broadening coefficient, the speed dependence of collisional broadening coefficient and the line-mixing coefficients have been predicted. For this objectives, our calculations were performed at 1000 K for pure CO at 1 atm and for various Doppler widths. Therefore, the obtained absorption spectra have a large range of collisional to Doppler widths ratio. In the calculation, a total of 100×10^6 molecules were considered, and the obtained spectra have a signal-to-noise ratio of up to 1000. To deduce the corresponding spectroscopic parameters, the obtained spectra were then fitted using multi-spectrum procedure and using two line-shape profiles: the usual Voigt profile, the speed-dependent Voigt, both associated with the first-order line-mixing approximation. The results show a good agreement with available experimental data for all the considered transitions. These results confirm the quality of predictions using rCMDS to improve spectroscopic databases for remote sensing applications.

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PI-46

RESEARCH ON DEVELOPING A METHOD TO EVALUATE CAMOUFLAGE EFFECTIVENESS BASED ON HISTOGRAM GRAY LEVEL SIMILARITY

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Abstract. In this study, a new method to evaluate camouflage effectiveness is presented, based on gray level Histogram analysis. Using a tool built on a computer, the research team analyzed the color histogram of the camouflaged target image and the background image and compared the two obtained color histograms to give results about their similarity. In addition, comparing the average gray level of the target image and the background image also shows their similarity. Research results show that good camouflage products produce similarity of grey level over 70%, and the average grey intensity difference is only about 10. These are the grounds for concluding about similarity of the camouflaged target and the background.

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PI-47

RESEARCH AND DEVELOP A METHOD TO EVALUATE CAMOUFLAGE EFFECTIVENESS BASED ON THE RADIATION ENERGY REDUCTION COEFFICIENT

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Abstract. A method to evaluate camouflage effectiveness is mentioned in this study, based on analysis of the emission energy spectrum measured from the target. An advanced device SR5000N was used to measure the energy emitted from the target, at different temperature levels, in camouflaged and undisguised states. Based on the results obtained, it is possible to calculate the target's emission reduction coefficient after being camouflaged. Experimental results show that with camouflaged targets, energy reduction can reach over 80%, for both the 3 - 5 μm and 8 - 14 μm spectral ranges. This is one of the highly scientific evaluation criteria that can serve as an objective basis for drawing conclusions about the effectiveness of camouflage products.

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PI-48

RESEARCH ON OPTIMAL DESIGN OF OPTICAL AND MECHANICAL SYSTEMS MULTI-FUNCTIONAL DIGITAL CAMERA MOBILE DEVICE INTEGRATING DAY, NIGHT AND NIGHT AND LASER CHANNELS

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Abstract. Specialized and imported camera mobile device products will be passive and difficult to repair and maintain when damage occurs. Besides, foreign products used in temperate countries with high humidity will make preservation difficult during use. Domestically, the research and production of handheld multi-purpose digital camera mobile device faces a number of limitations, leading to the inability to optimize size and mass. Some current urgent requirements need to be achieved such as: 1) Enhance proactiveness and flexibility; 2) Reduce the amount of equipment on staff, convenient for equipment management; 3) Convenient in preservation, maintenance and repair work; 4) Reduce device size and weight and integrate many features; 5) Gradually mastering domestic processing technology is essential. This article presents research on the optimal design of multi-purpose digital camera mobile device to serve made in Vietnam.

PI-49

INVESTIGATING SLOW-LIGHT SOLITON PROPAGATION IN A TRIPOD-TYPE ATOMIC SYSTEM BY AN ANALYTICAL APPROACH

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Abstract. In the past few decades, many researchers have comprehensively studied a large number of nonlinear optical phenomena based on atomic coherence and quantum interference. One of the most significant phenomena is optical soliton, a kind of special preserved-shape wave propagation phenomenon in nonlinear media, which originates from the balance between the nonlinear effects and the dispersion properties of the media under excitation. Optical soliton is of exceptional interest to researchers due to its wide range of potential applications in optical communication, optical computing, and information processing [1-2]. Recently, the discovery of the electromagnetically induced transparency (EIT) effect [3] has created a resonant non-absorption medium. In addition to a large suppression of optical absorption, the EIT effect can be used to substantially enhance the efficiency of nonlinear optical processes [4]. Studies have shown that optical solitons, which have ultraslow propagation velocity and ultraslow generation power, can be generated in the system via EIT and stored and retrieved with high efficiency and fidelity [5-6].

In this paper, we develop a systematic analytical approach on linear and nonlinear pulse propagations in a four-level tripod-type atomic system. The optical responses in the linear dispersion domain with EIT are calculated in detail. Then, using the method of multiple scales, we derive a nonlinear envelope equation for probe-field propagation. We show that stable ultraslow solitons can be realized in the four-level tripod system.

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PI-50

QUANTUM COHERENCE PROPERTIES IN PULSE PROPAGATION IN DOUBLE EIT WINDOW OF ATOMIC MEDIUM

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Abstract. Coherent interaction by laser light of quantum states of atoms and molecules can lead to quantum interference in the amplitudes of optical transitions [1]. Quantum interference and quantum coherence in an atomic system can lead to many important optical phenomena such as lasing without inversion [2], enhanced index of refraction [3], electromagnetically induced transparency [4], and slow light propagation [5]. EIT is a quantum interference effect that occurs when a weak probe light field, resonant with an atomic transition, propagates through a medium whose absorption is reduced due to the presence of a strong coupling light field on the linked transition. The EIT can be created from basic three-level configurations: Ξ, Λ, and V [6]. However, for a three-level configuration, only one EIT window is created. This will reduce the application requirements for transmission bandwidth expansion. Therefore, the study of multi-level atomic systems becomes necessary, and the study of EIT and other coherent effects in four-level systems is fundamental to nonlinear optics.

In this paper, we study the influence of quantum interference and quantum coherence on the pulse propagation process in the four-level tripod configuration of ^{87}Rb atomic system [7]. By changing the parameters of two strong control laser fields, the propagation of the weak probe laser field in the EIT windows changes significantly. In particular, this paper emphasizes the comparison between the propagation at the resonant frequency and at the windows outside the resonant frequency. Consequently, the proper sets enable us to flexibly switch different controlling or probe frequency detunings from absorption to transparency, which is completely equivalent of diminishing or allowing stable pulse propagation. Besides, when choosing the position of the windows symmetrically through the resonance center, the propagation efficiency in these two windows is equal. This investigation will be very useful for realizing the storage and retrieval of light in quantum information.

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PI-51

CONTROLLING OF SYNCHRONOUS ALL-OPTICAL SWITCHING VIA A RELATIVE PHASE UNDER THE INFLUENCE OF SGC

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Abstract. Since the end of the 20th century, the use of one light beam to turn on or off another light beam in all-optical switching has attracted great attention from modern physicists in the field of quantum optics and nonlinear optics due to their potential applications in quantum information systems and quantum computers [1-3]. In particular, the advent of the electromagnetically induced transparency (EIT) effect has led to an excellent method for all-optical switching at low light levels. The EIT medium not only suppresses linear absorption but also enhances the nonlinear induction in the vicinity of the atomic resonance frequency [4]. Thus, the EIT can can considerably enhance the interaction between light and matter, enabling nonlinear optical processes to achieve significant efficiency even at one single-photon level. The EIT effect can also modify the propagation dynamics of light pulses such as the formation and propagation of optical solitons, optical bistability, all optical switching and so on.

In this paper, A three-level V-type atomic model is proposed to study all-optical switching in the presence of spontaneous coherence [6]. By simultaneously solving the coupled Maxwell-Bloch equations for the atom and the field on the space-time grid, we demonstrate that the continuous-wave probe field can be synchronously switched in the [0-π] phase domain by varying the control parameters. Our results open a route not only for all optical switching of nonlinear optical pulses but also for promising applications in optical and quantum information processing and transmission.

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PI-52

COMPARISION OF ANTHOCYANIN CONTENT OF PURPLE SWEET POTATO AND RED CABBAGE USING SPECTROSCOPIC TECHNIQUES

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Abstract. Anthocyanin pigments are natural antioxidants which have many benefits in the food, health, and medicine. Anthocyanins originating from different commodities have different constituent components and this will affect the anthocyanin content of total in foodstuff. This research aims to assess differences of extracted anthocyanin in purple sweet potato, red cabbage and in vegetable varieties. Various spectroscopic techniques, including Ultraviolet-Visable Spectrocopy (UV-Vis), Fourier Transform Infrared Spectrocopy (FTIR), were employed to investigate the characteristics of these pigments [1]. The research on anthocyanins in red cabbage and purple sweet potatoes reveals significant differences in both anthocyanin content and structural characteristics between the two vegetables [2]. Spectroscopic analysis using UV-Vis shows pronounced absorption peaks at 520 nm and 550 nm for purple sweet potatoes, indicating a higher concentration of anthocyanins [3], whereas purple cabbage exhibits weaker absorption at these wavelengths. FTIR spectroscopy further supports these findings, with distinct absorption peaks for purple sweet potatoes at 3350 cm^{-1} (associated with -OH groups) and 1620 cm^{-1} (linked to C=C bonds), suggesting a more complex anthocyanin structure [4]. In contrast, red cabbage shows less pronounced peaks at these wavelengths, reflecting a simpler anthocyanin profile. Additionally, significant differences in anthocyanin profiles were observed at pH 1.0, with a notable disparity compared to pH 4.5 and other pH levels, indicating that anthocyanin stability and structural characteristics are significantly influenced by acidic conditions [5]. Overall, the study brings out substantial differences in anthocyanin content and structure between purple sweet potatoes and red cabbage, emphasizing the impact of pH on anthocyanin behavior.

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PI-53

PARTICLE SIZE EFFECTS IN THE ABSORPTION AND SCATTERING SPECTRA OF SPHERICAL GOLD AND SILVER NANOPARTICLES

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Abstract. The influence of the sizes of silver and gold nanoparticles on their absorption and scattering spectra in the optical range has been investigated. Numerical calculations of extinction cross-sections were performed using Mie theory, which provides solutions to Maxwell's equations for the incidence of a linearly polarized monochromatic plane wave on a spherical surface. It was found that the spectra of nanoparticles of different sizes qualitatively differ from each other as their sizes change. The obtained results can be used in the development of spectroscopic methods for determining the shape of metallic nanoparticles and for quantitatively assessing their characteristic sizes.

Keywords: nanoparticles; localized surface plasmon; absorption and scattering of light.

PI-54

SURFACE MODIFICATION OF NITROGEN-DOPED CARBON QUANTUM DOTS FOR ENHANCED FUNCTIONALITIES

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Abstract. A facile and controllable one-step atmospheric pressure microplasma method was employed to synthesize nitrogen-doped carbon quantum dots (N-CQDs) with tunable optical properties. The N-CQDs were characterized using Fourier transform infrared spectroscopy, high-resolution transmission electron microscopy, UV–Vis absorption spectroscopy, and photoluminescence spectroscopy. HRTEM revealed uniformly distributed spherical nanoparticles with a graphite-like structure. FTIR confirmed effective nitrogen doping, enhancing chemical stability. UV–Vis spectroscopy revealed redshifted absorption peaks, indicating improved electronic interactions and a reduced bandgap (3.12 eV) compared to those of undoped CQDs (3.84 eV). PL analysis revealed excitation-dependent emission and a significantly higher photoluminescence quantum yield (PLQY) of 33.09%. These results suggest that N-CQDs hold promise for applications in optoelectronics and bioimaging, providing a foundation for further optimization in future studies.

Keywords: Microplasma, nitrogen-doped carbon quantum dots, optical properties, surface modification.

PI-55

SOI SLOTTED L3 PHOTONIC CRYSTAL MOLECULES FOR QUANTUM OPTICS

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Abstract. This report presents our results on the design of coupled L3 slotted photonic crystal (PhC) cavities on a silicon-on-insulator (SOI) platform using Finite-Difference Time-Domain method. A series of L3 slotted PhC cavities operating in telecommunication range have been investigated by controlling PhC lattice constants in single slot cavities (silicon thickness of 300 nm, radius hole of 105 nm, slot width of 110 nm and lattice constant varies between 330 nm and 400 nm). These L3 slotted PhC cavities possess Q factor of several hundreds and confine light in an extreme small mode volume of wavelength cubic scale. Based on these results, the resonance wavelengths of coupled L3 slot cavities have been successfully determined. The electric field distributions, Q factors of single L3 slotted PhC cavities, and $\Delta\lambda$ (the difference between the two resonance wavelengths) of coupled L3 slotted PhC cavities which are of several tens nanometer, reveal the behavior of light in the telecommunication range within PhC cavities with different lattice constants. This work contributes to the advancement of photonic integrated circuits and these structures can be promising candidates for applications in fields such as quantum optics, where precise control over resonant modes is crucial.

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POSTER SESSION II

PII-01

SINGLE- AND MULTIVARIATE FLUORESCENT THERMOMETRY WITH MPy(OPrOH)$_2$ PORPHYRIN FOR BIOLOGICAL APPLICATION

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Abstract. Fluorescence thermometry is characterized by high thermal, temporal and spatial resolution and is promising to study biological activity down to the cellular and subcellular scale. In [1] MPyPP(OH)$_2$ porphyrin was successfully demonstrated as a subcellular ratiometric thermal sensor in different types of cells. In this work the fluorescent properties of MPy(OPrOH)$_2$ porphyrin is studied and single- and multivariate strategies are applied for temperature calibration from 293 to 318 K with a step of 0.5 K. Fluorescence spectra were recorded by the Fluorolog-3 modular fluorometer in the range of 540-760 nm. For single-variate thermometry the fluorescence intensity ratio (FIR) [2] between two spectral peaks (612 nm and 664 nm) and the valley between them (643 nm) was selected. Principal component analysis (PCA) [3] was used for advanced selection of wavelengths for the FIR method and for multivariate thermometry along with the partial least squares method (PLS) [4].

FIR thermometry is shown to be preferable with wavelengths (610 nm, 664 nm and 585 nm) being extrema of the first principal component loadings spectrum. The relative sensitivity S_r of these models is 0.46 and 0.44 %K^{-1} for 610/585 nm and 664/585 nm compared to 0.13 and 0.12 %K^{-1} for 612/643 nm and 664/643 nm. Corresponding values of the temperature uncertainty δT are 0.88 and 0.94 K as compared to 2.00 and 1.72 K for traditional selection of fluorescence wavelengths. For temperature calibration by scores in the first principal component S_r=4.72 %K^{-1} and δT=0.33 K.

Multivariate calibration models use the regularly selected non-repeating training and test subsets of fluorescence spectra. Comparison of single- and multivariate models was carried out by values of the temperature uncertainty using the same test subsets. δT for FIR with advance selecting wavelength are 0.37 and 0.39 K for 610/585 nm and 664/585 nm. For multivariate PLS and principal component regression (PCR) δT=0.16 K and δT=0.15 K, respectively. Using the selection of spectral variables in the interval PLS method by searching the combination moving window (scmwiPLS) [5], the δT value can be reduced to 0.10 K. Thus, multivariate thermometry is significantly superior to single-variate one in terms of sensitivity and temperature uncertainty and is promising for monitoring biological activity at the subcellular level using MPy(OPrOH)$_2$ porphyrin fluorescence.

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PII-02

CHANGES IN THE MECHANISM OF DARK CHEMICAL REACTIONS INDUCED BY LIGHT AND CURCUMIN IN CANCER CELLS OVER TIME AFTER CESSATION OF LIGHT EXPOSURE

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Abstract. Despite the large number of publications about use of curcumin as a photosensitizer for antimicrobial photodynamic therapy and sensitized inhibition of cancer cell growth, the detailed mechanism of chemical reactions underlying this technology remains unclear. In this work, we show for the first time that after the cessation of light exposure on cancer cells sensitized with curcumin, chemical processes continue to occur in the cells, and the contribution of various types of reactive oxygen species (ROS) to these reactions depends on the duration of the dark period. The studies were performed with HeLa cells. The parameters of light-induced chemiluminescence of cell suspension, as well as the metabolic activity of the cells, which was assessed using the colorimetric MTT test, served as tests indicating photodamage to cells sensitized with curcumin. Moreover, the parameters (intensity and light sum) of chemiluminescence were analyzed immediately after the cessation of light exposure, and the metabolic activity of the cells compared to non-irradiated samples was assessed 21 hours after irradiation of cell monolayers. It is characteristic that after the cessation of light exposure to cells sensitized with curcumin, the chemiluminescence signal exceeds the spontaneous chemiluminescence of the non-irradiated suspension for several tens of minutes. This indicates the occurrence of dark chemical processes in the cells with time after the cessation of their irradiation. The long-term occurrence of dark chemical processes in cells sensitized with curcumin is also evidenced by the greater effect of inhibition of their metabolic activity when monitoring MTT 21 hours after the cessation of irradiation than 1 hour after irradiation of monolayers.

Chemiluminescence studies performed using specific quenchers (interceptors) of active oxygen species, which were added to the cell suspension before irradiation (laser with λ = 405 nm, irradiance - I = 50 mW/cm^2), showed that the most pronounced effect on the intensity and light sum of chemiluminescence is exerted by the singlet oxygen quencher sodium azide, as well as the universal antioxidant quercetin. At the same time, the hydrogen peroxide interceptor, sodium pyruvate, has virtually no effect on the efficiency of photodamage to cells. In contrast to these data, the effect of light on the metabolic activity of cells sensitized with curcumin, assessed 21 hours after the cessation of irradiation, showed that the main intermediate determining the decrease in metabolic activity is hydrogen peroxide. It was concluded that after the cessation of cell irradiation, the formation of singlet oxygen sensitized by curcumin stops. At the same time, a wave of massive secondary production of ROS, and, above all, hydrogen peroxide, is launched, which is recorded in cells long after the end of irradiation.

PII-03

THE DEPENDENCE OF METABOLIC ACTIVITY OF CANCER CELLS AND EFFICIENCY OF INTRACELLULAR GENERATION OF REACTIVE OXYGEN SPECIES ON WAVELENGTH OF AFFECTED RADIATION OF VIOLET AND BLUE SPECTRAL RANGES

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Abstract. Studies, carried out in this work, showed that the effect of optical radiation from LED sources in blue spectral region peaking at λ_{max} = 395 nm, 405 nm, 415 nm, 445 nm and 465 nm, in the energy dose range of D = 1.5 –15.0 J/cm^2 has a dose-dependent inhibitory effect on the metabolic activity of HeLa cells, controlled 21 h after cessation of irradiation. At a constant energy dose, the inhibitory effect of blue light decreases with increasing wavelength of the applied radiation. A similar pattern can be observed when monitoring the level of light-induced ROS formation using chemiluminescence.

It has been shown that the observed spectral-dependent light-induced inhibition of the metabolic activity of cancer cells and the light-induced formation of ROS is due to the changing contribution of endogenous porphyrins and flavins to the total absorption of the influencing radiation when its wavelength changes within the blue spectral region. In this case, the contribution of each endogenous photosensitizer is determined by its concentration, molar absorption coefficient, ROS generation efficacy, spatial localization in the cell near photosensitive molecules and ROS quenchers (interceptors), which have a decisive influence on the efficacy of sensitized processes.

Despite the significantly lower concentration of endogenous porphyrins compared to flavins, tetrapyrrole photosensitizers (protoporphyrin IX, coproporphyrin III, uroporphyrin III, Zn-protoporphyrin IX, Zn-coproporphyrin III) play a decisive role in the generation of ROS and inhibition of the metabolic activity of cancer cells during exposure to blue light, which is confirmed by the higher efficacy of the above processes when exposed to radiation with λ_{max} = 405 nm (corresponding to the maximum of the Soret band of endogenous porphyrins and the local minimum of the absorption band of flavins) in comparison with λ_{max} = 445 nm (corresponding to the long-wavelength maximum of the absorption spectrum of flavins and minimal absorption of porphyrins).

Using specific quenchers (interceptors) of ROS, it was shown, for the first time, that immediately after the cessation of irradiation, the decisive role in light-induced damage to cancer cells is played by singlet oxygen, formed due to the excitation of endogenous photosensitizers, and, to a lesser extent, by hydrogen peroxide. When monitoring the light-induced decrease in the metabolic activity of cells one day after their irradiation, it was found that the decisive role in this process belongs to hydrogen peroxide. It is concluded that the change in the contribution of various types of ROS to the effects of photobiomodulation over time after the cessation of light exposure on cells is explained by a wave of massive secondary production of ROS, and above all, hydrogen peroxide, which, according to literature data, during sensitized processes is recorded in cells several hours later after completion of irradiation.

PII-04

NANOCOMPOSITES OF DETONATION NANODIAMOND WITH FLUORESCENT MEROCYANINE DYES

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Abstract. In the field of biomedical research, it is an important problem to increase the sensitivity of fluorescent methods of analysis for controlling selectivity of distribution in the tissues of the organism of biologically active agents injected as part of drug delivery systems.
Detonation nanodiamonds (DNDs) are a perspective basis for nanocomplexes for biomedical applications, having low toxicity, high biocompatibility and possibility of surface composition modification. With a size less than 100 nm, DNDs are able to cross into body cells without cyto- and genotoxic effects, thus allowing to create complexes with drugs and biomarkers on their platform. Therefore, application of DNDs with fluorescent dyes used as markers for a different biomolecule increases the sensitivity of the analysis and allows controlling the biodistribution of the active substance. In the present work has been developed synthesis of complexes DNDs with fluorescent dyes, which can be used in the field of biomedical applications, has been studied their optical properties. Monofunctionalized DND powders of two types - nanoparticles with surface OH-groups and with a hexamethylethylenediamine linker with a terminal NH_2-group - were used as the basis for the complexes [1]. A number of merocyanine dyes with different polymethine chain absorbing in different spectral ranges were selected for modification of DND. In this way, 4 samples were synthesised - conjugates of mono- and dicarbocyanine dyes with DND-OH and DND-NH_2 [2]. The Mikayama`s reaction allows the preparation of esters and amides under mild conditions (24 h, 25 °C) due to specific activation of the carboxyl group of C dyes by N-bromopyridinium mesylate in dimethylformamide (DMF) environment in the presence of N-methylmorpholine. The resulting suspension of DNDC conjugate is repeatedly centrifuged and dispersed in solvent in order to extract the dyes from the reaction mixture and then dried. Mass fraction of dyes of the obtained powders of nanocomplexes is 5%. Changes in the composition of powders during modification and grafting were confirmed by IR spectroscopy and electronic spectra. The influence of interaction with the surface of DND on the fluorescent properties of dyes requires additional study and is the subject of further research.

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PI-05

ELECTRICALLY CONTROLLED LIQUID CRYSTALIC FRENEL LENS AND DETERMINATION OF TOPOLOGICAL CHARGE OF OPTICAL VORTICES

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Abstract. The unique physical properties and the possibility of effective electrical control of anisotropy have become the determining factors for the use of nematic liquid crystals (NLCs) in the development of new optical devices of flat optics, which are characterized by simplicity, compactness, reliability and affordable price [1-3]. Currently, the key areas of research of many scientific groups are the development of liquid crystal lenses with improved characteristics [4] and the development of simple and inexpensive methods for determining the phase topology of optical vortices [5].

In the work, an anisotropic diffraction structure with a spatial frequency gradient, representing an electrically switchable Fresnel lens, was formed in the NLC layer based on the photoorientation method of the AtA-2 azo dye [6-9]. Effective focusing of radiation in the visible and near-infrared ranges has been experimentally demonstrated. It has been experimentally demonstrated that the application of an external control voltage to a Fresnel lens makes it possible to adjust the focusing efficiency of laser radiation and turn off the lens when the voltage reaches a value of about 20 V. The liquid crystal element has a maximum focusing ability at a voltage of about 3 V. A new simple method for determining the phase topology of optical vortex beams is proposed, based on the coherent addition of beams scattered in the direction of the zero and first orders of diffraction, while information about the topology of the optical vortex is encoded in the resulting interference pattern. The effectiveness of the developed method has been confirmed both experimentally and theoretically.

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PII-06

OPTICAL AND ELECTROPHYSICAL PROPERTIES OF GRANULAR SILVER NANOSTRUCTURES

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Abstract. Plasmonic nanostructures have unique properties due to the presence of surface plasmon absorption resonance (SPRA) bands in the visible and near-IR spectral regions [1, 2]. For silver, compared to other noble metals, the highest quality factor of the SPRA band is achieved [1].

Despite the presence of a large number of works devoted to the study of the optical and electrophysical properties of silver nano- and microstructures, the questions of establishing the relationship between the morphology of such structures and their optical and electrophysical properties have not been sufficiently studied. Detail elucidation of such relationships can be useful in the development of new functional optoelectronic elements that use near-field effects to control their electrical characteristics.

In this work, we studied the optical and electrophysical characteristics of granular silver nanostructures fabricated by the electron beam method on glass substrates at different metal deposition rates. The average particle size d in the initial close-packed monolayers was ~10–15 nm, and its increase to ~35 nm and ~50 nm was achieved during the annealing process.

It has been shown that for silver nanostructures obtained at a low deposition rate (~ 0.02 nm/sec) a pronounced SPRA band is observed in the visible region. These nanostructures are high-resistivity and characterized by a dielectric type of conductivity. The current value when a voltage of 1-20V is applied to the sample is ~ 10^{-9}-10^{-11}A. An analysis of the photoconductivity of the fabricated nanostructures showed that in the region of small negative voltage values, the current value significantly depends on the irradiation wavelength. It should be noted that using the radiation of a certain wavelengths can lead as to increase of the current relative to its dark values, and vice versa, to a decrease. This apparently reflects the peculiarities of the manifestation of electron-photon and electron-phonon interactions in “island film - glass substrate” systems, where there are a large number of bulk and surface traps.

It has been established that close-packed silver nanostructures with particle sizes d ~ 15 nm, obtained at a high deposition rate (~ 0.07 nm/sec), are characterized by a metallic type of conductivity. The current value in them when a voltage of 1-2V is applied is ~ 10^{-2}-10^{-3}A. Nanostructures in which a percolation conduction mechanism was observed were also identified.

Calculations of the changes in extinction for silver nanospheres adjacent to air using Mie theory show that an increase in particle diameter from 10 to 50 nm leads to an increase in extinction by more than 4 times. Granular silver nanostructures with a nanoparticle diameter of 50 nm may be of interest for use as substrates for SERS, and nanostructures with a particle diameter of 10–15 nm are promising for sensor applications.

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PII-07

EFFICIENCY OF PICOSECOND SRS IN LIGHT WATER VERSUS THE DEPTH OF IMMERSION OF THE FOCAL BEAM WAIST OF EXCITING RADIATION INTO IT

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Abstract. The energy efficiency of the generation of the first Stokes component of forward and backward stimulated Raman scattering (SRS) in light water (H_2O) has been studied depending on the position of the focal beam waist of exciting radiation in water volume and near water-air interface. SRS was excited using vertical scheme by the focused beam (focal length of the focusing lens is 83 mm) of picosecond laser pulses (pulse width is 50 – 57 ps, repetition rate is 15 Hz) at 532 nm. The depth of immersion of the focal beam waist center in ampoule water placed in an open-type cuvette (diameter 25 mm, length 75 mm) varied from 64 mm to 0 mm (water-air interface). In each position of the focal beam waist, the dependence of the pulse energy of the first Stokes component on the energy of the pumping pulses was measured. Measurements were made for the forward and backward SRS. For the forward SRS (FSRS), it is shown that when focusing deeper than 14 mm, the conversion efficiency increases sharply at low pumping pulse energies (3 – 5 mJ) and increases smoothly with their increase to 6 mJ, reaching saturation at 7 – 10 mJ with a maximum conversion efficiency of about 33 % at a depth of 64 mm. With decreasing depth, the efficiency decreased to several percent at a depth of 5 mm, then increasing to about 10 % near the water-air interface (0 mm). The behavior of the efficiency change in the depth range of 0 – 5 mm is consistent with the sharp decrease of SRS threshold near water-air interface observed by us earlier. Also, we observed the sharp decrease of optical breakdown threshold of water in the depth range of about 1 – 4 mm. For the backward SRS (BSRS), at great depths (more than 40 mm) the BSRS is weak (the efficiency is not more than 5 %). As the depth decreases, the efficiency of BSRS increases. However, the nature of the dependence on the pumping energy is mirror-symmetrical compared to FSRS – the efficiency of BSRS decreases with increasing pumping energy. Starting from about a depth of 16 mm, the nature of the dependence changes dramatically – the BSRS increases to a maximum and then begins to weaken. The optimal depth for BSRS is 12 mm. An energy conversion efficiency of 30 – 32 % has been achieved here. Then, as the depth decreases, the BSRS drops sharply. The research was carried out within the framework of joint work under the project F23RSF-040 of the Belarusian Republican Foundation for Fundamental Research and grant No. 23-42-10019 of the Russian Science Foundation.

PII-08

PICOSECOND RANDOM RAMAN LASER BASED ON POLICRYSTALLINE SOLID MIXTURE OF LiOH + $Sr(NO_3)_2$

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Abstract. Research in the field of lasers based on the use of polycrystalline laser media began relatively recently [1]. Typically, such lasers generate spectrally broadband radiation, which limits the scope of their practical application. In Random Raman lasers (RRL), generation occurs in a spectrally limited range or ranges that are determined by the physical characteristics of the Raman media used [2]. Previously, we investigated generation in RRL based on a polycrystalline mixture of LiOH, LiOD, $LiOH{\cdot}H_2O$, and Li_2CO_3 [3]. In particular, it was established that in the generation spectrum the band caused by symmetrical breathing vibrations of the [OH] group of lithium hydroxide has the greatest frequency shift of 3 660 cm^{-1}. This is apparently a record value of a frequency shift for solids. To obtain generation of RRL on a large number of lines in the UV, visible and near IR spectral ranges, in this work we use a polycrystalline mixture LiOH + $Sr(NO_3)_2$, since in spontaneous Raman scattering spectrum in $Sr(NO_3)_2$ a high-quality fully symmetric mode with a frequency shift of only 1057 cm^{-1} is dominated.

In the experiments, for RRL pumping the radiation of the second and third harmonics of picosecond Nd:YAG laser was used (60 ps, 15 Hz, 20 mJ). The polycrystalline mixture consisted of approximately equal parts of LiOH and $Sr(NO_3)_2$ polycrystals. Generation of RRL was obtained at three Stokes and two anti-Stokes lines of LiOH when excited by the third harmonic of Nd-YAG laser. In the case of using the second harmonic, generation was obtained at one Stokes and one anti-Stokes lines of LiOH as well as three Stokes and one anti-Stokes lines of $Sr(NO_3)_2$. Thus, in total, generation was obtained at the following eleven wavelengths: 281,8 nm; 314,2 nm; 405,7 nm; 445,3 nm; 479,6 nm; 503,7 nm; 563,7 nm; 599,4 nm; 639,9 nm; and 660,6 nm.

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PII-09

RAMAN CONVERSION OF MULTIMODE LASER RADIATION: TRANSITION FROM NON-COHERENT TO COHERENT REGIME

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Abstract: One of the important applications of stimulated Raman scattering is conversion of multimode or non-coherent radiation to coherent one [1, 2]. There are a lot of publications in this area. The main features of the process are in detail described theoretically and partly supported experimentally. It is shown that at Raman conversion of multimode laser radiation there are two regimes of conversion – a non-coherent regime and a coherent one. There is critical laser intensity I_{cr} at which a coherent regime starts. Calculation of I_{cr} needs detailed knowledge about a scattering medium, conditions of pump-medium interaction, and other parameters, which can be a problem. In this report, we discuss the experimental data characterizing both regimes and transition between them additionally to I_{cr}.

In our experiments, a multimode pulsed Nd:YAG laser generating at the wavelength of 532 nm with a pulse duration of about 10 ns and energy up to several hundred millijoules was used. The laser beam was focused into the center of 1.5 meter length Raman cell with hydrogen at pressure of 26 atm. The laser and converted radiation were spatially dispersed by Pellin-Broca prisms and directed to the optical detectors with computer control that allowed accumulating data and carrying out statistical analysis. Pulse-energy statistical data were obtained. Mean energies, standard deviations, and energy histograms were analyzed at different laser energies. Dependence of standard deviation normalized to the mean energy value was used to show transformation of multimode fluctuations effect on pulse-energy statistics. Experimental results for the first Stokes (683 nm) and laser (532 nm) pulses are obtained. The dependence for the first Stokes consists of three parts: non-coherent regime with normalized standard deviation lying in the interval of 12 – 68 %, the transitional regime (7 – 8 %), and the coherent regime with normalized standard deviation decreasing from 8 % to the level of 1 – 2 %. Thus, we demonstrate for the first time existence of the transitional range between non-coherent and coherent regimes at Raman conversion that manifests in the dependence of normalized standard deviation on laser pulse energy. Similarity with the phase transition [1, 3, 4] will be also noted.

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PII-10

STIMULATED RAMAN SCATTERING IN WATER, EXCITED BY BESSEL BEAM

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Abstract. Water (H_2O) is characterized by a low value of a gain at Stimulated Raman Scattering (SRS). Thus, focused beams of picosecond pulses with a Gaussian transverse intensity distribution in a beam are used to excite SRS in water. In this case, the SRS excitation threshold in water is achieved at the laser radiation intensity of ~ 0.5 – 1 TW/cm^2 in the caustic waist of a focusing lens [1]. On the other hand, it is known that Bessel laser beams (BLB), often called "diffraction-free" beams [2] since their transverse intensity distribution is invariant along the propagation axis, have such unique properties as high intensity on an axis, a large length of a diffraction-free propagation region, and resistance to amplitude and phase aberrations [3].

In this report, the comprehensive experimental studies of the output characteristics of SRS in water pumped by BLB of picosecond pulses are presented. In the experiments we used the second harmonic radiation of a Nd:YAG laser (532 nm, 60 ps, 15 Hz, 20 mJ). The BLB was formed using an axicon with a base angle of 2° and a collecting lens with a focal length of 120 mm, which was placed behind the axicon. Thus, it was possible to form a diffraction-free caustic of the BLB with the length of 20 – 25 mm. The cell with water was placed and moved vertically so that the caustic waist of the BLB reached the open water surface. It has been established that excitation of SRS in water by BLB provides a conversion efficiency of 20% to the first Stokes component (651.5 nm) with the divergence of the axial part of the beam less than 1 mrad and output peak power more than 10 MW. An asymmetrical and significant (up to 70 cm^{-1}) narrowing of the OH band of the first Stokes line of forward SRS has been detected compared to the width of the OH band of Spontaneous Raman scattering in water (400 cm^{-1}). The width of the OH band of the first Stokes line of the backward SRS was 90 cm^{-1}.

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PII-11

INVESTIGATION OF TERAHERTZ EMISSION CHARACTERISTICS OF COHERENT INAS/INGAAS QUANTUM-DASH AND QUANTUM-DASH-IN-A-WELL

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Abstract. The terahertz (THz) generation of molecular beam epitaxy (MBE)- grown InAs quantum dash (Qdash) and quantum dash-in-a-well (DWELL) were assessed using THz-Time-Domain Spectroscopy (TDS) measurements in reflection geometry. The study involved InAs Qdash structures featuring a varying number of monolayers (MLs). Specifically, Qdash-1 contained 5 MLs, Qdash-2 had 7 MLs, and a DWELL sample, which included a Qdash within an InGaAs quantum well, also had 7 MLs. The samples were optically pumped using a 1550 nm-wavelength femtosecond laser, and detected using an optically gated photoconductive antenna (PCA). The measured peak-to-peak difference THz time domain photocurrent signal values for samples Qdash-1, Qdash-2, and DWELL were 11 pA, 13 pA, and 6 pA, respectively. Fast Fourier Transform (FFT) power spectra revealed that the central frequency of the samples were 0.72 THz for Qdash-1, 0.72 THz for Qdash-2, and 0.65 THz for the DWELL. Moreover, the differences in observed signals between Qdashes and DWELL were demonstrated, and were attributed to variations in carrier lifetimes from the different samples. Additionally, differing degrees of carrier confinement in Qdashes and DWELL were discussed in relation to their respective THz generation characteristics.

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PII-12

OPTIMIZATION OF TERAHERTZ TAPERED PARALLEL PLATE WAVEGUIDE VIA FDTD SIMULATION

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Abstract. A tapered-parallel plate waveguide was simulated using finite-difference time-domain (FDTD) method to parametrize the opening angle and its effect on the transmitted terahertz electric field amplitude and spectra. Transverse electric (TE) and transverse magnetic (TM) mode gaussian terahertz beams having a diameter of 3mm and a bandwidth of 1.4 THz were used as light sources. The tapered-parallel plate waveguide consists of a V-groove and parallel plate region. The opening angle of the V-groove region was parameterized using 10, 20, and 30-degree angles while the parallel plate separation was kept constant at 600 μm. The highest amplitude and spectral power were obtained with a 10-degree opening angle for both TE and TM modes. The TE mode terahertz source also showed higher electric field amplitude using the simulated waveguide structure. A cut-off frequency at 240 GHz was observed with the TE mode terahertz source. This work shows the potential of FDTD in the simulation and optimization of more complex terahertz waveguide design for various applications and real-world experiments.

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PII-13

DEMONSTRATION OF INTERFERENCE FOR FAR-INFRARED BROADBAND ULTRASHORT PULSES IN A MICHELSON INTERFEROMETER USING TERAHERTZ TIME-DOMAIN SPECTROSCOPY

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Abstract. Standard Michelson interferometers typically employ narrowband, continuous-wave light for basic setups as their longer coherence lengths allow a larger margin of error as far as experimental design is concerned since interference can be more easily inferred that way. Broadband, pulsed light, on the other hand, have coherence lengths which lie in the micrometer range, making interference more challenging to ascertain. This paper makes use of terahertz time-domain spectroscopy to demonstrate that interference still takes place involving far-infrared, broadband (50-1000 GHz), ultrashort (~50ps) light pulses. Based on the calculations from the measured central frequency, a maximum of 6.66% error was recorded.

Figures

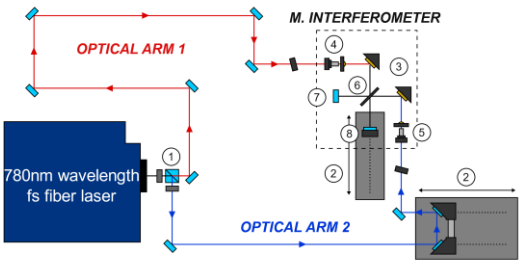

Figure 1: The experimental set-up, comprised of a beamsplitter (1), delay stages (2), paraboloid mirrors (3), photoconductive antenna (PCA) detector (4), PCA emitter (5), Si mirror (6), the transmitted arm (7), and the reflected arm (8). Both PCAs are spiral with gaps of 5μm.

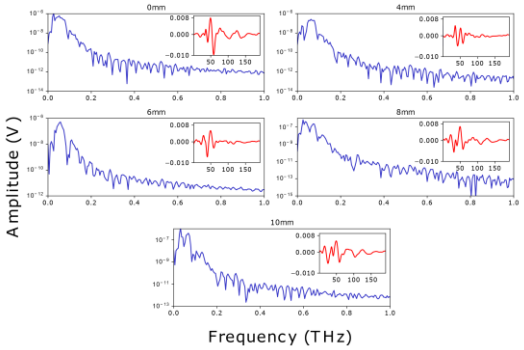

Figure 2: Fourier transforms (FT) for each Δx for the time-domain data (inset) as gathered by the PCA detector. Note that both the time-domain waveform and its FT recorded here is a single scan.

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PII-14

DESTRUCTIVE IMPACT OF PULSE LASER RADIATION ON CAMERA SENSOR SURFACES

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Abstract. The study further explores the phenomena that occur when a laser beam is directed onto the surface of a camera sensor. The experimental setup was improved, using a 532nm wavelength pulsed laser with a beam diameter at the focal point equivalent to the pixel size of the sensor. Experimental results indicate that the damage threshold for red and blue pixels is comparable, while the threshold for green pixels is higher. The sensor surface after laser exposure was examined using a scanning electron microscope, establishing a correlation between damage morphology and output results.

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PII-15

DESIGN OF A FRESNEL LENS FOR USE IN PASSIVE INFRARED SENSORS WITHIN SECURITY MONITORING SYSTEMS

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Abstract. Passive infrared (PIR) motion sensors are extensively employed in both residential and commercial security monitoring system. These sensors operate on the principle of pyroelectric detection, wherein pyroelectric detectors convert incident infrared radiation into electrical signals. The optical configuration of the PIR sensor is designed with an array of Fresnel lenses, which focus the infrared radiation from the source onto the sensor's surface. This configuration not only enables the sensor to distinguish between moving objects and the background environment but also enhances its overall detection range. The use of Fresnel lenses is therefore critical in optimizing the sensor's sensitivity and coverage, making PIR sensors highly effective in various security applications.

This paper presents the design of a novel Fresnel lens structure aimed at addressing limitations in traditional coaxial Fresnel lens designs, where all light rays converge towards the central axis, leading to excessively high light intensity at the focal plane's center. A new design method for uniformly converging Fresnel lenses is proposed. Using ray tracing principles, optical simulation software is employed to analyze the focusing performance and obtain illumination distribution data on the output surface. Key parameters, such as focusing efficiency and uniformity of the light distribution, are evaluated. Based on the final parameters, a mold is created, and the physical lens is fabricated. This newly designed Fresnel lens is particularly suited for applications requiring small angles, high gain, and short focal lengths in PIR security monitoring systems.

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PII-16

ACCELERATING OF SILVER NANOPARTICLES DISSOLUTION IN CHLORIDE MEDIA BY CUPRIC ION

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Abstract. We demonstrate here that cupric ions can significantly accelerate the dissolution rate of PVP-coated AgNPs dispersed in sodium chloride solution. To assess the effects of cupric concentration on the degree of dissolution, we compared the results of experiments performed in chloride media to those obtained in deionized (DI) water. In chloride media, the dissolution amount of AgNPs is stoichiometric to the concentration of cupric ions. The dissolution of AgNPs, based on their plasmonic properties, in sodium chloride medium was monitored using UV-Vis absorption spectroscopy. This approach allowed us to study the dissolution mechanism of PVP-coated AgNPs in sodium chloride medium in the presence of cupric ions. The rapid transformation of AgNPs into solid AgCl in sodium chloride media in the presence of cupric ions was also demonstrated by EDX analysis.

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PII-17

MODIFICATION OF PINEAPPLE FIBER FOR METAL ION ADSORPTION APPLICATION

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Abstract. This study presents the results of modifying cellulose extracted from pineapple fiber (PALF) to adsorb metal ions, such as copper ions Cu^{2+} in copper salt solution $CuSO_4$ and iron Fe^{3+} in iron salt solution $FeCl_3$. The modification process involved using NaOH and Ethylenediaminetetraacetic acid (EDTA), limiting environmental pollution by eliminating intermediate steps and avoiding toxic organic compounds. Following the modification process, we analyzed the presence of adsorbed metal ions in the modified cellulose using modern analytical techniques such as Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR), and Energy Dispersive X-ray Spectroscopy (EDX). The results confirmed that the modified cellulose can effectively adsorb heavy metal ions in wastewater.

Keywords: *Cellulose, Modification, Absorption, NaOH, EDTA*

PII-18

OBSERVATION OF ENHANCED GROUP INDEX IN ^{85}Rb ATOMIC MEDIUM DUE TO SATURATION ABSORPTION SPECTROSCOPY

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Abstract. In recent decades, research has focused on controlling light pulse speed using various media like atomic vapors and photonic crystals by modifying the refractive index. This control over light, whether subluminal or superluminal, is significant for applications in imaging spectroscopy [1], high-precision interferometry [2], enhancing the nonlinear effect and microwave photonics [3-5].

Techniques to manipulate light speed include electromagnetically induced transparency (EIT)[6], electromagnetically induced absorption (EIA)[7], and photonic crystals. Experimental observations often involve measuring pulse delays or phase shifts using methods like beat note measurements. Recent experiments, such as those by Agarwal, Perdian and wang[8-10], have used saturation absorption spectroscopy to induce slow light in ^{87}Rb atomic vapors.

We report an experiment observing large group index in ^{85}Rb atomic vapor under saturation absorption spectroscopy, by employing a Mach-Zehnder interferometer to measure optical phase shifts. We will describe our experiment, including the working principle and method, to measure the optical phase shift and hence the group index. In addition, we will show our observation, by the detailed comparison with a theoretical model.

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PII-19

FABRICATION OF GOLD NANORODS WITH TUNABLE LONGITUDINAL SURFACE PLASMON RESONANCE FOR SERS APPLICATION

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Abstract. Gold nanorods (Au NRs) exhibit unique optical properties, particularly tunable longitudinal surface plasmon resonance (LSPR), making them highly suitable for surface-enhanced Raman scattering (SERS) applications. This study focuses on the fabrication of Au NRs with control over their aspect ratio, enabling the tuning of LSPR across the visible to near-infrared spectrum. A seed-mediated growth method was employed, with systematic variations in synthesis parameters to achieve desired nanorod dimensions and plasmonic properties. The synthesized Au NRs were characterized using UV-Vis spectroscopy, transmission electron microscopy (TEM), and energy-dispersive X-ray (EDX) spectroscopy. The tunability of LSPR was demonstrated by correlating the aspect ratio of the nanorods with their plasmonic response. SERS performance was evaluated using standard analytes, confirming the enhanced Raman signals and the potential of these tunable Au NRs in sensitive molecular detection. This work provides insights into the controlled synthesis of Au NRs for optimizing SERS substrates, paving the way for advanced plasmonic sensing technologies.

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PII-20

HIGH CONTRAST AND SENSITIVE NEAR-INFRARED REFRACTIVE INDEX SENSORS BASED ON TRIANGULAR PLASMONIC STRUCTURES

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Abstract. This work presents a numerical study of triangular plasmonic metasurface-based refractive index sensors that have high contrast and sensitive in the near-infrared region. The triangular plasmonic structure consists of SiO_2/Ag layers on Si solid to strong confinement of incoming light, the Ag thin film have a thickness of 100 nm to block all transmission through the structure. Two simulation methods of boundary element method (BEM) and finite-difference time-domain (FDTD) are used to determine the optical characteristics of the designed structure. Results show that the optical properties of designed structures are strongly dependent on the triangular disk parameters and polarization of the light source. The strong confinement of incident light localized inside the SiO_2 spacer-layer. The refractive index sensor based on that proposed structure was also investigated. As results have shown, the refractive index sensor based on that shows the figure-of-merit (FOM) to have the selectivity higher than that of other established plasmonic sensors.

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PII-21

A STUDY ON THE ANTIBACTERIAL PROPERTIES OF DOPED GRAPHENE QUANTUM DOTS FOR APPLICATIONS IN BIOMEDICAL

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Abstract. The widespread use of traditional antibiotics has led to an increase in antibiotic resistance in bacteria globally, raising unprecedented risks for the medical profession. Therefore, there is an urgent need to develop novel and intelligent antibacterial agents that can effectively kill or inhibit the growth of bacteria. Graphene quantum dots (GQDs) have attracted a lot of attention because of their special properties, such as tunable luminescence, various possibilities for their functionalization, photostability, high biocompatibility, non-toxicity, and good dispersion in water. In this report, we present new results on the use of nitrogen-doped (N) and sulfur-nitrogen (S-N) co-doped graphene quantum dots in our study of their antibacterial properties against different types of gram-negative and gram-positive bacteria, namely *Escherichia coli (E. coli), Pseudomonas aeruginosa (P. aeruginosa), Staphylococcus aureus (S. aureus), and Staphylococcus hyicus (S. hyicus)*. An explanation of the causes related to the antibacterial efficiency for each case has been provided to better clarify the possible underlying mechanisms.

PII-22

ANALYSIS OF BIREFRINGENT PROPERTIES IN A NEW DESIGN OF CCl_4-CORE PHOTONIC CRYSTAL FIBERS WITH HEXAGONAL LATTICE

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Abstract. This study suggests a method to increase the birefringence of CCl_4-core photonic crystal fibers with hexagonal lattice. This method is based on designing air holes of different sizes in the photonic cladding. This can increase the propagation efficiency in PCF due to the decrease in the average refractive index of the cladding. FEM, known as the full vector finite element method, is considered to analyze the birefringence properties accurately. Numerical results show that the birefringence of CCl_4-PCFs depends strongly on the effective refractive index difference of the X and Y-polarized fundamental modes. For all filling factor values, the birefringence curves of the PCFs with the lattice constant of 1.5 µm are always above the other cases. Among them, the structure with 0.7 filling factor has the highest birefringence. This value remains in the range of 5.02×10^{-5} to 2.5×10^{-3} in the near-infrared and up to 3.6×10^{-3} at a maximum wavelength of 3.5 µm. Highly birefringent PCFs have applications in optical fiber sensing, e.g., polarization-maintaining fibers.

Keywords: High birefringence, Photonic crystal fiber, Hexagonal lattice, Effective refractive index difference, CCl_4 core.

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PII-23

STUDY ON THE INFLUENCE OF CORE DIAMETER ON CHROMATIC DISPERSION CHARACTERISTICS OF CCl_4-CORE PHOTONIC CRYSTAL FIBERS

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Abstract. In this work, we present a new photonic crystal fiber (PCF) structure with a CCl4-infiltrated core, and the cladding consists of five rings of air holes arranged in a hexagonal lattice. We analyzed and compared the structures' dispersion characteristics concerning the air hole diameter variation. The obtained PCF structures have an anomalous dispersion regime with a zero-dispersion wavelength in the long range. Flat dispersion and closeness to the zero-dispersion curve in the long wavelength range are the advantages of these structures. Based on the analysis and comparison of fiber structures with different air hole diameters, we proposed structures with optimal dispersion and pump wavelength suitable for the generation of supercontinuum with a broad, flat, and smooth spectrum.

Keywords: Photonic crystal fibers (PCFs), dispersion, anomalous dispersion, hexagonal lattice.

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PII-24

THE POTENTIAL OF USING SATELLITE IMAGES IN AIR POLLUTION MONITORING

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Abstract. Each year, tens of millions of people over the world die from causes related to air pollution. This alarming consequence highlights the importance of monitoring, forecasting, and preventing air pollution. Numerous modern methods have been employed to provide the most accurate solutions to this issue. Among these, satellite remote sensing is an effective tool that helps to better understand pollutants. Satellite remote sensing can be used to measure and map air pollution, providing comprehensive data on pollutants over large areas. Satellite images can cover millions of square kilometers, with spatial resolution as precise as 100 square meters and temporal resolution down to a daily frequency. The variety of satellites enables the measurement of different emissions, such as carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ammonia (NH_3), volatile organic compounds (VOCs), and aerosol optical depth (AOD), enabling the estimation of the surface-level fine particulate matter (PM2.5). This work provides an overview of the capabilities of satellite remote sensing technology for measuring air pollutants, as well as the methods for processing and accessing satellite data to map pollutant concentrations.

Keywords: Remote Sensing, Satelite Data, Air Quality and Air Pollution

Key Points:

- **Air Pollution Health Impact**: The paper highlights how millions of people suffer from health problems due to air pollution.
- **Satellite Remote Sensing**: Satellites play a critical role in monitoring pollutants by providing comprehensive coverage of large areas with high temporal resolution.
- **Pollutants Measured**: Key pollutants detected through satellite data include nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ammonia (NH_3), carbon monoxide (CO), volatile organic compounds (VOCs), and particulate matter (PM2.5).
- **Pollution Mapping**: The study reviews methods for mapping pollutant concentrations using satellite data.

This research provides insights into the integration of satellite technologies for improved air pollution monitoring and analysis.

PII-25

AN DFT INVESTIGATION ON STRUCTURAL, ELECTRONIC AND OPTICAL PROPERTIES OF BNT

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Abstract. In this study, a complete investigation on the structural, electronic and optical properties of rhombohedral sodium bismuth titanate $Bi_{0.5}Na_{0.5}TiO_3$ (BNT) was performed using Materials Studio. The Generalized Gradient Approximation parametrized by Perdew-Burke-Ernzenhof (GGA-PBE) was used to describe the exchange-correlation interactions. The calculated band structure shows that BNT is a direct bandgap semiconductor with the bandgap value of 2.859 eV. The PDOSs of BNT reveal that Bi-6p, O-2p and Ti-3d play the most important roles in the formation of BNT valence and conduction bands. The optical bandgap estimated from absorption spectra are 3.55 eV and 2.42 eV for direct and indirect bandgaps. Other optical characteristics such as dielectric functions, reflectivity, optical conductivity, refractive index and loss function of BNT have been calculated and discussed in details. The method used in this research can be used to predict new applications of BNT-based materials.

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PII-26

PHYSICAL PROPERTIES OF GRAPHENE: EXPERIMENT AND CALCULATION

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Abstract. Graphene sheets have been successfully fabricated using a CVD system on Cu substrates. The XRD patterns show that all achieved samples contain only graphene, no secondary phase is detected. Raman spectrum of achieved samples show the corresponding peaks of C-C bonds. To compare with experimental results, theoretical calculations have been performed using Materials Studio software. The Generalized Gradient Approximation parametrized by Perdew-Burke-Ernzenhof (GGA-PBE) was used to describe the exchange-correlation interactions. The geometry optimization process points out that stable structure of graphene has lattice constants of a = b = 2.4658 Å and cell formula of C_2. Other optical characteristics such as dielectric functions, reflectivity, optical conductivity, refractive index and loss function of graphene have been calculated, compared to experimental results, and discussed in details. The method used in this research can be used to study the properties of graphene-based materials.

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PII-27

DISPERSION ENGINEERING IN DUAL-CORE PHOTONIC CRYSTAL FIBERS BASED ON PBG08

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Abstract. We numerically investigated the dispersion properties of dual-core photonic crystal fibers (PCFs). The fiber is made of lead-bismuth-gallate glass with a cladding structure consisting of seven rings of air holes. Using the full vector finite element method with a perfectly matched layer boundary condition, we examined the dispersion characteristics of the fundamental super-modes. The results show that the dispersion profile of these super-modes can be tuned by varying the lattice pitch and air hole diameter in the cladding. Specifically, increasing the air-hole diameter shifts the dispersion from the normal to the anomalous dispersion region, while a larger lattice pitch results in higher dispersion values and a less flat curve.

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PII-28

RESEARCH ON EVALUATING CAMOUFLAGE EFFECTIVENESS BASED ON THE DATA ENVELOPMENT ANALYSIS (DEA) MODEL

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Abstract. Camouflage to prevent and reduce the detection capabilities of enemy electro-optical devices is becoming a trend that many countries are interested in and researching. Therefore, evaluating the effectiveness of camouflage products such as camouflage nets, camouflage covers, camouflage paint, and camouflage suits after research is a crucial step that determines whether the product can be practically applied. However, globally and domestically, there is still no specific, reliable standard to evaluate camouflage effectiveness. As a result, many methods for evaluating camouflage effectiveness have been researched and published recently, with two main approaches: subjective evaluation and objective evaluation. Each method of assessing camouflage effectiveness has its own advantages and disadvantages, and no method is superior for evaluating camouflage effectiveness. Furthermore, to achieve a comprehensive evaluation of camouflage effectiveness, many criteria must be considered simultaneously, such as color blending, contrast level, surface temperature, and so on, between the target and the background. This paper presents an objective evaluation method using the Data Envelopment Analysis (DEA) model based on the characteristic physical parameters of the target and background. The DEA model is a non-parametric analysis method that can fully rank the Decision Making Units (DMUs). Experimental results on several camouflage samples show that the DEA model is effective for evaluating camouflage effectiveness in Vietnam.

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PII-29

MODELING LIGHT PROPATION IN THE KNEE FOR RHEUMATOID ARTHRITIS TREATMENT USING COMSOL MULTIPHYSICS

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Abstract. Rheumatoid arthritis (RA) is a common degenerative joint disease characterized by the gradual and irregular degradation of joint cartilage, abnormalities in the synovial membrane, and surrounding joint structures. Photobiomodulation or low-level laser therapy is promising for treating rheumatoid arthritis. However, in practice, it is quite difficult to select appropriate device parameters (wavelength, power density, treatment time). Previous studies used Monte Carlo simulations on parallel planar multilayer models to investigate light propagation in biological tissues. This study models and simulates the knee joint using the Diffusion Equation (DE) method in COMSOL Multiphysics to gain a understanding of the interaction between light beams and joint tissues, such as synovial fluid and cartilage, at wavelengths of 633 nm, 785 nm, 810 nm, and 980 nm. The spatial distribution of light density within biological tissues is simulated and examined under various optical properties, revealing physiological conditions. The study evaluates the influence and effectiveness of light source characteristics, including wavelength and delivered energy, on knee joint tissues, aiming to identify appropriate parameters in photobiomodulation treatments for patients with rheumatoid arthritis.

Keywords: Low-level laser therapy, knee joint, light-tissue interaction, photobiomodulation.

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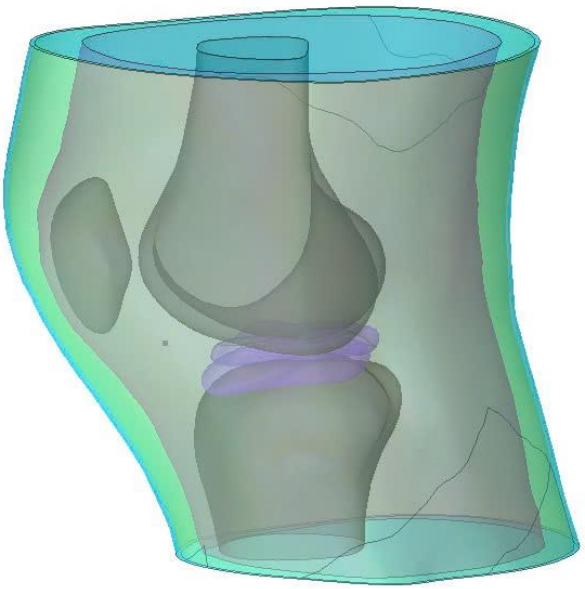

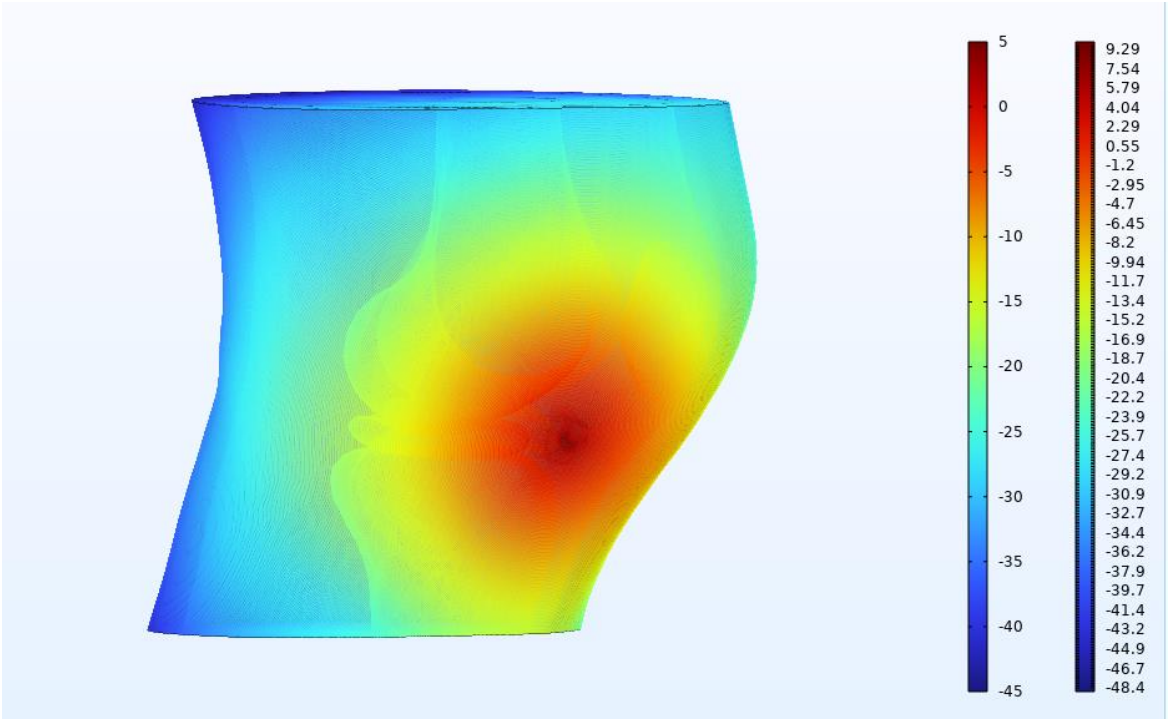
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PII-30

SIMULATING INTERSTITIAL LASER THERAPY IN THE KNEE FOR RHEUMATOID ARTHRITIS TREATMENT USING COMSOL MULTIPHYSICS

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Abstract. Rheumatoid arthritis (RA) is an inflammatory autoimmune disorder characterized by joint inflammation, pain, physical disability, and morning stiffness. RA poses a major public health challenge due to its impact on cartilage and bone, resulting in functional impairment, high socioeconomic costs, and early mortality and decrease patient life quality. Along with advances in modern science, technology and medicine, light therapy applications such as Low-Level Laser Therapy or Laser Interstitial Thermal Therapy are becoming increasingly popular with treatment advantages such as non-invasive, minimally invasive and drug-free. This study investigates Laser Interstitial Thermal Therapy by simulating an optical needle inside the knee joint using COMSOL MultiPhysics. The optical needle acts as a light source directly injected through the skin to the treatment region. The result of this study shows the absorption, the power density, and the light distribution in the knee joint with differents wavelength of 633 nm, 785 nm, 810 nm, and 980 nm. It would help to design laser therapy devices and help to understand how light beams interact with joint tissues, such as synovial fluid and cartilage.

Keywords: Knee Joint, Laser Interstitial Thermal Therapy, Low-Level Laser Therapy, Optical Needle, Rheumatoid Arthritis, Simulation.

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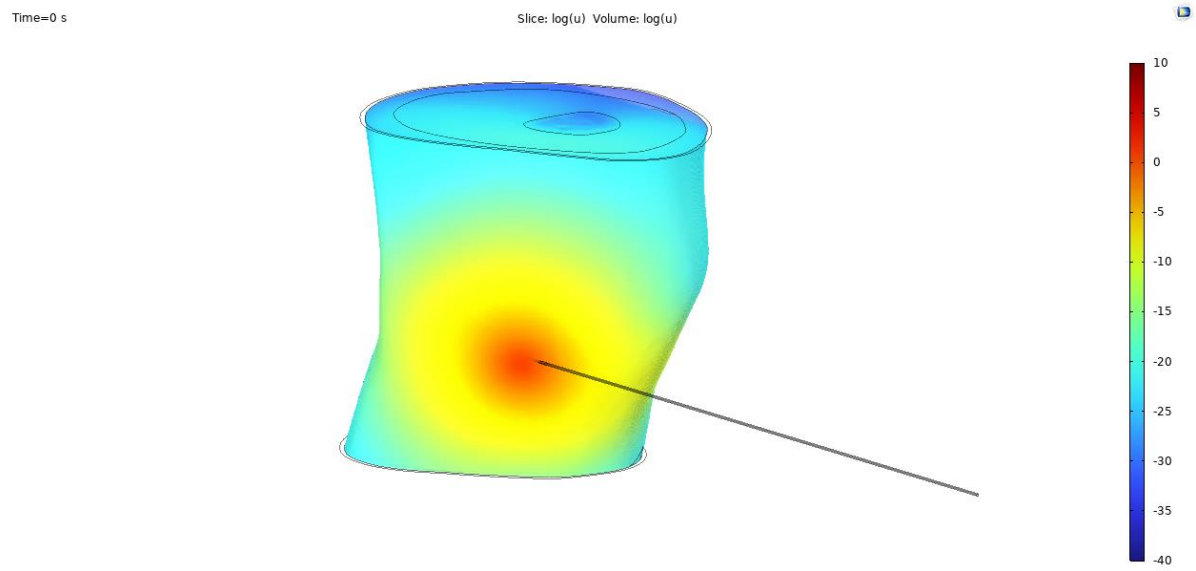
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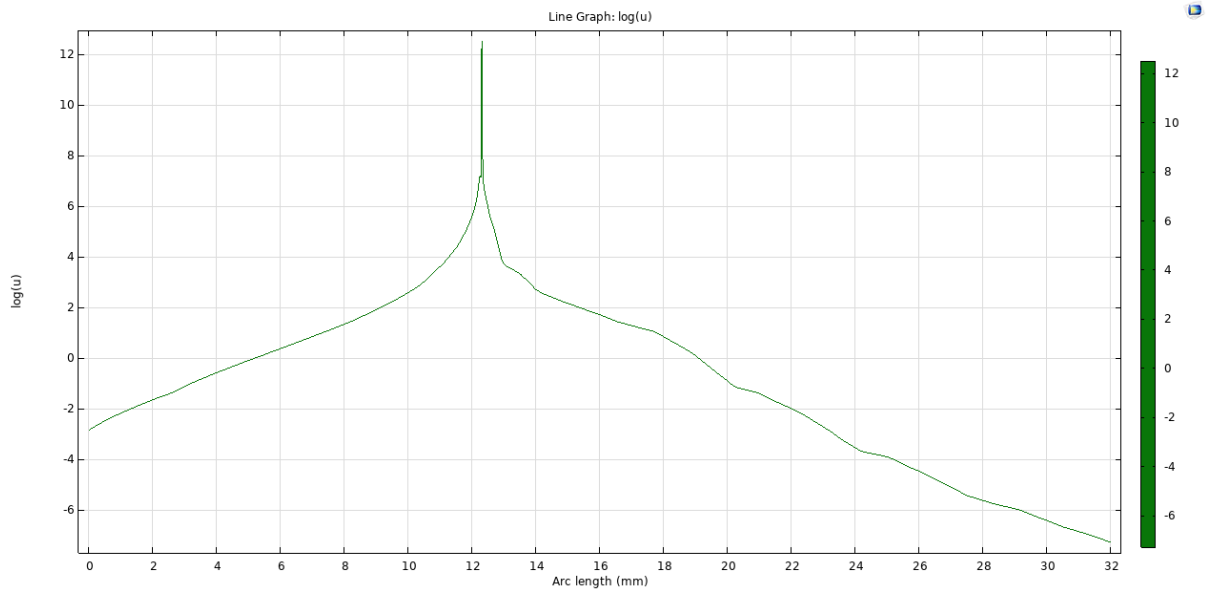
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Arc length (mm)

PII-31

DESIGN AND ASSESSMENT OF A LASER-BASED OPTICAL TRAP SYSTEM FOR PRECISION DETECTION AND CONTROL OF HALMFUL INSECTS

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Abstract. In this study, we present an optical trap device utilizing laser technology for the precise detection and handling of harmful insects. The device integrates a laser control system with a camera, enabling effective identification, classification, and targeting of insects. Through extensive simulation and prototype testing, the trap has demonstrated accurate recognition of various simulated targets and effective laser targeting actions. The experimental results suggest broad potential for applying laser technology in insect control, contributing to enhanced management efficiency and environmental protection.

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PII-32

NITROGEN-DOPED GRAPHENE QUANTUM DOT NANOCOMPOSITE FILMS FOR POTENTIAL APPLICATION IN SOLAR CELLS

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Abstract. Graphene quantum dots (GQDs) are researched combining with various materials to improve rapidly transforming the energy fields. We used nitrogen-doped graphene quantum dots (N-GQDs) for fabricating two kind of nanocomposite films as N-GQD:TiO_2 and N-GQD:SnO_2. The analysis methods as UV-VIS, photoluminescence, Raman, HR-TEM, SEM and XRD were conducted for this research purpose with explanations. This work presents some important aspects of N-GQD:TiO_2 and N-GQD:SnO_2 nanocomposites as photocatalysts in solar cell applications. These include: synthesis methods of nanocomposites with structural formulations and various characterization techniques which can be used to judge the photocatalytic performance for the application in solar energy conversion devices and although some new challenges.

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PII-33

INVESTIGATION OF THE OPTICALPROPERTIES OF THE N-GQDs@WO_3 NANOCOMPOSITE SYNTHESIZED VIA DIRECT HYDROTHERMAL METHOD

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Abstract. In this study, the nanocomposite material between nitrogen-doped graphene quantum dots (N-GQDs) and WO_3 was synthesized via direct hydrothermal method at 120^{o}C for 24 hours. The interaction as well as the influence of N-GQDs content on the optical properties of the nanocomposite N-GQDs@WO_3 will be investigated through analytical techniques such as Raman spectroscopy, Fourier transform infrared spectroscopy (FTIR), UV-vis absorption spectroscopy, PL spectroscopy. The nanocomposite has a hexagonal phase of $WO_3.0{,}33H_2O$ with nano wire in morphology. The Raman results show that the vibrational qualities at 329cm^{-1} are specific for the W^{6+}-O-W^{6+} bond of the hydrated WO_3 phase, at 808cm^{-1} are specific for the O-W^{6+}-O bond, at 927cm^{-1} the double bond is specific for W=O. The energy band gap of the nanocomposite samples is higher than that of the WO_3 pure sample (Eg = 2.75eV).
The results show that N-GQDs have enhanced the optical properties of the N-GQDs@WO_3 nanocomposite compared to the WO_3 pure material, while enhancing the applicability in the processing environment as well as other applications in sustainable development such as electrochromic glass and energy storage.

PII-34

EVALUATE COLORIMETER CHARACTERISTICS IN SMARTPHONE

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Abstract. Colorimeters have important applications in industry such as identification of key process parameters in some pharmaceutical process, color printer calibration sensor, robot vision, odor discrimination, as well as color-match sensing in textiles [1]. The cameras and color sensors included in mobile devices like tablets and smartphones are becoming more sophisticated. Software for color measuring functions is also being developed to benefit from advancements in hardware. These elements enable the use of color measuring apps and smartphones as colorimeters. Tristimulus colorimetry is based on the integral measurement of radiation with three detectors that have spectral responsivity functions equal to the Commission of Internationale de l'Eclairage (CIE) standard colorimetric observer functions X, Y, and Z [2]. This work presents a calibration method for smartphone cameras when it is used as a tristimulus reflective colorimeter. The characteristics of the colorimeter application are assessed and compared with the Pantone Formula Guide Set. The results of the application are contrasted with professional colorimeter YD5050 by 3nh Technology. The colour triangle of application is obtainted by extrapolation. The colorimeter results are calibrated by matrix method [3]. Color error is evaluated after the results are transformed into L*a*b* space. This method could be applied for many other color image capture devices.

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PII-35

STUDY ON GRINDING TECHNOLOGY OF SPHERICAL GERMANIUM LENSES

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Abstract. Spherical lenses made of Germanium (Ge) crystal material are very important components of infrared optical systems. In Vietnam, infrared optical systems have been increasingly applied, especially in security and defense. However, domestic research facilities have not yet mastered the technology of manufacturing Ge spherical lenses. This article introduces the results of our group in the grinding of Ge spherical lenses. The grinding process is carried out on a high-speed grinding machine using a grinding tool with bonded diamond abrasives. The Ø66mm diameter convex lens has been completely ground (smoothed/polished). The characteristics of the Ge aspherical lens are evaluated, including: diameter, radius of curvature of the spherical surface, spherical surface figures, and smoothness of the spherical surface. After being completely ground, the Ge spherical lens has been coated with anti-reflective films on both spherical surfaces, with a residual reflection coefficient of R~ 1% in the 3-5µm wavelength range. The Ge lens has been tested on a thermal imaging optical system, providing images with high sharpness and contrast.

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PII-36

TWO-DIMENSIONAL CORRELATION SPECTROSCOPY OF $Sm_2Ir_2O_7$ STUDIED BY RAMAN SPECTROSCOPY

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Abstract. Recently pyrochlore iridates $R_2Ir_2O_7$ (R=Y, rare earth) have been studied extensively because they are predicted to host none trivially topological states such as Weyl semimetal, axion insulator, etc, as a result of time reversal symmetry breaking by all-in-all-out (AIAO) magnetic order [1]. AIAO magnetic order is only symmetry allowed spin structure when the structure does not accompany with any distortion across the magnetic phase transition. Previous Raman study of Sm2Ir2O7 (Sm227) [2] suggested the existence of structural phase transition in these compounds. In our study, 2D correlation spectroscopy (2DCOS) was performed on temperature dependent Raman spectra of poly crystalline Sm2Ir2O7 and show contrary results. The Sm227 is under the magnetic transition simultaneously with metal to insulator transition (MIT) at TN ~115 K. Five of six Raman active phonons are well observed in all temperatures, while the Eg is only clearly seen at T>TN. In addition, Raman spectra of Sm227 show a set of multiple M peaks ~ 200 cm-1 arising below the TN. Our analysis by 2DCOS showed there is no structural distortion on Sm227. The absence of Eg phonon at low temperature could be explained by the overlapping with the T2g(1) phonon. It was anomalously shifted to higher frequency with increasing temperature so that it could be observed separately at room temperature. The analysis of 2DCOS suggests that the cubic symmetry of F*d-3m* phase is not broken through magnetic (or MIT) transition. The conservation of cubic symmetry (F*d-3m*) through magnetic transition (or MIT) supports the existence of all-in-all-out (AIAO) magnetic order in *R*2Ir2O7.

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PII-37

LASER BEAM SHAPING USING SEMI-NONLINEAR MICHELSON INTERFEROMETER

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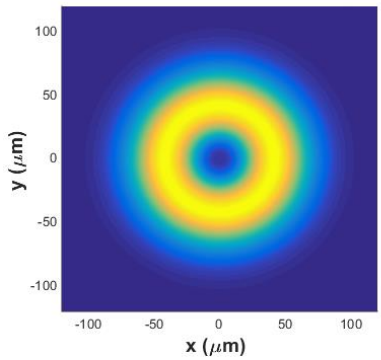
Abstract. In this paper a semi- nonlinear Michelson interferometer, with one branch filled nonlinear medium is proposed. Basing on the ray optics the relation between input and output laser intensities is derived. The shapes of the output beam, particularly a flat-top intensity profile are numerically observed and controlled by change the nonlinearity of medium. The obtained results show an opportunity to use in the modern optical system.



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PII-38

RESEARCH AND DEVELOPMENT OF AN ALL-SOLID STATE TUNABLE ULTRAVIOLET SUPER-NARROW LASER USING CE:LICAF CRYSTAL IN LITTMAN CONFIGURATION

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Abstract. In this work, we present the results of theoretical and experimental studies on a tunable, narrow-linewidth ultraviolet laser using a Ce:LiCAF crystal in a Littman configuration. The laser resonator is constructed with a 2400 lines/mm grating, a 100% reflectivity end mirror, and a 90% reflectivity output coupler designed for the ultraviolet range. The pumping source is the fourth harmonic (266 nm) of a Lotus Nd:YAG laser operating at a 10 Hz repetition rate, with a 7 ns pulse duration and a maximum power of 1.2 W. Our results demonstrate a linewidth on the order of picometers and continuous tunability within the wavelength range of 282 nm to 315 nm. The laser output power is 1.5 mW, corresponding to an efficiency of 1% at the peak spectrum wavelength of 288.5 nm.

Keywords: Ultraviolet laser, Ce:LiCAF crystal, continuous tunability.

PII-39

STUDYING THE DYNAMICS OF BROAD-SPECTRUM ULTRAVIOLET LASERS USING A RESONATOR WITH WAVELENGTH-DEPENDENT MIRROR REFLECTIVITY

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Abstract. This report presents the results of a spectral dynamics study on a Ce:LiCAF ultraviolet laser using a resonator with a wavelength-dependent mirror reflectivity. The results show that by using a resonator mirror with reflectivity varying according to the wavelength, the output laser spectrum can be broadened. By optimizing the mirror reflectivity of the resonator, a broad-band laser emission ranging from 285 nm to 295 nm can be achieved. These research results pave the way for many applications for ultrawide-band ultraviolet radiation in environmental research

Keywords: ultraviolet laser, broad laser emission spectrum, Ce:LiCAF crystal.

PII-40

RESEARCH AND DEVELOPMENT OF ULTRAWIDE-BAND ULTRAVIOLET LASER USING CE:LICAF CRYSTAL

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Abstracts. In this work, we present the results of simulation and experimental studies on an ultrawide-band ultraviolet solid-state laser using a Ce:LiCAF crystal. The pumping source is the fourth harmonic (266 nm) of a Lotis Nd:YAG laser operating at 10 Hz repetition rate, and a 7 ns pulse duration. The results show that, with direct amplification of the Ce:LiCAF fluorescence, an ultrawide emission in the wavelength range from 280 nm to 335 nm with the output power of few miliwatt can be achieved. These research findings open many potential applications for ultrawide-band ultraviolet lasers for environmental research.

Keywords: Ultraviolet solid-state laser, ultrawide-band laser, Ce:LiCAF crystal.

PII-41

RESEARCH AND FABRICATION OF A MULTI-CHANNEL HIGH-POWER LED DEVICE FOR ANTIMICROBIAL PHOTODYNAMIC THERAPY

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Abstract. Recently, research on antimicrobial photodynamic therapy, which uses light radiation to activate photosensitizers to produce oxidative free radicals, thereby inhibiting the activity of pathogenic bacteria, has achieved very positive results. Light from semiconductor sources such as lasers and LEDs in photodynamic therapy is being emphasized due to its advantages: the wavelength range emitted by these sources matches the absorption spectrum of photosensitizers, allows for adjustable radiation intensity, and provides a uniform light output distribution. This report presents the results of manufacturing a high-power LED photodynamic device consisting of 4 optical fiber channels with 4 different wavelength ranges (from the ultraviolet UVA to the red light region), each with a maximum optical power of 1.5W, featuring a user-friendly, intelligent interface that is easy to operate. This high-power LED photodynamic device is used for antibacterial purposes when combined with photosensitizers.

Keywords: antimicrobial photodynamic therapy, LED devices, antibacterial

PII-42

USING MACHINE LEARNING FOR QUANTITATIVE ANALYSIS OF RAMAN SPECTRA OF AMINO ACIDS AND MINERAL MIXTURES

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Abstract. This study shows the feasibility of using machine learning for quantitative analysis of raman spectra. We can improve the accuracy by getting and analyzing multiple Raman spectra of each sample. On the other hand, for the application of monitoring a large amount of product, we would want to minimize the time spent on scanning each sample while keeping a sufficient level of accuracy. Therefore, this study focuses on studying the relationship between the amount of Raman spectra recorded for each sample and the accuracy of the quantitative prediction of the chemical composition. There are 48 distinct mixtures, each of them contains various amounts of six amino acids (L-histidine, L-glutamic acid, L-aspartic acid, L-(+)-asparagine, DL-alanine, and D-glucosamine-HCl) as well as varying levels of bentonite, calcite, and quartz.

PII-43

AN ANALYSIS ON PARAMETERS AFFECTING CROSS-TALK BETWEEN HYBRID PLASMONIC WAVEGUIDES FOR INTEGRATED PHOTONIC CIRCUITS

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Abstract. The photonic technologies are interested to develop for numerous applications, especially in high density integrated photonic circuits for the next generation, high speed communication. Although the dielectric waveguides have proved that they can guide lightwaves in small sizes, optical diffraction limit is the neck-bottle to low-loss light propagation at optical communication wavelengths. Recently, guiding lightwave by plasmonic waveguides is considered as a feasible solution [1-5]. Plasmonic waveguides can propagate lightwave with deep-subwavelength mode size due to surface plasmon wave propagating along the metal–dielectric interface. The coupling length is a critical parameter used to evaluate the cross-talk between the adjacent waveguides. The coupling length ultimately limits the integration density of photonic components. In this study, we investigate coupling between two metal strip hybrid plasmonic waveguides via varying geometrical parameters. Based on the investigated results, we derive the optimal parameters to decrease cross-talk between the adjacent waveguides. This study is a guideline for designing metal strip hybrid plasmonic waveguides for application in high density integrated photonic circuits.

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PII-44

SYNTHESIS AND CHARACTERIZATION OF Co-DOPED ZnCdS QUANTUM DOTS

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Abstract. Quantum dots (QDs) made of ZnCdS doped with Cobalt (Co) have been successfully synthesized using a wet chemical method, the concentrations of Co is 0, 1, 3, and 5%. The structure, composition, and optical properties of the QDs have been analyzed in detail. The average crystal size of the QDs was calculated using the Debye-Scherrer equation, ranging from 2.7 to 3.2 nm. X-ray diffraction (XRD) and Raman scattering analyses show that Co^{2+} ions were successfully incorporated into the ZnCdS matrix without altering its zinc-blende (ZB) cubic structure. We used energy-dispersive X-ray spectroscopy (EDX) and Raman spectroscopy to identify the presence of elements and their composition in the samples. The optical properties of the Co-doped ZnCdS nanocrystals were investigated through UV-Vis absorption and photoluminescence (PL) spectroscopy. The emission peak intensity of the ZnCdS matrix decreased, while the intensity of the surface and dopant emission peaks increased with increasing Co concentration. The bandgap energy (Eg) of the Co-doped ZnCdS decreased gradually as the Co concentration increased. Due to their strong photoluminescence, Co-doped ZnCdS quantum dots have potential applications in optoelectronic devices, spintronics, and photocatalysis.

Keyword: Semiconductor Quantum Dots, Doped Quantum Dots, ZnCdS, Cobalt (Co), Optical Properties.

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PII-45

RESEARCH ON THE FABRICATION OF $C_OFe_2O_4$ NANOMATERIALS FOR SUPERCAPACITOR ELECTRODE APPLICATIONS

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Abstract. In this report, a simple and effective method for producing $CoFe_2O_4$ nanoparticles using the solution combustion (SC) technique has been investigated and tested. Additionally, the synthesized material has been applied in energy storage. Structural analysis via X-ray diffraction (XRD) confirmed the formation of well-crystallized spinel phase, while scanning electron microscopy (SEM) revealed a uniform distribution of nanoparticles with sizes ranging from 50 to 60 nm. Furthermore, electrochemical evaluations of the $CoFe_2O_4$ nanoparticles, conducted using cyclic voltammetry (CV), galvanostatic charge-discharge (GCD), and electrochemical impedance spectroscopy (EIS), demonstrated their superior performance as supercapacitor electrodes. These findings highlight the potential of $CoFe_2O_4$ nanoparticles as advanced electrode materials, contributing to the development of high-performance supercapacitors for next-generation energy storage solutions.

Keyword: Nanomaterials, Solution combustion method, Supercapacitor, Electrochemical properties, $CoFe_2O_4$

PII-46

PHOTO-AND THERMO-LUMINESCENCE PROPERTIES OF ALUMINO-TELLUROBORATE GLASS DOPED WITH Eu^{3+} IONS

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Abstract. Alumino-telluroborate glass doped with Eu^{3+} ions was successfully fabricated by the melt quenching method. The amorphous nature of the fabricated glass was confirmed through the X-ray diffraction patterns. The optical properties of materials were studied using excitation and emission spectra. The thermoluminescence (TL) properties of the materials were studied by analyzing the glow curve and the TL spectra. The dynamics parameters for the main TL peaks on the glow curve were calculated using the heating rate variation method.

Keywords: Alumino-telluroborate glass, thermoluminescence.

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PII-47

DIFFERENTIAL OPTICAL ABSORPTION SPECTROSCOPY OF ATMOSPHERIC NO2 GAS WITH SUPERCONTINUUM LASER SOURCE

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Abstract. Differential optical absorption spectroscopy (DOAS) offers the possibility to simultaneously detect the presence and accurately measure the concentration of trace gases in the atmosphere. The DOAS instruments usually use a high power ultrastable UV lamp as light source and a telescope mirror to send the light beam to a retro-reflector placed at a certain distance away and to collect the back reflected light beam. High power supercontinuum laser sources offer the opportunity to enhance the DOAS flexibility and data quality. In this paper we describe the incorporation of a supercontinuum laser source from NTK into our long path DOAS instrument, covering the spectral region from 40 nm to 600nm, and detail the procedure for data analysis. We present some initial measurements of the NO2 concentration in the urban environment in Hanoi.

PII-48

PHOTOCATALYTIC PROPERTIES OF Ce-X DOPED TiO_2 THIN FILMS (X = Ni, Mg, Fe)

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Abstract. TiO_2 has become the most popular used semiconductor catalyst [1]. Nevertheless, the broad bandgap of TiO_2 limits its application in visible light as well as the recombination rate of the photogenerated electron and hole is high which reduces the quantum efficiency of degradation [2]. The primary limitations of TiO_2 can be addressed by metal-doping or band-gap engineering, which combines various semiconductor materials [3]. In this study, TiO_2 thin films doped with Ce and Ni, Ce and Mg, and Ce and Fe were synthesized and investigated using the sol-gel method and spin coating. The doping concentration of each metal in the thin film samples was 1% by weight relative to TiO_2. The characteristics of the thin films indicated that the band gap energies for the Ni-Ce-TiO_2, Mg-Ce-TiO_2, and Fe-Ce-TiO_2 samples were 3.53 eV, 3.59 eV, and 3.62 eV, respectively. The photocatalytic efficiency of the films with methyl violet (MV) dye under UV irradiation for 120 minutes was 70.65% for the Ni-Ce-TiO_2 film, 48.72% for the Mg-Ce-TiO_2 film, and 39.06% for the Fe-Ce-TiO_2 film.

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PII-49

SUPERCONTINUUM GENERATION IN PHOTONIC CRYSTAL FIBERS INFILTRATED WITH BUTANOL

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Abstract. In this work, we designed a suspended core optical fiber with 4 air holes impregnated with CS2 and using $AsSe_2$ substrate. We investigated the characteristics of this optical fiber and its application in supercontinuum emission in the mid-infrared region. As a result, with low laser power, we obtained a supercontinuum emission spectrum from 2150nm to 4450nm wavelength.

Keywords: Supercontinuum generation, Supended core, AsSe2.

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PII-50

MID-INFRARED SUPERCONTINUUM GENERATION IN A FOUR-HOLE GeAsSe CHALCOGENIDE SUSPENDED-CORE FIBER

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Abstract. In this work, we designed a suspended core optical fiber with 4 air holes impregnated with CS2 and using GeAsSe substrate. We investigated the characteristics of this optical fiber and its application in supercontinuum emission in the mid-infrared region. As a result, with low laser power, we obtained a supercontinuum emission spectrum from 1900nm to 5500nm wavelength.

Keywords: GeAsSe, Supercontinuum generation, Supended core.

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PII-51

STUDY OF FLUORESCENCE EMISSION DYNAMICS OF NANOCARBON QUANTUM DOTS FABRICATED BY SOLUTION-INTERACTING PLASMA

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Abstract. In this study, we present the results of the fabrication of nanocarbon quantum dots using the solution interaction plasma method and investigate the photoluminescence kinetics of nanocarbon quantum dots through the evaluation of fluorescence characteristics, fluorescence lifetime when changing the fabrication conditions, dispersion environment and excitation wavelength. The results aim to develop new environmentally friendly photonic materials based on simple, easy-to-implement methods with high fluorescence efficiency and quantum efficiency in Vietnam. Through the evaluation of morphology, structure, and fluorescence spectra, it is noted that the fabricated carbon quantum dots have rich functional groups, the average size achieved is 4.4 nm, and a wide fluorescence emission spectrum from 320 - 650 nm with the peak spectrum changing according to the excitation wavelength. The influence of fabrication parameters, environmental conditions, excitation wavelength, and emission wavelength distribution on the photodynamic characteristics of carbon quantum dots has also been studied.

Keywords: *nanocarbon quantum dots, fluorescence emission dynamics, plasma solution interactions.*

PII-52

PREPARATION AND PHOTOCATALYTIC ACTIVITY OF TiO_2-CeO_2 HETEROSTRUCTURE HETEROSTRUCTURE FOR RHODAMINE B DEGRADATION UNDER VISIBLE LIGHT IRRADIATION

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Abstract. The TiO_2-CeO_2 heterostructure was successfully synthesized using the hydrothermal method, yielding an average particle size of 17.45 nm with high uniformity. The morphology and structure of the samples were characterized and analyzed using Field Emission Scanning Electron Microscopy (FESEM), X-ray Diffraction (XRD), and Fourier-Transform Infrared Spectroscopy (FTIR). The results confirmed that all samples contain a highly crystalline anatase phase. Additionally, the TiO_2-CeO_2 heterostructure demonstrated enhanced photocatalytic activity in the visible light region with Rhodamine B (RhB). The coupling of TiO_2 with CeO_2 promoted efficient electron and hole transfer from TiO_2 to CeO_2, facilitating the separation of electron-hole pairs and consequently improving the photocatalytic activity of the material. This work presents a novel strategy for enhancing photocatalytic activity through semiconductor junctions, with promising application prospects in environmental remediation.

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PII-53

CONTROLLING KERR NONLINEARITY IN A THREE-LEVEL LADDER-TYPE ATOMIC SYSTEM

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Abstract. For traditional materials, due to the nonlinear coefficient is usually very small (about 10^{-15} - 10^{-20} cm^2/W), the nonlinear optical effects are only possible with high intensity light sources. Therefore, scientists are always looking for solutions to enhance the nonlinear coefficient of the medium to increase sensitivity and reduce the intensity of the optical signal. Currently, an excellent proposal to attain this goal is to use lights working in vicinity of atomic resonances under electromagnetically induced transparency (EIT) [1, 2]. In addition to dramatic reduction of resonant absorption, the behavior of steeper dispersion that leads to greatly lengthen interaction time, EIT media therefore become ideal for the applications needed materials having giant nonlinear coefficient [3, 4]. The first experimental evidence showing the enhancement of the Kerr nonlinearity due to the EIT effect was observed by M. Xiao et al [5]. The results showed that the Kerr nonlinearity was greatly enhanced around the resonance frequency (about 10^{-6} cm^2/W).

In this work, we study the control of Kerr nonlinearity of a three-level ladder atomic medium under EIT. It shows that, in the presence of the EIT effect, the Kerr nonlinear coefficient is enhanced several order of magnitude (about 10^{-5} cm^2/W) around transparent spectral region. The amplitude and the sign of the Kerr nonlinear coefficient can be controlled versus the intensity or frequency of the coupling laser field. Analytical results are useful for experimental observation and related applications.

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PII-54

COMPARISON OF THE EFFECTIVE MODE AREA OF POLARIZATION MODES IN DUAL-PBG08 CORE PHOTONIC CRYSTAL FIBERS WITH UV710 SUBSTRATE

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Abstract. In this research, we studied the effective mode area of polarization modes in dual-core photonic crystal fibers with a UV710 substrate and a PBG08 core with a regular hexagonal lattice. We analyzed and compared the effective mode area values of the polarization modes at wavelengths of 1.5 µm. The results showed that the effective mode area of the first polarization modes is 1.30687 µm², the second mode is 1.34095 µm², the third one is 1.34076 µm², and the fourth mode is 1.30656 µm², corresponding to the structural parameter values. The research indicates that the smallest polarization of the fundamental mode has a value of 1.30656 µm². These results will orient the selection of the optimal polarization for supercontinuum generation.

Keywords: *dual-core photonic crystal fibers, UV710 substrate, hexagonal lattice, effective mode area.*

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