THE 12th INTERNATIONAL CONFERENCE ON PHOTONICS AND APPLICATIONS (ICPA-12)

HỘI NGHỊ QUANG HỌC QUANG PHỔ TOÀN QUỐC LẦN THỨ 12 (HNQHQP-12)

Con Dao, Ba Ria Vung Tau, Vietnam

September 28 –October 1, 2022

ABSTRACTS & PROGRAM

https://iop.vast.ac.vn/~icpa/2022/index_e.html
https://iop.vast.ac.vn/~icpa/2022/index.html

2022

CONTENTS

THE 12th INTERNATIONAL CONFERENCE ON PHOTONICS AND APPLICATIONS (ICPA-12)

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Vietnam Academy of Science and Technology

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Vietnam National University, Hanoi

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Society of Optics & Spectroscopy, VPS

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Institute of Physics (IOP), VAST

Institute of Molecular Science in Orsay, Paris-Saclay Uni., French

Institute of Laser Engineering, Osaka University, Japan

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CONFERENCE SECRETARIAT

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THE 12th INTERNATIONAL CONFERENCE ON PHOTONICS AND APPLICATIONS (ICPA-12)

CONFERENCE TOPICS

Optics, Photonics and Spectroscopy

Photonics Materials and Devices

Advanced Laser Light Sources

Optoelectronics and Integrated Optics

Nonlinear Optics

Spectroscopy of Nano and Photonic Materials

Applications of Optics, Photonics and Spectroscopy

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HỘI NGHỊ QUANG HỌC QUANG PHỔ TOÀN QUỐC LẦN THỨ 12

CƠ QUAN TỔ CHỨC

Viện Hàn lâm Khoa học và Công nghệ Việt Nam

Đại học Quốc gia thành phố Hồ Chí Minh

Đại học Quốc gia Hà Nội

Hội Vật lý Việt Nam

Hội Quang học Quang phổ

Trung tâm Vật lý Quốc tế, Viện Vật lý

Viện Vật lý, Viện Hàn lâm KH&CN VN

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 (Viện Vật lý, VAST)
Lâm Quang Vinh (Đại học Quốc gia TP. HCM)
Đinh Xuân Khoa (Trường Đại học Vinh)
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Nguyễn Thế Bình (HUS, Đại học Quốc gia Hà Nội)
Trần Quốc Tiến (Viện Khoa học Vật liệu, VAST)
Nguyễn Huy Bằng (Trường Đại học Vinh)
Ngạc An Bang (HUS, Đại học Quốc gia HN)
Lê Vũ Tuấn Hùng (Đại học Quốc gia TP. HCM)

HỘI NGHỊ QUANG HỌC QUANG PHỔ TOÀN QUỐC LẦN THỨ 12 (HNQHQP-12)

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)

Trung tâm Vật lý Lý thuyết Châu Á Thái Bình Dương (APCTP)

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

Viện Vật lý (IOP), VAST

Advanced Photonics Research Institute (APRI), GIST

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Nguyễn Thị Khánh Vân

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Phạm Hồng Minh

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HỘI NGHỊ QUANG HỌC QUANG PHỔ TOÀN QUỐC LẦN THỨ 12 (HNQHQP-12)

CHỦ ĐỀ KHOA HỌC CỦA HỘI NGHỊ

Quang học và Quang phổ

Quang tử (quang tử nanô, linh kiện, thiết bị, vật liệu, mô hình hoá...)

Các nguồn sáng kết hợp tiên tiến

Quang học phi tuyến

Quang tích hợp và quang điện tử

Quang phổ của vật liệu nano và quang tử

Ứng dụng quang học, quang tử, quang phổ và laser

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BRIEF PROGRAM

Note: - *SESSION A:* PHOTONICS AND APPLICATIONS
- *SESSION B*: OPTICS AND SPECTROSCOPY

Date ***Time***	**WEDNESDAY** ***28 September 2022***	**THURSDAY** ***29 September 2022***	**FRIDAY** ***30 September 2022***	**SATURDAY** ***01 October 2022***
8:30 - 12:15		- ***Registration*** - ***Official Opening*** - ***PLENARY SESSION*** - ***SESSION A*** - ***SESSION B***	- ***SESSION A*** - ***SESSION B***	***Social Program***
		LUNCH (offered by Conference Organizing Committee)		
13:30 - 17:30	***Registration*** (Marina Bay Con Dao Hotel - Nguyen Hue street, Con Dao)	- ***SESSION A*** - ***SESSION B*** - ***SESSION POSTER I***	- ***SESSION A*** - ***SESSION B*** - ***SESSION POSTER II*** - ***PLENARY SESSION*** ***(Official Closing)***	
18:00 - 20:00	Editorial Board Meeting of *Communications in Physics* (19.00 pm)	***Welcome Party offered by the ICPA Organizing Committee***	***Conference Party offered by VNU HCMC***	

PROGRAM

PLENARY SESSION

PROGRAM

September 29, 2022 (Thursday)

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

08:30 - 09:00 **Official Opening** (Nguyen Thanh Binh & Tran Quoc Tien)

Welcoming speech of Local Governor
Speech by M. Huynh Thanh Dat (Conference President)
Speech by M. Nobuhiko Sarukura (Osaka University, Japan)
Speech by M. Pino Thomas (Paris-Saclay University, France)
Speech by M. Yeung Lak Lee (APRI, GIST. R. Korea)
Speech by M. Nguyen Dai Hung (Conference President)
Speech by M. Do Hoang Tung (International Centre of Physics)

PLENARY SESSION

Chairperson:

Prof. Nobuhiko Sarukura (Osaka University, Japan)
Prof. Lam Quang Vinh (VNU Ho Chi Minh City)

PL-01
09:00 - 9:30 **INFRARED EMISSION AND COMPETING PROCESSES IN MOLECULAR SYSTEMS OF ASTROPHYSICAL RELEVANCE**

Thomas Pino

Institute of Molecular Science in Orsay, CNRS, France

PL-02
9:30 - 10:00 **OPTICS IN COHERENT ATOMIC GASEOUS MEDIUM: A RECENT PROGRESS IN VINH UNVERSITY**

Nguyen Huy Bang

Vinh University, Vietnam

PL-03
10:00 - 10:30 **RESEARCH ACTIVITIES OF APRI**

Yeung Lak Lee

Advanced Photonics Research Institute (APRI), R. Korea.

10:30 - 10:50 **CONFERENCE PHOTOGRAPH/COFFEE BREAK**

SESSION A
PHOTONICS AND APPLICATIONS

SESSION A:
PHOTONICS & APPLICATIONS
September 29, 2022 (Thursday)

Chairperson:

Prof. Marek Trippenbach (University of Warsaw, Poland)
Prof. Fabrice Vallée (University of Lyon, French)

A-01
10:50 - 11:15

GAS PHASE RELAXATION DYNAMICS OF DITHIENYLETHENE PHOTOCHROMIC MOLECULE

(Invited talk)

Chesta Chopra, Aude Lietard, Lou Barreau, Jean-Michel Mestdagh, Lionel Poisson
Université Paris-Saclay, CNRS, Institut des Sciences Moléculaires d'Orsay, 91405, Orsay, France

A-02
11:15 - 11:40

OPTICAL ANALOGS OF ELECTRON-POSITRON PAIR PRODUCTION AND ANNIHILATION IN BINARY WAVEGUIDE ARRAYS

(Invited talk)

Truong X. Tran
Department of Physics, Le Quy Don Technical University, 236 Hoang Quoc Viet street, Hanoi, Vietnam

A-03
11:40 - 12:05

ULTRAFAST THERMO-OPTICAL DYNAMICS OF A SINGLE PLASMONIC NANOPARTICLE

(Invited talk)

Natalia Del Fatti*, Clément Panais, Aurélien Crut, Noëlle Lascoux, Paolo Maioli, Fabien Vialla, Francesco Banfi, and Fabrice Vallée
FemtoNanoOptics group, Institut Lumière Matière, CNRS - Université Claude Bernard Lyon 1, Université de Lyon

A-04
12:05 - 12:30

DETERMINISTIC COUPLING OF A QUANTUM DOT BASED SINGLE PHOTON SOURCE INTO POLYMERIC PHOTONIC STRUCTURES

(Invited talk)

Ngoc Diep LAI
Laboratoire Lumière, Matière et Interfaces (LuMIn), UMR 9024, ENS Paris-Saclay, 4, Avenue des Sciences, 91190 Gif-sur-Yvette, France

12:30-13:30 LUNCH

Chairperson:

Prof. Natalia Del Fatti (University of Lyon, French)
Dr. Hoonsoo Kang (APRI, GIST, R. Korea)

A-05
13:30 - 13:55 **ADVANCED FEMTOSECOND LASER INSCRIPTION IN BULK DIELECTRICS: BASIC MECHANISMS AND POTENTIAL APPLICATIONS**

(Invited talk)

Sergey I. Kudryashov
Department of quantum electronics, Lebedev Physical Institute, Leninsky prospect 53, 119991 Moscow, Russia

A-06
13:55 - 14:20 **SELECTIVE ANALYSIS OF VIBRATIONAL DYNAMICS OF INDIVIDUAL METAL NANO-OBJECTS**

(Invited talk)

Fabrice Vallée, Michele Diego, Aurélien Crut, Noëlle Lascoux, Paolo Maioli, Fabien Vialla, Francesco Banfi and Natalia Del Fatti
Femto - Nano - Optics group, Institut Lumière Matière, CNRS - Université Claude Bernard Lyon 1, Université de Lyon

A-07
14:20 – 14:45 **ATOMS IN A SPIN DEPENDENT OPTICAL POTENTIAL: GROUND STATE TOPOLOGY AND MAGNETIZATION**

(Invited talk)

Marek Trippenbach
Institute for Theoretical Physics, University of Warsaw, Poland

A-08
14:45 – 15:10 **POLARITON BOUND STATES IN THE CONTINUUM: THE STRONG COUPLING REGIME BETWEEN A PHOTONIC TOPOLOGICAL CHARGE AND EXCITONS IN QUANTUM WELLS**

(Invited talk)

Hai Son Nguyen
Univ Lyon, Ecole Centrale de Lyon, CNRS, INSA Lyon, Université Claude Bernard Lyon 1, CPE Lyon, CNRS, INL, UMR5270, Ecully 69130, France
Institut Universitaire de France (IUF), Paris, France.

15:10 – 15:20 COFFEE BREAK

Chairperson:

Prof. Sergey I. Kudryashov (P.N. Lebedev IOP, Russia)
Prof. Julien Laverdant (Lyon 1 Uni., France)

A-09 **15:20 – 15:45**

SPECTRAL IMAGING OF CULTURAL ASSETS

(Invited talk)

Nobuhiko Sarukura

Institute of Laser Engineering, Osaka University, 2-6 Yamadaoka, Suita, Osaka Japan

A-10 **15:45 - 16:10**

CONTROLLING EXCITONS IN COLLOIDAL NANOMATERIALS

(Invited talk)

(Steve) Cuong Dang

Centre for OptoElectronics and Photonics (COEB), School of Electrical and Electronic Engineering, The Photonics Institute (TPI), Nanyang Technological University, 50 Nanyang Avenue, 639798, Singapore

A-11 **16:10 – 16:35**

DESIGN OF CPV MODULE FOR CAR-ROOF APPLICATION

(Invited talk)

Seoyong Shin, Vu Hoang
Department of Information and Communication Engineering, Myongji University, 116, Myongji-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea

A-12 **16:35 - 16:55**

THEORETICAL STUDY OF DYNAMIC STARK-INDUCED DEGENERATE VIBRONIC STATE BY TWO NON-RESONANT SHIFT-UP LASERS

H. Mineo, Q. H. Ho, N. L. Phan, Y. Fujimur

Science and Technology Advanced Institute (STAI), Van Lang University, 69/68 Dang Thuy Tram Str, Binh Thanh Dist, Ho Chi Minh City, Vietnam

16:00 - 18:00 **SESSION POSTER I**

SESSION POSTER I

September 29, 2022 (Thursday)

Chairperson:

Prof. Tran Quoc Tien (IMS, VAST)
Prof. Pham Hong Minh (IOP, VAST)

18:00 - 19:30 WELCOME CONFERENCE PARTY

SESSION A:

PHOTONICS & APPLICATIONS

September 30, 2022 (Friday)

<u>Chairperson:</u>

Prof. ***Dao Van Lap (Swinburne Uni. Technology, Australia)***
Prof. Akira Yoshikawa (Osaka Uni., Japan)

A-13
08:30 - 08:55 **ULTRAFAST SPIN DYNAMICS IN FERROMAGNETIC AND ANTIFERROMAGNETIC THIN FILMS STUDIED BY X-RAY AND LASER**

(Invited talk)

Hiroki WADATI

University of Hyogo, 651-2197 Hyogo, Kobe, Nishi Ward, Gakuen Nishimachi, 8 Chome-2-1, Japan

A-14
08:55 - 09:20 **FEMTOSECOND SPECTROSCOPY OF TRANSIENT ABSORPTION IN Ag_2S AND CdS QDs**

(Invited talk)

S. A. Tikhomirov, A. N. Ponyavina, K. A. Barbarchyk, O. V. Ovchinnikov, M. S. Smirnov, T. S. Kondratenko, A. I. Zvyagin, I. G. Grevtseva, Pham Hong Minh, Nguyen Thanh Binh

B. I. Stepanov Institute of Physics, National Academy of Science of Belarus, 68 Nezavisimosti Ave, Minsk 220072, Belarus

A-15
09:20 - 09:45 **DEVELOPMENT OF A MINIATURE TIME-OF-FLIGHT MASS ANALYZER FOR COMBINATION WITH A HIGHLY-REPETITIVE FEMTOSECOND LASER SOURCE AND A TIME-CORRELATED SINGLE ION COUNTING SYSTEM**

(Invited talk)

Tomoko Imasaka and Totaro Imasaka

Facultyl of Design, Kyushu University, Fukuoka, Japan

A-16 **09:45 - 10:10** **GENERATION OF AN ULTRASHORT OPTICAL PULSE IN THE NEAR-INFRARED AND VACUUM-ULTRAVIOLET REGIONS FOR USE AS THE IONIZATION SOURCE IN MASS SPECTROMETRY**

(Invited talk)

Tomoko Imasaka and Totaro Imasaka

Facultyl of Design, Kyushu University, Fukuoka, Japan

A-17 **10:10 - 10:35** **INVESTIGATION OF CHARGE PHOTOACCUMULATION IN PHOTOCATALYTIC SYSTEMS FOR CO_2 REDUCTION**

(Invited talk)

M.-H. Ha-Thi, D. Cruz, P. Gotico, E. Pugliese, A. Quaranta, W. Leibl, Z. Halime, A. Aukauloo, T. Pino

Université Paris-Saclay, CNRS, Institut des Sciences Moléculaires d'Orsay, 91405, Orsay, France

10:35 - 10:45 **COFFEE BREAK**

Chairperson:

Prof. Totaro Imasaka (Kyushu Uni., Japan)
Prof. S. A. Tikhomirov (NAS, Belarus)

A-18 **10:45 - 11:10** **PROPAGATION OF ELEKTROMAGNETIC PULSES IN NONLINEAR MEDIA: APPLICATION IN SUPERCOTINUUM GENERATION**

(Invited talk)

Cao Long Van

Institute of Physics, University of Zielona Gora, Prof. Szafrana 4a, 65-516 Zielona Góra, Poland

A-19 **11:10 - 11:35** **PROGRESS IN TIME-RESOLVED MEASUREMENTS IN X-RAY FREE-ELECTRON LASER SACLA**

(Invited talk)

Tadashi TOGASHI

Japan Synchrotron Radiation Research Institute (JASRI), 1-1-1, Kouto, Sayo-cho, Sayo-gun, Hyogo 679-5198 Japan

A-20 **234 NM DEEP ULTRAVIOLET SECOND HARMONIC**
11:35 - 12:00 **GENERATION FROM SRB4O7 MICROCAVITY**

(Invited talk)

Tomoaki Nambu

Osaka University, 2-6 Yamadaoka, Suita, Osaka 565-0871, Japan

A-21 **GENERATION AND APPLICATION OF FOUR-WAVE MIXING**
12:00 - 12:25 **IN COLLINEAR HIGH HARMONIC GENERATION**

(Invited talk)

Dinh Ba Khuong, Tran Anh Khoa, Chau Huy Thong, Truong Vi Khanh, Nguyen Ba Hoi, Nguyen Tan Hung and Dao Van Lap
Optical Sciences Centre, Swinburne University of Technology, VIC 3122, Australia

12:30 - 13:30 **LUNCH**

Chairperson:

Prof. Cao Long Van (Zielona Gora Uni., Poland)
Prof. Tran Xuan Truong (Le Quy Don University)

A-22 **HYBRID PLASMONIC NANOSTRUCTURES FOR PHOTONIC**
13:30 - 13:55 **APPLICATIONS**

(Invited talk)

Julien Laverdant, Cam-Nhung Vu, Michel Pellarin, Zakarya Ouzit, Agnès Maître, Laurent Coolen, Trinh Thi Hue, Pham Thu Nga, Frédéric Lerouge
Institut Lumière Matière, Université Claude Bernard Lyon 1, CNRS, Université de Lyon, F-69622 Villeurbanne, France

A-23 **CROSS-PHASE MODULATION BETWEEN PULSE MATCHED**
13:55 - 14:20 **LIGHTS IN OPTICAL LOOP SYSTEM**

(Invited talk)

Bongjune Kim and Hoonsoo Kang
Advanced Photonics Research Institute, GIST, Gwangju 61005 South Korea

A-24 **14:20 - 14:45** **PREPARATION OF DEFECT-LESS PEROVSKITE QUANTUM DOTS AND LIGHT-EMITTING DIODE (LED) APPLICATIONS**

(Invited talk)

Chang-Lyou Lee

Advanced Photonics Research Institute (APRI), Gwangju Institute of Science and Technology (GIST), Gwangju 61005, Republic of Korea

A-25 **14:45 - 15:10** **LASING ACTION IN THE BOUND STATE IN THE CONTINUUM ORIGINATED FROM DESTRUCTIVE INTERFERENCE OF OPTICAL MULTIPOLE RESONANCES**

(Invited talk)

Son Tung Ha, Mengfei Wu, Ramón Paniagua-Domínguez, Hilmi Volkan Demir, Arseniy I. Kuznetsov

Institute of Materials Research and Engineering, Agency for Science, Technology and Research, Singapore 138634, Singapore

15:10 - 15-20 **COFFEE BREAK**

15:30 - 17:00 **SESSION POSTER II**

SESSION POSTER II

September 30, 2022 (Friday)

Chairperson:

Prof. Le Vu Tuan Hung (VNU Ho Chi Minh city)
Prof. Chu Van Lanh (Vinh University, Vinh, VN)

Chairperson:

Prof. ***Ryuji Katayama (Osaka Uni., Japan)***
Prof. ***Thomas Pino (Ecole Centrale de Lyon, France)***

A-26 **15:20 - 15:45** **MANAGEMENT OF POLARIZATION PROPERTIES IN NANOSTRUCTURED OPTICAL FIBERS**

(Invited talk)

Ryszard Buczynski
Faculty of Physics, University of Warsaw

A-27 **15:45 - 16:10** **WAVE SHAPING IN SECOND HARMONIC GENERATION IN NONLINEAR PHOTONIC CRYSTALS**

(Invited talk)

Wieslaw Krolikowski
Texas A&M University at Qatar, Qatar

A-28 **16:10- 16:35** **FUNCTIONAL OPTICAL IMAGING WITH NOVEL WAVELENGTH RANGE AND IMAGE ENHANCEMENT USING MACHINE LEARNING METHOD**

(Invited talk)

Tae Joong Eom
Dep. of Optics and Mechatronics Engineering, Pusan National University
Color-Modulated Extra-Sensory Perception Technology Engineering Research Center, Pusan National University

A-29 **16:35- 17:00** **DEVELOPMENT OF NOVEL CRYSTALLINE MATERIALS AND TECHNOLOGIES AT THE UNIVERSITY AND THEIR SOCIAL IMPLEMENTATION THROUGH ACADEMIC START-UPS**

(Invited talk)

Akira YOSHIKAWA
Institute for Materials Research (IMR), Tohoku University, Japan

17:00 – 17:30 **PLENRARY SESSION**

Official Closing

18:00 – 19:30 **CONFERENCE PARTY**

SESSION B

OPTICS AND SPECTROSCOPY

SESSION B:

OPTICS AND SPECTROSCOPY

September 29, 2022 (Thursday)

<u>Chairperson:</u>

Prof. Le Vu Tuan Hung (VNU TP. HCM)
Prof. Ngac An Bang (HUS, VNU Hanoi)

B-01 **10:50 - 11:15** **MICROLASER BASED NATURAL MATERIALS FOR BIOLOGICAL APPLICATIONS**

(Invited talk)

Hanh Hong Mai, Trong Tam Nguyen, Tien Thinh Nguyen, Thanh Thuy To, Toan T Nguyen, Do Xuan Tien, Giang Manh Khoi, Youngwoon Choi, Wonshik Choi and Van Duong Ta

Department of Quantum Optics, Faculty of Physics, VNU University of Science, Vietnam National University, 334 Nguyen Trai, Hanoi 100000, Vietnam

B-02 **11:15 - 11:40** **INFLUENCE OF A COMPRESSIVE STRAIN ON THE HIGH-TEMPERATURE THERMOELECTRIC(TE) PROPERTIES OF EUROPIUM ORTHOFERRITE**

(Invited talk)

Carlos Baldo III

Department of Physics, Map`ua University, Intramuros, Manila, Philippines

B-03 **11:40 - 12:05** **COLLABORATIVE RESEARCH EFFORTS BETWEEN NIP-UPD AND IOP - VAST ON THE DEVELOPMENT OF NANOSTRUCTURED SILICON FOR TERAHERTZ APPLICATIONS**

(Invited talk)

Elmer Estacio

National Institute of Physics, University of the Philippines Diliman, Quezon City 1101, Philippines

B-04 **12:05 - 12:30** **FAST-RESPONSE SCINTILLATORS THROUGH CROSS LUMINESCENCE IN WIDE BAND GAP FLUORIDE CRYSTALS**

(Invited talk)

Luong Viet Mui*, Marilou Cadatal-Raduban, Akira Yoshikawa, Toshihiko Shimizu, Nobuhiko Sarukura, Tadashi Togashi, and Kohei Yamanoi

Graduate School of Engineering, Osaka University, 2-1 Yamadaoka, Suita, Osaka, Japan

12:30 - 13:30 **LUNCH**

Chairperson:

Prof. Nguyen The Binh (HUS, VNU Hanoi)
Prof. Chu Viet Ha (Thai Nguyen Uni.)

B-05 **13:30 - 13:55** **ELECTRIC CIRCUIT MODELS OF LIGHTNING AND OPTICAL BREAKDOWN BASED ON PERCOLATION**

(Invited talk)

Jacque Lynn Gabayno*, Akira Sasaki, Kevin Paolo Icaro, Emmanuel Delos Reyes , Christian Joseph Payag, Rayda Gammag, Susumu Kato, Nobuhiko Sarukura

Department of Physics, Mapua University, Intramuros, Manila, Philippines

B-06 **13:55 - 14:20** **FABRICATION OF TRIANGULAR SILVER NANOPARTICLES DECORATED ON TIN DIOXIDE FOR NITROGEN OXIDE REMOVAL**

(Invited talk)

Viet Van Pham*, Dieu Thien Bui, Thi Minh Cao

University of Science, VNU HCMC

B-07 **14:20 - 14:45** **FORMATION OF FOCUSED OPTICAL VORTEX BEAMS IN LIQUID MEDIA USING FIBER-BASED MICROPROBE WITH NANOSTRUCTURED ALL-GLASS COMPONENTS**

(Invited talk)

Hue Thi Nguyen*, Adam Filipkowski, Rafal Kasztelanic, Dariusz Pysz, Wieslaw Krolikowski and Ryszard Buczynski

Faculty of Physics, University of Warsaw, Pasteura 5, 02-093 Warsaw, Poland

B-08 **14:45 – 15:05** **DISPERSION CONTROL IN LEAD-BISMUTH GALLATE GLASS PHOTONIC CRYSTAL FIBERS INFILTRATED WITH OLIVE OIL**

Hieu Van Le*, Thao Thi Nguyen, Dung Thi Nguyen, Quang Ho Dinh, Tham Tran Hong, Ngoc Vo Thi Minh, Bien Chu Van

Faculty of Natural Sciences, Hong Duc University, 565 Quang Trung Street, Thanh Hoa City, Vietnam

15:05 – 15:20 **COFFEE BREAK**

Chairperson:

Prof. Le Van Hoang (HCM Univ. Edu.)
Dr. Pham Van Viet (VNU HCMC)

B-09 **15:20 – 15:45** **BIOIMAGING AND BIOSENSING STRUCTURAL DEVICES USING NEAR - INFRARED METAL - DIELECTRIC - METAL PLASMONIC METASURFACES: SIMULATION AND FABRICATION**

(Invited talk)

Huu Tu Nguyen, Thu Trang Hoang, Xuan Bach Nguyen, Thanh Son Pham, Khai Q. Le, and Quang Minh Ngo*

University of Science and Technology of Hanoi, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Hanoi, Vietnam

B-10 **15:45 – 16:05** **g-JITTER EFFECT ON HEAT AND MASS TRANSFER OF THREE-DIMENSIONAL STAGNATION POINT NANOFLUID FLOW**

Mohamad Hidayad Ahmad Kamal, Anati Ali, Noraihan Afiqah Rawi, Sharidan Shafie

Department of Mathematical Sciences, Faculty of Science, Universiti Teknologi Malaysia 81310 UTM Johor Bahru, Johor Darul Takzim, Malaysia

B-11 **16:05 – 16:25** **COLOUR FADING EFFECT OF DENIM FABRIC DURING WASH IN CREATING WHISKERS BY CO2 LASER**

Trang Huynh Dang Khoa*, Doan Tran Thien Duc, Le Mai Trinh, Le Van Nam, Nguyen Thi Thu Hien, Hoang Minh Dong, Thai Doan Thanh, Nguyen Tuan Anh, Bui Quoc Trung, Pham Minh Nguyet, Ta Thi Kim Tuyen, Mai Huu Phuoc, Dinh Son Thach

Ho Chi Minh City University of Food Industry, Ho Chi Minh City, Vietnam

16:00- 18:00 SESSION POSTER I

SESSION POSTER I

September 29, 2022 (Thursday)

Chairperson:

Prof. Tran Quoc Tien (IMS, VAST)
Prof. Pham Hong Minh (IOP, VAST)

18:00 - 19:30 Welcome conference party

SESSION B:

OPTICS AND SPECTROSCOPY

September 30, 2022 (Friday)

<u>Chairperson:</u>

Prof. Vu Thi Kim Lien (Duy Tan Uni.)
Dr. Nguyen Thi Mai Huong (IOP, VAST)

B-12 **08:30 - 08:55** **SMART BIOLOGICAL MICROLASERS AND THEIR POTENTIAL APPLICATIONS**

(Invited talk)

Ta Van Duong*, Le Hoang Hai, Nguyen Van Toan, Nguyen Tien Anh, Pham Van Nhat

Department of Optical Devices, Le Quy Don Technical University, 236 Hoang Quoc Viet, Hanoi, Vietnam

B-13 **08:55 - 09:20** **PREPARATION OF SERS SUBSTRATES BY USING LASER ABLATION METHOD AND APPLICATIONS**

(Invited talk)

Nguyen The Binh*, Tran Trong Duc, Nguyen Quang Dong and Nguyen Thi Hue

Department of Physics, VNU University of sciences, 334 Nguyen Trai, Thanh Xuan, Hanoi

B-14 **09:20 - 09:45** **SOLUTION-BASED PROCESS OF REDUCED GRAPHENE OXIDE/B-Ga_2O_3 NANORODS HETEROJUNCTION FOR ULTRAVIOLET PHOTODETECTOR APPLICATION**

(Invited talk)

Tran Viet Cuong*, Huynh Tran My Hoa, Hoang Hung Nguyen, Hoai Phuong Pham, Dinh Tan Muon and Trung Tin Tran

VKTECH Research Center, NTT Hi-Tech Institute, Nguyen Tat Thanh University 298A-300A Nguyen Tat Thanh Street, Ward 13, District 4, Ho Chi Minh City, Vietnam

B-15 **09:45 - 10:10** **OPTICAL PROPERTIES OF NANOPHOSPHORS CONTAINNING RARE EARTH IONS Ce, Tb, Eu, Er, Yb and Gd APPLICATION POTENTIAL IN BIOMEDICIN AND SECURITY PRINTING**

(Invited talk)

Tran Kim Anh* and Le Quoc Minh

DuyTan University, 3 Quang Trung, Hai Chau, Danang, Vietnam

B-16 **10:10 - 10:35** **RETRIEVING TERAHERTZ TIME DOMAIN BY ODD-EVEN HIGH ORDER HARMONIC GENERATION**

(Invited talk)

Ngoc-Loan Phan*, Doan-An Trieu, Van-Hoang Le

Department of Physics, Ho Chi Minh City University of Education

10:35 - 10:45 **COFFEE BREAK**

Chairperson:

Prof. Ngo Quang Minh (USTH, VAST)
Prof. Nguyen Xuan Nghia (IOP, VAST)

B-17 **10:45 - 11:10** **ELECTRON SPIN RESONANCE AND PHOTOLUMINESCENCE OF OF DOPED/UNDOPED ZnO NANOPARTICLES**

(Invited talk)

Nguyen Xuan Sang*, Pham Thi Thuy

Saigon University, 273 An Duong Vuong, district 5, Ho Chi Minh City, Vietnam

B-18 **11:10 - 11:35** **INDUSTRIAL LASER APPLICATIONS**

(Invited talk)

Do Quoc Khanh

TRUMPF Vietnam Co. Ltd.

B-19 **11:35 - 11:55** **TEMPERATURE AND TIME MODIFICATION IN SYNTHETIZATION OF ALPHA NANO HEMATITE α-Fe_2O_3 USING CHEMICAL PRECIPITATION METHOD FOR GLASS FABRICATION**

Usman Iliyasu, Mohammad Syazwan Sanusi Mohd*, Nor Ezzaty Ahmad

Department of Physics, Universiti Teknologi Malaysia, Johor, Malaysia

B-20 **11:55 - 12:15** **STUDY OF STRUCTURE AND PHOTOLUMINESCENCE OF TITANIUM OXIDE NANOTUBE HYBRIDIZED WITH Ag NANOPARTICLE**

Pham Thi Thuy*, Nguyen Xuan Sang

Saigon University, 273 An Duong Vuong, District 5, Ho Chi Minh City, Vietnam

12:30 - 13:30 **LUNCH**

Chairperson:

Prof. Phan Thi Ngoc Loan (HCMC Uni. Edu.)
Dr. Ta Van Duong (Le Quy Don Uni.)

B-21 **13:30 - 13:55** **NGHIÊN CỨU CHẾ TẠO NANO BẠC/VÀNG TRÊN SỢI QUANG SỬ DỤNG PHƯƠNG PHÁP QUANG HÓA CÓ TRỢ GIÚP BẰNG CHÙM LASER ĐỂ PHÂN TÍCH DƯ LƯỢNG THUỐC BẢO VỆ THỰC VẬT BẰNG KỸ THUẬT SERS**

(Invited talk)

Phạm Văn Hội

Viện Khoa học Vật liệu, Viện Hàn lâm KHCNVN, 18 Hoàng Quốc Việt, Cầu Giấy, Hà Nội

B-22 **13:55 - 14:15** **BAND GAP ENGINEERING AND THERMOELECTRIC PROPERTY OF TWO-DIMENSIONAL MOLYBDENUM CARBON FLUORIDE**

Doan Thi Kieu Anh*, Luong Viet Mui, Pham Hong Minh, Nguyen Thanh Binh, Marilou Cadatal-Raduban

Institute of Physics, VAST, Vietnam

B-23 **14:15 - 14:35** **ORDERED AG NANOSTRUCTURE GENERATING SURFACE PLASMON EFFECT AT NEAR-INFRARED REGION: THEORY, SIMULATION AND EXPERIMENTAL FABRICATION**

Xuan-Bach Nguyen*, Thu-Trang Hoang, Quang-Minh Ngo

University of Science and Technology of Hanoi, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Ha Noi

B-24 **14:35 - 14:55** **PREDICTION OF REFINED LINE SHAPE PARAMETERS OF CO BROADENED BY N_2 USING THE CLASSICAL MOLECULAR DYNAMICS SIMULATIONS**

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

Faculty of Physics, Hanoi National University of Education, 136 XuanThuy, CauGiay, Hanoi, Vietnam

B-25 **14:55 - 15:15** **OPTIMIZATION OF THE ULTRA-FLATTENED NORMAL DISPERSION PHOTONIC CRYSTAL FIBERS INFILTRATED WITH TETRACHLOROETHYLENE FOR SUPERCONTINUUM GENERATION**

Ngoc Vo Thi Minh, Lanh Chu Van, Hieu Van Le, Quang Ho Dinh, Thao Thi Nguyen, Bao Le Xuan

Department of Physics, Vinh University, 182 Le Duan Street, Vinh City, Vietnam

15:15-15:20 **COFFEE BREAK**

15:30- 17:00 **SESSION POSTER II**

SESSION POSTER II

September 30, 2022 (Friday)

Chairperson:

Prof. Le Vu Tuan Hung (VNU Ho Chi Minh city)
Prof. Chu Van Lanh (Vinh University, Vinh, VN)

Chairperson:

Dr. Giang Manh Khoi (Nacentech.)
Dr. Le Van Doai (Vinh University)

B-26
15:20 - 15:45 **GREEN SYNTHESIS OF CuO NANOPARTICLES USING TEA EXTRACT AND THE FIRST OBSERVATION OF ITS ANTI-STAPHYLOCOCCUS AUREUS ACTIVITY BY SEM**

(Invited talk)

Thi Kim Oanh Vu

Institute of Physics, Vietnam Academy of Science and Technology, No. 10 Dao Tan, Ba Dinh, Ha Noi

B-27
15:45 - 16:05 **NGHIÊN CỨU CÔNG NGHỆ MÀI THẤU KÍNH CẦU VẬT LIỆU CaF_2**

Phạm Hồng Tuấn, Nguyễn Xuân Thành, Nguyễn Tuấn Vũ, Nguyễn Thành Hợp

Trung tâm Quang Điện tử, Viện Ứng dụng Công nghệ, C6 Thanh Xuân Bắc, Hà Nội

B-28
16:05- 16:25 **CONTROL OF PULSE PROPAGATION IN A FIVE-LEVEL ATOMIC MEDIUM**

Nguyen Thi Thu Hien*, Nguyen Huy Bang, Le Van Doai, Dinh Xuan Khoa, Thai Doan Thanh, Nguyen Tuan Anh, Hoang Minh Dong

Ho Chi Minh City University of Food Industry, Ho Chi Minh City, Vietnam

B-29
16:25- 16:45 **STUDY OF PARAMETERS AFFECTING FARICATION PROCESS OF PDMS MICROLENSES BASED ON PHOTORESIST MOLD**

Hoang Van Thinh*, Nguyen Xuan Ton, Tran Trong An, Chu Thi Xuan, Chu Manh Hoang

International Training Institute for Materials Science, Hanoi University of Science and Technology, No. 1, Dai Co Viet, Hai Ba Trung, Ha Noi, Viet Nam

17:00 – 17:30 **PLENRARY SESSION**

Official Closing

18:00 – 19:30 **CONFERENCE PARTY**

SESSION POSTER I

September 29, 2022 (Thursday)

Chairperson:

Prof. Tran Quoc Tien (IMS, VAST)
Prof. Pham Hong Minh (IOP, VAST)

PI-01 RAMAN FREQUENCY CONVERSION OF SPECTRALLY TUNABLE LASER RADIATION ON COHERENTLY DRIVEN MOLECULAR VIBRATIONS IN HIGH-PRESSURE HYDROGEN

V. A. Orlovich, R. V. Chulkov

B. I .Stepanov Institute of Physics, NAS of Belarus, Nesalezhnasti Ave. 68-2, 220072 Minsk, Belarus

PI-02 MULTIFREQUENCY STIMULATED RAMAN SCATTERING OF PICOSECOND PULSES IN A POLYCRYSTALLINE SOLID MIXTURE OF LITHIUM COMPOUNDS

V. A. Orlovich, A. V. Skrabatun, A. Yu. Pyatyshev, A. I. Vodchits, I. A. Khodasevich, O. P. Korozhan[1]

Department of Nonlinear Optics and Activated Materials, B. I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus, 68-2 Nezavisimosti Ave., Minsk, Belarus

PI-03 MULTIFREQUENCY PICOSECOND RANDOM RAMAN LASING IN POWDERS OF POTASSIUM, SODIUM, AND STRONTIUM NITRATES

A. Yu. Pyatyshev, A. V. Skrabatun, A. I. Vodchits, A. V. Larkina, I. A. Khodasevich, V. A. Orlovich

P. N. Lebedev Physical Institute, Russian Academy of Sciences, 53, Leninskiy Pr., Moscow, Russia

PI-04 NUMERICAL SIMULATION AND EXPERIMENTAL STUDY OF THE PULSED RING KTP-OPO GENERATING EYE-SAFE RADIATION

G. I. Timofeeva, Nguyen Dai Hung, V. I. Dashkevich, P. A. Apanasevich, V. A. Orlovich

B. I. Stepanov Institute of Physics, NAS of Belarus, Nesalezhnasti Ave. 68-2, 220072 Minsk, Belarus

PI-05 MULTIFREQUENCY PICOSECOND INFRARED STIMULATED RAMAN SCATTERING IN KGW AND LEAD TUNGSTATE CRYSTALS

A. I. Vodchits, I. A. Khodasevich, V. A. Orlovich

B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, 68-2 Nezavisimosti Ave., 220072 Minsk, Belarus

PI-06 HYBRID ASSOCIATES AND DYNAMICS OF ELECTRONIC EXCITATIONS IN THEM

S.A. Tikhomirov, A.N. Ponyavina, K. A. Barbarchyk, O.V. Ovchinnikov, M.S. Smirnov, T. S. Kondratenko, A. I. Zvyagin, I. G. Grevtseva, Pham Hong Minh, Nguyen Thanh Binh

B. I. Stepanov Institute of Physics of National Academy of Science of Belarus, 68 Nezavisimosti Ave, Minsk 220072, Belarus

PI-07 ELECTRONIC ENERGY TRANSFER BETWEEN A CYANINE-BASED MOLECULAR ROTORS SYBR GREEN INTERCALATED IN DNA

S. A. Tikhomirov, A.P. Blokhin, V. A. Povedailo, D. L. Yakovlev, Fan Fan, V. V. Shmanai, Pham Hong Minh, Pham Van Duong

B. I. Stepanov Institute of Physics, National Academy of Science of Belarus, Nesalezhnasti Ave. 68, 220072. Minsk, Belarus

PI-08 TWISTED INTRAMOLECULAR CHARGE TRANSFER IN BENZOTHIAZOLE-ANILINE MOLECULAR ROTORS

S. A. Tikhomirov, A. V. Povedailo, A. S. Pilipovich, T. F Raichenok, A. D. Shirokanov, D. L. Yakovlev, V. I. Stsiapura, Pham Hong Minh, Pham Van Duong

B.I. Stepanov Institute of Physics, National Academy of Science of Belarus, 68 Nezavisimosti Ave, Minsk 220072, Belarus

PI-09 SPECTRAL-LUMINESCENT PROPERTIES OF HYBRID PLASMON NANOSTRUCTURES AG-R6G AND AG-RC

S. A. Tikhomirov, K. A. Barbarchyk, A. D. Zamkovets, A. A. Romanenko, Pham Hong Minh, Pham Van Duong

B. I. Stepanov Institute of Physics, National Academy of Science of Belarus, 68 Nezavisimosti Ave, Minsk 220072, Belarus

PI-10 AN AUTO-TRACKING COMPOUND MICRO-OPTICAL MEASUREMENT SYSTEM FOR FORM AND ROUGHNESS OF OPTICAL FREEFORM SURFACES WITHOUT DATUMN

Vo Quang Sang, Duan Yiting

Department of Optical Engineering, Le Quy Don Technical University, Hanoi, Vietnam

PI-11 STUDYING THE NONLINEAR OPTICAL PROPERTIES OF Ce:LiCAF CRYSTAL IN THE ULTRAVIOLET WAVELENGTH REGION

Diep Van Nguyen, Tu Xuan Nguyen, Duong Van Pham, Doan Thi Kieu Anh, Marilou Cadatal-Raduban, Minh Hong Pham and Nobuhiko Sarukura

Institute of Physics, Vietnam Academy of Science and Technology, Ha Noi, Viet Nam

PI-12 DYNAMICS OF ULTRAVIOLET LASER PULSE AMPLIFICATION USING Ce:LiCAF CRYSTAL AS A BROADBAND, SOLID-STATE GAIN MEDIUM

Diep Van Nguyen, Duong Van Pham, Tu Xuan Nguyen, Doan Thi Kieu Anh, Marilou Cadatal-Raduban, Minh Hong Pham and Nobuhiko Sarukura

Institute of Physics, Vietnam Academy of Science and Technology, Ha Noi, Viet Nam

PI-13 MULTIPASS AMPLIFIER OF ULTRAVIOLET AND NARROWBAND LASER PULSES USING A Ce:LiCAF CRYSTAL

Tu Xuan Nguyen, Diep Van Nguyen, Duong Van Pham, Doan Thi Kieu Anh, Marilou Cadatal-Raduban, Minh Hong Pham and Nobuhiko Sarukura

Institute of Physics, Vietnam Academy of Science and Technology, Ha Noi, Viet Nam

PI-14 OPTIMIZATION OF DISPERSIONS IN GERMANIUM-DOPED PHOTONIC CRYSTAL FIBERS WITH SQUARE LATTICE

Thuy Nguyen Thi, Lanh Chu Van, Duc Hoang Trong

University of Education, Hue University, 34 Le Loi, Hue City, Viet Nam

PI-15 GREEN SYNTHESIS OF SILVER NANOPARTICLES USING TEA LEAF EXTRACT (CAMELLIA SINENSIS) FOR PHOTOCATALYST EFFECT

Do Thi Hue, Tran Khac Khoi, Luong Ba Son, Panhya Chanhthalangsy, Tran Thi Hue, Le Tien Ha

Thai Nguyen University of Education, Quang Trung ward, Thai Nguyen city, Vietnam

PI-16 CREATION OF RANDOM OPTICAL SIGNALS USING SEMI - NONLINEAR DIRECTION COUPLER

Bui Xuan Kien, Nguyen Manh Thang, Thai Doan Thanh, Ho Quang Quy

Electric Power University, 235 Hoang Quoc Viet, Ha Noi

PI-17 NUMERICAL INVESTIGATION ON SILICA MICROSPHERES COUPLED SILICON NITRIDE WAVEGUIDES

Thi Hong Cam Hoang, Quoc Trung Trinh, Quang Minh Ngo, Van Dai Pham, Thuy Van Nguyen, Thanh Binh Pham, Van Hoi Pham

University of Science and Technology of Hanoi, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Hanoi, Vietnam

PI-18 FABRICATION OF FLEXIBLE SERS SUBSTRATE BASED ON POLYDIMETHYLSILOXANE AND SILVER NANOPARTICLES

Nguyen Thi Hang Nga, Nguyen Duc Toan, Nguyen Trong Nghia, Vu Duong

Thuyloi University, 175 Tay Son, Dong Da, Hanoi, Vietnam

PI-19 OPTIMIZATION FOR SPATIALLY OFFSET RAMAN SPECTROSCOPY (SORS) UNDER RING EXCITATION CONFIGURATION

Nguyen Thi Hang Nga, Nguyen Duc Toan, Vu Duong*

Thuyloi University, 175 Tay Son, Dong Da, Hanoi, Vietnam

Institute of Physics, Vietnam Academic of Science and Technology, 18 Hoang Quoc Viet street, Cau Giay, Hanoi, Vietnam

PI-20 INVESTIGATION OF OPTICAL PROPERTIES OF OF CIRCULAR LATTICE PHOTONIC CRYSTAL FIBERS BASED ON GeO_2-SiO_2 Glasses

Duc Hoang Trong, Lanh Chu Van, Thuy Nguyen Thi

University of Education, Hue University, 34 Le Loi, Hue City, Viet Nam

PI-21 SYNTHESIS AND CHARACTERIZATION OF ZnSe/CdS CORE/SHELL TYPE-II AND ZnSe/CdS/ZnS CORE/SHELL/SHELL TYPE-II/TYPE-I NANOCRYSTALS

P. M. Tan, Van Truong-Nguyen, N. X. Ca and N. T. Hien

Faculty of Fundamental and Applied Sciences, Thai Nguyen University of Technology, Vietnam

PI-22 SCATTERING SPECTRA OF SINGLE GOLD NANOCRESCENT

Pham Thi Thu Ha, Vu Xuan Hoa, Tran Thu Trang, Nguyen Van Hao, Nguyen Thi Huong, Nguyen Dac Dien

Faculty of Chemistry, TNU- University of Sciences, Tan Thinh ward, Thai Nguyen city, Vietnam

PI-23 SURFACE-ENHANCED RAMAN SCATTERING SPECTROSCOPY FOR PROBING METHYL RED ON ZNO DECORATED Ag NANOPARTICLES DUE TO THE SYNERGISTIC EFFECT

Tran Thu Trang, Pham Thi Thu Ha, Ngo Thi Lan, Nguyen Dac Dien, and Vu Xuan Hoa

Institute of Science and Technology, TNU- University of Sciences, Tan Thinh ward, Thai Nguyen city, Vietnam

PI-24 TEMPERATURE DEPENDENCE OF THE MASS DIFFUSION FOR H_2O DILUTED IN N_2 USING THE CLASSICAL MOLECULAR DYNAMIC SIMULATION

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

Faculty of physics, Hanoi National University of Education, 136 XuanThuy, CauGiay, Hanoi, Vietnam

PI-25 SPATIAL DISTRIBUTION OF SIGNALS OF RANGE-GATED VIEWING SYSTEM AT DIFFERENT ILLUMINATION ANGLES

Vitaly Kabashnikov, Boris Kuntsevich

Robotic systems laboratory, State Scientific and Production Association "Optics, Optoelectronics and Laser Technology", 68, Nezalezhnasti Ave., Minsk, Belarus, 220072

PI-26 NGHIÊN CỨU, XÂY DỰNG HỆ ĐO CÁC THÔNG SỐ QUANG HỌC LỐI RA CỦA LASER DIODE BƠM VÀ LASER SỢI QUANG CÔNG SUẤT 1 KW

Giang Mạnh Khôi, Đỗ Xuân Tiến, Trần Thị Vân Anh, Phạm Chí Hiếu, Trương Đức Toàn1, Bành Quốc Tuấn

Viện Ứng dụng Công nghệ (Nacentech), 25 Lê Thánh Tông, Phan Chu Trinh, Hoàn Kiếm, Hà Nội

PI-27 COMPARISON OF DISPERSION CHARACTERISTICS OF CIRCULAR AND SQUARE PHOTONIC CRYSTAL FIBER WITH CORE-FILLED CS_2

Ho Thi Anh Thu, Ngoc Vo Thi Minh, Chu Thi Hoai Sam, Vinh Nguyen Thanh, Tuyen Ta Thi Kim, Thanh Thai Doan, Hieu Le Van, Chu Van Lanh

Lap Vo 2 High School, Dong Thap, Vietnam

PI-28 COMPARISON OF EFFECTIVE MODE AREA AND NONLINEAR COEFFICIENT CHARACTERISTICS OF CIRCULAR AND RECTANGULAR PHOTONIC CRYSTAL FIBER WITH HOLLOW-CORE INFILTRATED CARBON DISULFIDE

Oanh Truong Thi Chuyen, Ngoc Vo Thi Minh, Thanh Thai Doan, Trang Do Mai, Hoang Trinh Ngoc, Mai Nguyen Thi Quynh, Thuy Hoang Van, Lanh Chu Van

Nguyen Quang Dieu High School for the Gifted, Cao Lanh, Vietnam

PI-29 FABRICATION OF ALUMINUM-DOPED ZINC OXIDE THIN FILMS WITH SILVER NANOPARTICLES SERS SUBSTRATES TO DETECT RHODAMINE 6G

Le Thi Minh Huyen, Nguyen Anh Tuan, Huynh Thuy Doan Khanh, Le Vu Tuan Hung

Faculty of Physics - Engineering Physics, VNUHCM-University of Science, 227 Nguyen Van Cu, Ward 4, District 5, Ho Chi Minh City.

PI-30 FLUOROALUMINATE GLASSES WITH LOW $Ba(PO_3)_2$ CONTENT: PROMISING MATERIAL FOR PHOSPHORS AND THERMOMETRY

I. Khodasevich, E. Kolobkova, A. Piotukh, M. Korolkov, D. Mogilevtsev, A. S. Grabtchikov

B.I.Stepanov Institute of Physics NAS Belarus, 68-2 Nezalezhnasti Ave., Minsk, 220072, Belarus

PI-31 COOPERATIVE ENERGY TRANSFER AS A PROBE OF Yb-Yb* CLUSTERS IN RE^{3+}-Yb^{3+} DOPED FLUOROALUMINATE GLASSES WITH LOW PHOSPHATE CONTENT

I. A. Khodasevich, E. V. Kolobkova, V. A.Orlovich, P. A. Apanasevich, A. S. Grabtchikov

B.I.Stepanov Institute of Physics, National Academy of Sciences of Belarus, 68-2 Nezalezhnasti Ave., Minsk, 220072, Belarus

PI-32 INVESTIGATION OF C_{60} FULLERENE SOLUTIONS IN THE TOLUENE–XYLENE SOLVENT SYSTEM

S. A. Bakhramov, A. M. Kokhkharov, U. K. Makhmanov, S. A. Esanov

[1]Institute of Ion-Plasma and Laser Technologies, Uzbekistan Academy of Sciences, Uzbekistan

PI-33 ROLE OF THE CHARGE OF ANALYTE MOLECULES ADSORBED ON THE HYDROXYAPATITE/SILVER NANOPARTICLES ON THE SERS SIGNAL KINETICS

S. N. Terekhov, A. Yu. Panarin, P. Mojzeš

B.I. Stepanov Institute of Physics NASB, Nezalezhnasti Ave., 68-2, 220072, Minsk, Belarus

PI-34 LIGHT-ACTIVATED MEDICINAL PLANTS EXTRACTS: A GREEN APPROACH TO ANTIMICROBIAL PHOTODYNAMIC THERAPY

A. Mikulich, Tran Quoc Tien, Quang Cong Tong, Thanh Phuong Nguyen, N. Dudchik, O. Emeliyanova, A. Zhabrouskaya, A. Tretyakova, R. Nahorny, T. Ananich, A. Sobchuk, L. Plavskaya, O. Dudinova, I. Leusenka, S. Yakimchuk, V. Plavskii

State Scientific Institution, B. I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus", 68-2 Nezavisimosti Ave., 220072 Minsk, Republic of Belarus

PI-35 THIẾT KẾ HỆ QUANG SỬA DẠNG CHÙM RA LASER BÁN DẪN TIẾT DIỆN LỚN (BALs)

Nguyễn Văn Bình, Nguyễn Quang Minh

Trung tâm Công nghệ Laser, Viện Ứng dụng Công nghệ, Hà Nội

PI-36 APPLICATION OF NIR SPECTROSCOPY, PRINCIPAL COMPONENT ANALYSIS AND CLASSIFICATION TREES FOR PLASTIC SORTING

M. Khodasevich, P. Kulikovskaya

B.I.Stepanov Institute of Physics of the National Academy of Sciences of Belarus, Nezavisimosti Ave., 68, 220072, Minsk, Belarus

PI-37 MULTIVARIATE CALIBRATION OF CONCENTRATION OF THE MAIN ALLOYING ADDITIVES IN LOW-ALLOY STEELS BY LOW RESOLUTION LASER INDUCED BREAKDOWN SPECTROSCOPY

M. V. Belkov, D. A. Borisevich, K. Y. Catsalap, M. A. Khodasevich

B. I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus, Nezavisimosti Ave., 68, 220072, Minsk, Belarus

PI-38 CLASSIFICATION OF SUGAR TYPES BY UV-VIS-NIR SPECTROSCOPY AND MULTIVARIATE ANALYSIS

M. Khodasevich, P. Kolodochka, E. Ilhan, H. Eriklioglu, M. Öztop

B. I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus, Nezavisimosti Ave., 68, 220072, Minsk, Belarus

PI-39 CALIBRATION OF COCOA AMOUNT IN CHOCOLATE USING MULTIVARIATE METHODS IN THz SPECTROSCOPY

M. Khodasevich, A. Lyakhnovich, D. Borisevich, H. Eriklioğlu, M. H. Öztop

B.I.Stepanov Institute of Physics of the National Academy of Sciences of Belarus, Nezavisimosti Ave., 68, 220072, Minsk, Belarus

PI-40 COMPARATIVE EFFICACY OF THE ACCUMULATION OF ENDOGENOUS PORPHIRINS IN CANCER AND NON-TRANSFORMED CELLS AND MECHANISMS OF THEIR SELF-SENSITIZED INACTIVATION

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

State Scientific Institution, B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, 68-2 Nezavisimosti Ave., Minsk, 220072, Republic of Belarus

PI-41 MAIN PATTERNS AND METHODS FOR INCREASING THE EFFICACY OF THE ANTIMICROBIAL EFFECT OF BLUE LIGHT

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

State Scientific Institution "B. I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus", 68-2 Nezavisimosti Ave., Minsk, 220072, Republic of Belarus

PI-42 STRENGTHENING THE ANTIMICROBIAL EFFECT OF NITROFURAN ANTISEPTICS DUE TO THEIR SENSITIZING PROPERTIES

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

State Scientific Institution "B. I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus", 68-2 Nezavisimosti Ave., Minsk, 220072, Republic of Belarus

PI-43 TARGETED DELIVERY OF PHYTOCHEMICAL COMPOUNDS AND PACLITAXEL ENCAPSULATED IN THERMOSENSITIVE NANOCARRIERS

V. Plavskii, O. Dudinova, L. Plavskaya, A. Sobchuk, R. Nahorny, T. Ananich, A. Tretyakova, A. Mikulich, I. Leusenka, S. Yakimchuk, Le Hang Dang, Ngoc Quyen Tran

Institute of Physics of the National Academy of Sciences of Belarus, 68-2 Nezavisimosti Ave., 220072 Minsk, Republic of Belarus

PI-44 ANTI-REFLECTED AND ANTI-ICING SURFACE FABRICATED ON TRANSPARENT SUBSTRATE

Thanh Binh Nguyen, Thi Hong Hanh Vu, Thuy Chi Do, Thi Minh Thuy Nguyen

Faculty of Physics in Education, Thai Nguyen University of Education, Thai Nguyen, Vietnam

PI-45 ANALYSIS OF THE EFFECTIVE MODE AREA CHARACTERISTICS OF SQUARE SOLID-CORE PHOTONIC CRYSTAL FIBERS WITH As_2S_3 SUBSTRATE

Trong Dang Van, Bao Tran Le Tran, Thu Ho Thi Anh, Sam Chu Thi Hoai, Anh Ta Tram, Vu Nguyen Quang, Luu Mai Van, Thuy Nguyen Thi, Lanh Chu Van

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PI-46 COMPARISON OF OPTICAL NONLINEAR PROPERTIES OF SQUARE AND HEXAGONAL LATTICES SOLID-CORE PHOTONIC CRYSTAL FIBER WITH $Ge_{20}Sb_5Se_{75}$ SUBSTRATE

Trong Dang Van, Tuan Doan Anh, Anh Nguyen Thi Quynh, Duc Dang Minh, Huy Dao Danh, Linh Dang Thuy, Tan Tran Duy, Phu Nguyen Van, Lanh Chu Van

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PI-47 COMPARISON OF DISPERSION CHARACTERISTICS OF SOLID-CORE PHOTONIC CRYSTAL FIBERS WITH As_2S_3 AND $Ge_{20}Sb_5Se_{75}$ SUBSTRATES FOR SUPERCONTINUUM GENERATION

Trong Dang Van, Ngoan Le Thi, Duy Pham Dinh, Ngan Nguyen Thi, Mai Tran Thi, Hang Trang Nguyen Minh, Vu Quoc Tran, Thuy Nguyen Thi, Lanh Chu Van

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PI-48 SIMULATION OF THE LENS INFLUENCE ON OPTICAL INTENSITY DISTRIBUTION FOR DESIGNING FIBER-COUPLED DIODE LASER

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PI-49 OPTICAL PROPERTIES OF THE DOPED-GRAPHENE QUANTUM DOTS AND THEIR APPLICATION PROSPECTS

Le Xuan Hung, Trinh Thi Hue, Nguyen Thi Mai Huong, Julien Laverdande, Pham Thu Nga

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PI-50 PHOTOTHERMAL PROPERTIES OF NANOFLUID CONTAINING METALLIC NANOPARTICLES DECORATED GRAPHENE OXIDE DIRECTLY PREPARED BY SOLUTION PLASMA EXFOLIATION TECHNIQUE

Nguyen Van Hao, Do Hoang Tung, Vu Xuan Hoa, Nguyen Thi Khanh Van, Nguyen Van Tu, Bui Hung Thang, Phan Ngoc Minh, and Pham Van Trinh

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PI-51 NGHIÊN CỨU PHÁT TRIỂN THIẾT BỊ LASER ĐIỀU TRỊ DỰA TRÊN CÔNG NGHỆ FRACTIONAL RF-CO_2

Phan Thị Cảnh, Thái Quang Tùng, Nguyễn Tuấn Anh, Hà Hoài Nam

Trung tâm Công nghệ Laser, Viện Ứng dụng Công nghệ, C6 Thanh Xuân Bắc, Thanh Xuân, Hà Nội

PI-52 A COMPACT LONG PATH DIFFERENTIAL OPTICAL ABSORPTION SPECTROSCOPY INSTRUMENT FOR CONTINUOUSLY MONITORING GASEOUS POLLUTANTS SO_2, O_3 AND NO_2

Dinh-V-Trung, Bui Van Hai, Nguyen Thi Thanh Bao, Pham Dong Bang, Vu Thi Kim Oanh, Nguyen Xuan Tu, Phung Viet Tiep, Pham Minh Tien, Nguyen Gia Cuong

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PI-53 THE SENSITIVE DETECTION OF NITRIC OXIDE ADDRESSING ITS STRONG ELECTRONIC BAND BY FARADAY MODULATION SPECTROSCOPY

Lemthong Lathdavong, Jie Shao, Jonas Westberg, and Ove Axner

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PI-54 HYBRID Q-SWITCHED LASER Nd:YVO4 WITH A Cr:YAG SATURABLE ABSORBER AND AN ACOUSTO-OPTIC MODULATOR

Nguyen Xuan Tu, Bui Van Hai, Vu T. Kim Oanh, Doan T. Kieu Anh, Nguyen Van Diep, Pham Van Duong, Phung Viet Tiep, Pham Hong Minh and Dinh Van Trung

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No. 10 Dao Tan, Ba Dinh, Ha Noi

PI-55 REDUCING THE REPETITION RATE OF MODE-LOCKED LASER WITH A PULSE PICKER USING ACOUSTO-OPTIC MODULATOR

Nguyen Xuan Tu, Bui Van Hai, Vu T. Kim Oanh and Dinh Van Trung

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No. 10 Dao Tan, Ba Dinh, Ha Noi

PI-56 SURFACE LATTICE RESONANCE AND BOUND STATE IN THE CONTINUUM IN METASURFACE

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SESSION POSTER II

September 30, 2022 (Friday)

Chairperson:

Prof. Le Vu Tuan Hung (VNU Ho Chi Minh city)
Prof. Chu Van Lanh (Vinh University, Vinh, VN)

PII-01 RETRIEVAL OF POLAR MOLECULE ASYMMETRICITY FROM HIGH ORDER HARMONIC GENERATION

Van-Hoang Le, Ngoc-Loan Phan, Kim-Ngan H. Nguyen, Cam Tu Le

Department of Physics, Ho Chi Minh City University of Education, Vietnam

PII-02 EFFECT OF SIZE ON STABILITY AND ANTI-BACTERIAL ACTIVITY OF SILVER NANOPARTICLES

Nguyen Thi Thuy, Nguyen Trong Nghia, Nguyen Duc Toan, Nguyen Thi Bich Ngoc, Vu Duong, Nguyen Thi Minh Huyen, Nghiem Thi Ha Lien

Institute of Physics, No. 10 Dao Tan, Ba Dinh, Ha Noi

PII-03 FREQUENCY ANALYSIS OF AN ALL-SPIN LOGIC CIRCUIT SIMULATION

Kevin Paolo G. Icaro, Carlos F. Baldo III

Department of Physics, Mapúa University, Intramuros, Manila, Philippines

PII-04 TERAHERTZ EMISSION FROM GaAs/AlGaAs ASYMMETRIC DOUBLE QUANTUM WELLS

Alexander De Los Reyes, Elizabeth Ann Prieto, Lean Dasallas, Hannah Bardolaza, Mae Agatha Tumanguil-Quitoras, Neil Irvin Cabello, Armando Somintac, Arnel Salvador, and Elmer Estacio

National Institute of Physics, University of the Philippines Diliman, Quezon City 1101, Philippines

PII-05 ENHANCED TERAHERTZ EMISSION FROM P-CUXO/N-SI HETEROSTRUCTURES GROWN THROUGH THERMAL OXIDATION

Horace Andrew F. Husay, Arven I. Café, Lorenzo P. Lopez, Maria Herminia M. Balgos, Elmer S. Estacio, Arnel A. Salvador, and Armando S. Somintac

National Institute of Physics, University of the Philippines, Diliman, Quezon City, Philippines

PII-06 CARRIER CAPTURE DYNAMICS IN INAS/GAAS SINGLE-LAYER QUANTUM DOTS OBSERVED USING TIME-RESOLVED TERAHERTZ SPECTROSCOPY

Vince Paul Juguilon, Deborah Anne Lumantas-Colades, Neil Irvin Cabello, Alexander De Los Reyes, Inhee Maeng, Chul Kang, Chul-Sik Kee, and Elmer Estacio

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PII-07 OXYGEN VACANCY-RELATED LUMINESCENCE PROPERTIES OF SnO_2 NANORODS AND NANOPARTICLES

Vu Hoang Huong, Nguyen Thanh Binh, Trinh Thi Loan, Ngac An Bang

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PII-08 NUMERICAL STUDY OF LINEAR OPTICAL PROPERTIES OF AS_2S_3 GLASS PCF TAKING INTO ACCOUNT THE DIFFERENCE IN STRUCTURAL PARAMETERS

Tran Tran Bao Le, Minh Nguyen Hong, Dung Tran Tien, Anh Truong Duc, Duy Le Pham, Phuong Nguyen Thi Hong, Luu Mai Van, Thuy Do Thanh, Lanh Chu Van

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PII-09 CONTROLLING EFFECTIVE MODE AREA AND CONFINEMENT LOSS OF CIRCULAR ARSENIC TRISULFIDE PHOTONIC CRYSTAL FIBERS FOR OPTICAL TECHNOLOGY APPLICATIONS

Tran Tran Bao Le, Hieu Tran Trung, Tan Tran Duy, Trang Nguyen Thi Ha, Vu Tran Quoc, Luu Mai Van, Thuy Nguyen Thi, Vinh Nguyen Thanh, Lanh Chu Van

Department of Physics, Vinh University, 182 Le Duan, Vinh City, Vietnam

PII-10 INVESTIGATION OF NITROGEN OXIDE PHOTOCATALYTIC OXIDATION ABILITY OVER SEMICONDUCTOR/CNT HETEROJUNCTION

Hoang-Phuong Nguyen, Cao Minh Thi, Pham Van Viet

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PII-11 INVESTIGATE THE NONSEQUENTIAL DOUBLE IONIZATION OF ATOM BY TWO-COLOR PARALLEL LASER PULSE OF MID-INFRARED WAVELENGTH

Thu D.H. Truong, Vinh N.T. Pham

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PII-12 THE INVESTIGATE MODELING OF THE EFFECT OF LOW-LEVEL LASER ON PIPER SARMENTOSUM

Hong Duyen Trinh Tran, Nhu Hao Le, Nguyen De Tran, Truc Lam Ngo Thi, Phuong Linh Thai Ha, Khanh Nhi Huynh Thi, Anh Tu Tran, Trung Nghia Tran

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PII-13 RESTORED ALGORITHM FOR WAVEFROTN CODING TECHNIQUE IN WIDE FIELD MICROSCOPY

Le Van Nhu, Nguyen Trung Thanh, Pham Minh nghia

Le Quy Don Technical University, 236 Hoang Quoc Viet, Cau Giay, Ha Noi

PII-14 QUANLITY ENHANCEMENT OF FLUORESCENCE EMISSION MICROSCOPY BY TWO SATURATED POINT SPREAD FUNCTIONS

Le Van Nhu, Nguyen Trung Thanh, Pham Minh Nghia, Le Hoang Oanh

Le Quy Don Technical University, 236 Hoang Quoc Viet, Cau Giay, Ha Noi

PII-15 FABRICATION OF SILVER NANOFLOWERS ON COPPER USING FOR SURFACE-ENHANCED RAMAN SCATTERING

Nguyen Manh Cuong, Luong Truc Quynh Ngan, Dao Tran Cao, Cao Tuan Anh, Kieu Ngoc Minh and Vu Thi Thu

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PII-16 STUDY ON FABRICATION OF TRIANGULAR SILVER NANOPLATS FOR APPLICATION AS SURFACE-ENHANCED RAMAN SCATTERING SENSORS

Vu Thi Thu, Luong Truc Quynh Ngan, Dao Tran Cao, and Nguyen Manh Cuong

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PII-17 PHOTOLUMINESCENCE PROPERTIES OF Eu-MOF AND ITS APPLICATION FOR SENSING ATP

Nguyen Thi Lien, Nguyen Thi Dien, Tran Thuong Quang, Nguyen Duc Trung, Nguyen Ngoc Tue, Nguyen Xuan Truong

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PII-18 SYNTHESIS AND CHARACTERIZATION OF Fe_3O_4-Au CORE-SHELL NANOPARTICLES FOR METHYLENE BLUE DETECTION

Nguyen Thi Thuy, Nghiem Thi Ha Lien, Fayna Mameri, Souad Ammar

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PII-19 MỘT SỐ KẾT QUẢ NGHIÊN CỨU, ỨNG DỤNG ĐẦU THU QUANG ĐIỆN PHÁT HIỆN TÁC NHÂN SINH HỌC CẢNH BÁO SỚM TRONG MÔI TRƯỜNG ĐÔ THỊ

Dương Ngọc Tùng

Viện Vật lý Kỹ thuật, Viện KH&CN quân sự, 17 Hoàng Sâm, Nghĩa Đô, Cầu Giấy, Hà Nội

PII-20 NGHIÊN CỨU CÁC TIÊU CHÍ LỰA CHỌN ROBOT CÔNG NGHIỆP ỨNG DỤNG TRONG HỆ CẮT LASER 3D

Nguyễn Văn Thưởng, Trần Xuân Thịnh, Giang Mạnh Khôi, Trương Đức Toàn

Viện Ứng dụng Công nghệ (Nacentech), 25 Lê Thánh Tông, Phan Chu Trinh, Hoàn Kiếm, Hà Nội

PII-21 FIRST-STEP FABRICATION AND APPLICATON OF FIBER BRAGG GRATING SENSORS IN MEASURING DEFLECTION OF THE BEAM

Viet Phuong Han, Tin Phan Nguy, Truong Thi Ngoc Lien, Kwan Il Lee, Sang Bae Lee, Tran Quoc Tien

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PII-22 GOLD-NANOPARTICLE/FILTER-PAPER SUBSTRATES AS HIGHLY EFFECTIVE PLATFORMS FOR SURFACE-ENHANCED RAMAN SPECTROSCOPY

Nguyen Duy Khanh, Pham Dien Khoa, Luong Minh Thu, Le Hoai Trung, Pham Minh Khoa, Nguyen Tan Minh Tien, Doan Thi Mai Linh, Le Van Ngoc, Le Vu Tuan Hung

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PII-23 SYNTHESIS, CHARACTERIZATION AND OPTICAL PROPERTIES OF FLUORESCENT CdSe/CdS/SiO_2 NANOPARTICLES

Chu Anh Tuan, Vu Thi Kim Lien, Nguyen Thi Bich Ngoc, NguyenThi Hang Nga, Vu Thi Hong Hanh, Nghiem Thi Ha Lien, Chu Hoang Lan, Chu Viet Ha

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PII-24 OPTICAL CHARACTERIZATION OF Ce DOPED ZnS QUANTUM DOTS

Chu Anh Tuan, Vu Thi Kim Lien, Vu Thi Hong Hanh, Chu Hoang Lan, Nguyen Thi Hang Nga, and Chu Viet Ha

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PII-25 COMPARATIVE ANALYSIS ON PROPAGATION CHARACTERISTICS OF DOUBLE HYBRID WEDGE PLASMONIC WAVEGUIDES

Trinh Thi Ha, Nguyen Thanh Huong, Dang Van Hieu, Nguyen Viet Hung, Chu Manh Hoang

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PII-26 A SIMULATION OF PHOTOCATALYTIC MATERIAL TIO_2/G-C_3N_4 USING DENSITY FUNCTIONAL THEORY

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PII-27 PHÁT TRIỂN KĨ THUẬT KHOAN-MÀI ĐỂ TẠO LỖ TRÊN THẤU KÍNH THỦY TINH QUANG HỌC

Phạm Hồng Tuấn, Nguyễn Xuân Thành, Nguyễn Tuấn Vũ, Nguyễn Thành Hợp

Trung tâm Quang Điện tử, Viện Ứng dụng Công nghệ, C6 Thanh Xuân Bắc, Hà Nội

PII-28 UV-VIS ABSORPTION AND PHOTOLUMINESCENCE CHARACTERISTICS OF Cu - DOPED $Zn_{0.6}Cd_{0.4}S$ QUANTUM DOTS

Nguyen Dieu Linh, Nguyen Thi Minh Hien, Nguyen Xuan Nghia, Nguyen Thi Thuy Lieu

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PII-29 COMPARISON OF DIFFERENT SUBSTRATES ON PROPERTIES OF InSb THIN FILMS DEVELOPED BY PHYSICAL DEPOSITION

Thin Pham Van, Dat Tran Quang, Ha Nguyen Tran, Tung Nguyen Vu, Tuan Nguyen Van

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PII-30 NGHIÊN CỨU, THIẾT KẾ BỘ KHUẾCH ĐẠI LASER MÀU TRONG VÙNG PHỔ 610 – 650 NM

Phùng Việt Tiệp, Nguyễn Văn Điệp, Phạm Văn Dương, Nguyễn Xuân Tú

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PII-31 ACCURATELY IDENTIFY THE CONCENTRATION OF TRACE GASES USING THE DIFFERENTIAL OPTICAL ABSORPTION SPECTROSCOPY METHOD

Tiep Viet Phung, Hai Van Bui, Tu Xuan Nguyen, Trung Van Dinh, Tien Minh Pham, Thi Kim Oanh Vu, Bao Thi Thanh Nguyen, Bang Dong Pham

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PII-32 SYNTHESIS AND OPTICAL PROPERTIES OF CORE /SHELL NANOPHOSPHORS DOPED RARE EARTH IONS @ SILVER

Tran Thi Ngoc Dung and Tran Kim Anh

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PII-33 KHẢO SÁT CÔNG NGHỆ TÔI LASER VÀ KHẢ NĂNG ỨNG DỤNG CÔNG NGHỆ TRONG GIA CÔNG TÔI CỨNG CHI TIẾT CƠ KHÍ TẠI VIỆT NAM

Nguyễn Văn Thành, Nguyễn Thị Thanh Lan, Vũ Văn Liệu, Lê Bình Dương, Nguyễn Văn Đưa

Trung tâm Quang điện tử, Viện NACENTECH, C6 Thanh Xuân Bắc, Hà Nội

PII-34 ELECTRODEPOSITION OF Cu_2O/MoS_2 THIN FILMS ON FTO SUBSTRATE AS A HETEROJUNCTION PHOTOELECTROCHEMICAL CELL FOR WATER SPLITTING

Viet Hai Le, Le Thanh Nguyen Huynh, Thai Hoang Nguyen

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PII-35 NGHIÊN CỨU HIỆU QUẢ CỦA CÔNG NGHỆ PLASMA TRONG VIỆC CHUẨN BỊ BỀ MẶT CHO PHỤC HÌNH RĂNG SỨ

Nguyễn Ngọc Anh, Bùi Thị Thu Phương, Đỗ Hoàng Tùng, Lê Hồng Mạnh, Nguyễn Thị Khánh Vân, Nguyễn Văn Khá

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PII-36 SYNTHESIS OF HIGHLY STABLE Ag NANOSTRUCTURE FOR SERS DETECTION OF FOOD DYES

Nguyen Hoang Long, Nguyen Huu Ke, Dao Anh Tuan, Le Vu Tuan Hung

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PII-37 ELECTROMAGNETICALLY INDUCED TRANSPARTENCY IN A FOUR-LEVEL ATOMIC LAMBDA SYSTEM: AN ANALYTICAL APPROACH

Nguyen Huy Bang, Dinh Xuan Khoa, Nguyen Van Phu, Doan Hoai Son, Nguyen Van Ai, Hoang Minh Dong, Nguyen Thi Thu Hien, Le Van Doai

Vinh University, Vinh City, Vietnam

PII-38 INFLUENCE OF SIGNAL LASER FIELD ON GROUP VELOCITY IN A FOUR-LEVEL INVERTED-Y ATOMIC SYSTEM

Le Van Doai, Nguyen Huy Bang, Nguyen Van Phu, Nguyen Van Ai, Hoang Minh Dong, Nguyen Tuan Anh, Luong Thi Yen Nga

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PII-39 INFLUENCES OF LASER FREQUENCY ON MAGNETO-OPTICAL SWITCHING BASED ON ELECTROMAGNETICALLY INDUCED TRANSPARENCY

Luong Thi Yen Nga, Nguyen Thi Thu Hien, Hoang Minh Dong, Nguyen Huy Bang, Do Mai Trang, Phan Van Thuan, Ho Hai Quang, Le Van Doai

Vinh Universiy, Vinh City, Vietnam

PII-40 PHASE CONTROL OF TRANSIENT EVOLUTION IN A VEE-TYPE DEGENERATE ATOMIC MEDIUM

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

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PII-41 HIGH SENSITIVITY NEAR-INFRARED REFRACTIVE INDEX SENSORS BASED ON METAL-DIELECTRIC-METAL PLASMONIC METASURFACES

Thu Trang Hoang, Thanh Sơn Pham, Xuan Bach Nguyen, Huu Tu Nguyen, Do Van Quan, and Quang Minh Ngo

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PII-42 APPLICATION OF UPCONVERSION $NAYF_4:Yb^{3+}/Er^{3+}$ NANO FOR LABELLING OF CANCER CELLS

Le Thi Vinh, Ha Thi Phuong, Hoang Thi Khuyen, Do Thi Thao, Le Quoc Minh, and Tran Thu Huong

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PII-43 LUMINESCENT PROPERTIES OF MULTIFUNCTIONAL NANOMATERIALS CONTAINING $Eu(TTA)_3$, $Tb(TTA)_3$ COMPLEXES

Hoang Thi Khuyen, Tran Thu Huong, Nguyen Thanh Huong, Pham Thi Lien, Nguyen Duc Van, Le Quoc Minh

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PII-44 HIGH-SENSITIVITY PARTICLE SPECTROMETER FOR CLASSIFYING AND COUNTERING ATMOSPHERIC PARTICULATE MATTER CONCENTRATION

Hai Van Bui, Tu Xuan Nguyen, Trung Van Dinh, Tien Minh Pham, Thi Kim Oanh Vu, Bao Thi Thanh Nguyen, Tiep Viet Phung, Bang Dong Pham

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PII-45 FAILURE ANALYSIS OF LOW PHOTOCURRENT ISSUE ON OPTICAL COMMUNICATION DEVICE

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PII-46 LASER DECAPSULATION GUIDELINE FOR PLASTIC PACKAGE

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PII-47 MODE CHARACTERISTICS OF TUNABLE WEDGE PLASMONIC WAVEGUIDE

Tran Trong An, Trinh Thi Ha, Chu Manh Hoang

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PII-48 TUNING THE INDEX OF SILICON WAVEGUIDES BY PERTURBING EVANESCENT FIELD

Trinh Thi Ha, Nguyen Thanh Huong, Tran Trong An, Vu Ngoc Hung, Chu Manh Hoang

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PII-49 PDMS MICROLENSES FORMED BY PATTERN TRANSFER PROCESS

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PII-50 OPTICAL PROPERTIES OF CQDs/Ag HYBRID NANO PARTICLES PREPARED BY SOLUTION INTERACTIVE PLASMA METHOD

Pham Van Duong, Do Hoang Tung, Pham Hong Minh, M. S. Smirnova, S. A. Tikhomirov, Nguyen Thanh Binh

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PII-51 ĐỘNG HỌC PHÁT XẠ BĂNG RỘNG, ĐƠN XUNG PICO GIÂY CHO LASER TỬ NGOẠI Ce:LiCAF

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PII-52 ĐỘNG HỌC PHÁT XẠ BĂNG HẸP, ĐIỀU CHỈNH BƯỚC SÓNG CHO LASER TỬ NGOẠI Ce:LiCAF SỬ DỤNG CÁCH TỬ LITTROW

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PII-53 ĐẶC TRƯNG QUANG HỌC CỦA HẠT NANO MoS_2 ĐƯỢC CHẾ TẠO BẰNG PHƯƠNG PHÁP TAN MÒN LASER

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PII-54 FABRICATION CARBON NANO QUANTUM DOTS BY SOLUTION-INTERACTION MICROPLASMA METHOD

Pham Van Duong, Doan Thi Kieu Anh, Pham Hong Minh, Do Hoang Tung, Nguyen Thanh Binh

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PII-55 CẤU TRÚC ĐIỆN TỬ VÀ TÍNH CHẤT QUANG HỌC CỦA NANO TINH THỂ CADMI SELENIDE TỪ TÍNH TOÁN NGUYÊN LÝ BAN ĐẦU

Trần Thanh Thuận, Trương Minh Đức, Nguyen Minh Hoa

Khoa Khoa học Cơ bản, Trường Đại học Y Dược, Đại học Huế

ABSTRACTS

PLENARY SESSION

PL-01

INFRARED EMISSION AND COMPETING PROCESSES IN MOLECULAR SYSTEMS OF ASTROPHYSICAL RELEVANCE

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Abstract.

Large interstellar molecules are known to efficiently absorb light in the UV-visible range and convert this radiation into infrared emission. Such a mechanism has been introduced almost 40 years ago to qualitatively explain the near-IR blackbody-like emission observed toward reflection nebulae, unaccounted for by simple reflection of light [1]. This process gave the foundation of the mechanism for the so-called PAH hypothesis formulated shortly after [2,3]. In order to progress on these hypothesis, we initiated a work on the infrared emission induced by UV photon absorption on several molecules of astrophysical relevance, to explore competing mechanisms. For the first time, we performed laser-induced vibrational emission in the gas phase to investigate isomerization reactions and anharmonicity effects. Interpretation was performed thanks to a modelling via a kinetic Monte Carlo simulation and the main results will be presented. The model was further extended to explore over long time scales the radiative cooling (through recurrent fluorescence and vibrational emission) [4]. Using a broad structural database of carbon cluster cages containing between 24 and 60 atoms, collective emission spectra in interstellar conditions could be simulated. Our modelling relies on molecular structures generated using a systematic multiscale approach [6], together with the determination of vibrational [6] and electronic spectra [8]. All recurrent fluorescence [5] and vibrational emission rate constants were calculated assuming an ergodic redistribution of internal energies among available vibronic states [4]. The main results will be presented.

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PL-02

OPTICS IN COHERENT ATOMIC GASEOUS MEDIUM: A RECENT PROGRESS IN VINH UNIVERSITY

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Abstract.

Optical properties likewise absorption, dispersion, and nonlinearity are fundamental for propagation of light in the medium. In an atomic resonant frequency region, such properties depend on coherences among the atomic quantum states. The advent of laser delivers light sources to manipulate such coherences in both phase and probability amplitude. A special case of these manipulations is a phenomenon of destructive interferences among the transition channels of atomic quantum states that vanishes the total probability amplitudes. This novel phenomenon is called as electromagnetically induced transparency (EIT) [1], and it has opened a new type of coherent medium with unusual optical properties. Since then, we have witnessed tremendous progress in EIT with new topics and applications [2-3].

In this talk, we present a recent progress concerning to five typical topics related to the EIT atomic gaseous medium, which is carried out in Vinh University. Firstly, in addition to physics of single-EIT, we brief a development in both theoretical- and experimental- aspects of multi-EIT [4-8]. Secondly, we present the results for controllable group velocity of light in which a special attention is given for optical soliton formation [9-15]. Thirdly, we introduce EIT-induced negative refractive index that generates a new type of metamaterial working in optical frequency domain [16-18]. Next, we present the topic of giant-Kerr nonlinearity which is accumulated due to long-interacting time between the photon and atom [19-26]. The last topic in this talk is given for optical bistability and optical switching at low-light intensity [27-31]. Finally, we discuss some prospective applications and development related to these topics.

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PL-03

RESEARCH ACTIVITIES OF APRI

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Abstract.

APRI (Advanced Photonics Research Institute) was established in 2001 by the Korean government. Since its foundation, APRI have conducted researches that includes the world's best 4.2 Petawat laser system, particle acceleration, and X-ray generation. APRI also have studied the spectroscopy, nonlinear optics, fiber optics, optical materials and components, laser processing, bio-photonics, and THz optics. In this talk, I will introduce the recent research activity of APRI.

SESSION A

PHOTONICS AND APPLICATIONS

A-01

GAS PHASE RELAXATION DYNAMICS OF DITHIENYLETHENE PHOTOCHROMIC MOLECULE

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Abstract.

Gas phase experiment provides the intrinsic properties of the molecules, without the influence of the environment. The relaxation dynamics for the cyclization of dithienylethenes molecules were investigated in the gas phase when excited in the UV range. This class of molecule is known to be photochromic with a high quantum yield, based on an internal cyclization process, and are interesting for their possible use as optical memories. There dynamics is known to involve two parallel relaxation pathways [1]. We will present here a recent study based on a tunable excitation of the molecule. The idea is to adjust the region where the dynamics is launched on the Potential Energy Surface (PES) to tune the passage to cyclization pathway. This dynamics was investigated at the femtosecond time-scale, using time-resolved photoelectron spectroscopy.

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A-02

OPTICAL ANALOGS OF ELECTRON-POSITRON PAIR PRODUCTION AND ANNIHILATION IN BINARY WAVEGUIDE ARRAYS

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Abstract.

A special phenomenon in quantum electrodynamics (QED) governed by the Dirac equation and first proposed by Dirac is electron-positron pair production (PP). This process (also known as the Schwinger mechanism [1]) is due to the quantum vacuum instability if an external electric field is applied to it. The PP process is possible because of the existence of both negative-energy and positive-energy states of free electrons with the energy gap $2m_ec^2$ between them. The Dirac sea (or vacuum) is filled up by electrons located on their negative-energy states, like the valence band of a semiconductor. This leads to a peculiar scenario in which an electron from a negative-energy state in the Dirac sea can jump to a positive-energy state by absorbing an external electromagnetic (EM) field. Then two particles are created: one is the electron that is now on the positive-energy state, and the other is a hole on the negative-energy state which has just been created in the Dirac sea. This hole is the positron with a positive charge – the first ever proposed and subsequently found antimatter particle. This picture is reminiscent of the more familiar creation of an electron-hole pair in semiconductors.

In this presentation we show that a binary waveguide array (BWA) with a curved section in the middle can help us mimic the pair production and annihilation via the beam breakup process [2]. Physically speaking, it mimics the relevant situation where an external field turns on and turns off again, allowing to have well-defined asymptotic states. Thanks to this, we can achieve three goals: (i) first, we can calculate the probability of the dynamic PP and annihilation via the beam propagation simulation, then verify it with the theoretical value; (ii) second, we can observe both the PP and annihilation in a single BWA with a single input beam; (iii) third, we can compare the results for the PP and annihilation of two models: the discrete one based on BWAs, and the continuous one represented by the truly Dirac equation in QED for electrons in free space.

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A-03

ULTRAFAST THERMO-OPTICAL DYNAMICS OF A SINGLE PLASMONIC NANOPARTICLE

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Abstract.
Understanding and mastering thermal energy exchanges of nano-systems is a fundamental challenge with many technological implications. Due to their direct dependence on the interface properties, detailed experimental studies can only be performed on single nano-objects [1]. In this context time-resolved pump-probe spectroscopy has emerged as a powerful tool, as it permits to drive a single nano-object out of equilibrium and follow its cooling dynamics in real time [2].

Using this approach, we investigated the cooling kinetics of single gold nanodisks deposited on various solid substrates differing by their compositions (sapphire, silica, Si_3N_4) and thicknesses (thick substrates or nanometric membranes). Cooling kinetics is shown to strongly depend on the disk thickness and weakly on its diameter, in agreement with numerical simulations based on Fourier law of heat diffusion and also accounting for the presence of an interfacial thermal resistance between the nanodisk and its substrate [3]. For the explored diameter range, the nanodisk cooling rate is limited by heat transfer at the gold–sapphire interface, whose thermal conductance could be estimated for each investigated nano-object. The observed substrate-dependence of the nanodisk cooling kinetics will also be discussed.

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A-04

DETERMINISTIC COUPLING OF A QUANTUM DOT BASED SINGLE PHOTON SOURCE INTO POLYMERIC PHOTONIC STRUCTURES

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Abstract.

Colloidal semiconductor quantum dot (QD) is a promising candidate for various applications, particularly single photon source generation, but its fluorescence signal is unstable. Besides, it is sensitive and vulnerable to the chemical environment, inducing thus an oxidation effect, which dramatically deteriorate its optical as well as electrical properties. We first demonstrated a simple technique to suppress the blinking effect by using low one-photon absorption (LOPA) excitation method. Secondly, we proposed a simple strategy to obtain a good preservation of colloidal semiconductor QDs by coating them with a protected polymer matrix. It showed that the oxidation of the core/shell QDs embedded in the SU-8 resist is completely avoidable. Then, we demonstrated that the quantum dot based single photon source can be inserted on demand into any polymeric photonic structure. We theoretically and experimentally demonstrated the use of a polymeric antenna, fabricated by the LOPA-based direct laser writing technique, to increase the collection efficiency of the single photon source. It was evident that the position of the QD inside a polymeric pillar is a crucial factor of the extraction of the emitted photons. The single photon number is enhanced up to 5 folds and the single photon quality is increased about 60% with a selected orientation of the QD thanks to the high directional emission of the coupled QD/photonic system.

A-05

ADVANCED FEMTOSECOND LASER INSCRIPTION IN BULK DIELECTRICS: BASIC MECHANISMS AND POTENTIAL APPLICATIONS

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Abstract.

During the last two decades, ultrashort-pulse lasers enabled the new modalities for nano- and micro-scale inscription in bulk dielectrics, based on densification (waveguide writing,…) and void formation (optical memory bits, microfluidic channels,…). Recently, color management in bulk dielectrics became possible via femtosecond laser inscription of birefringent nanogratings [1] and engineering of color centers [2,3]. In this talk a novel versatile bulk nanopatterning modality will be presented, overviewing the underlying sub-filamentary laser-beam delivery regime, wavelength, pulse energy and pulsewidth effects in interfacial plasmonic nanopatterning scenario, and potential applications in interference/polarization-based management of embedded colors. Also, permanent re-coloration of gems (diamonds etc.) via their intrinsic atomistic structural and corresponding spectral transformations, involving ultrashort-pulse laser induced damage features – Frenkel pairs of vacancies and interstitials, will be reported.

This research was supported by Russian Science Foundation (project #21-79-30063).

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A-06

SELECTIVE ANALYSIS OF VIBRATIONAL DYNAMICS OF INDIVIDUAL METAL NANO-OBJECTS

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Abstract.

Single-particle ultrafast optical spectroscopy methods are now enabling quantitative investigations of the electronic and lattice dynamics of nano-objects [1]. In particular, we showed that pump-probe time-resolved optical techniques offer the unique possibility of selectively probing either one or the other by using specific optical wavelengths [2]. Using this approach, we investigated the impact of morphology on the vibrational dynamics of nano-object in the case of single metal nano-disks.

Actually, vibrational dynamics of nano-objects has been widely studied over the last twenty years yielding a great deal of information on the dependence of their vibrational frequencies on their size, shape, crystallinity and environment. However, many questions remain open concerning their vibrational damping, a process very sensitive to the interfacial and intrinsic properties of the nano-objects, and whose quantitative study requires experiments on individual nano-objects. We analyzed the vibrational quality factors of gold nanodisks of variable diameter D and thickness h, lithographed on a sapphire substrate. A large dependence of the measured quality factors of the detected acoustic modes on the disk aspect ratio (D/h) is demonstrated due to acoustic modes hybridization [3], in qualitative agreement with the results of finite element simulations.

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A-07

ATOMS IN A SPIN DEPENDENT OPTICAL POTENTIAL: GROUND STATE TOPOLOGY AND MAGNETIZATION

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A-08

POLARITON BOUND STATES IN THE CONTINUUM: THE STRONG COUPLING REGIME BETWEEN A PHOTONIC TOPOLOGICAL CHARGE AND EXCITONS IN QUANTUM WELLS

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Abstract.

Non-perturbative radiation-matter coupling between dipole-active material excitations and confined modes of the electromagnetic field leads to the concept of polaritons, i.e., hybrid excitations of mixed nature involving at least two fields with different characteristics [1]. Exciton-polaritons, in particular, are mixed light-matter excitations resulting from the strong coupling regime between exciton in semiconductors and confined photons. Harnessing these hybrid excitations provides a rich playground to explore fascinating fundamental features, as out-of-equilibrium Bose-Einstein condensation and quantum fluids of light, plus novel mechanisms to be exploited in optoelectronic devices.

In this talk, I will present the theory and experimental realizations of the strong coupling regime between excitons in quantum wells and a peculiar confined photon state called Bound state In a Continuum (BIC). BICs are peculiar localized states that are forbidden to radiate despite lying in a continuum of propagating waves [2]. These states were first predicted by Von Neumann and Wigner in 1929, and were once regarded as an "exotic" quantum mechanical effect. The origin of BICs is nowadays fully unraveled as a particular solution of wave equations, which has led to their exploitation in other fields where it is straightforwardly attributed to destructive interference mechanisms or symmetry mismatches. Interestingly, each photonic BIC in an optical lattice is attributed to a topological charge pinned at a polarization singularity in the momentum space [2]. This topological nature will be perfectly transferred to the polaritonic states once the strong coupling regime is established.

As proofs of concept, I will show the experimental demonstration of a Bose Einstein condensation in a polariton bound state in the continuum [3]. This macroscopic states has been achieved with traditional inorganic quantum wells at cryogenic temperature. Finally, I will present the first demonstration demonstration of polariton BIC at room temperature using hybrid organic-inorganic quantum wells [4].

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A-09

SPECTRAL IMAGING OF CULTURAL ASSETS

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Abstract.

Spectroscopic techniques are attracting attention as a non-destructive method of analyzing cultural assets. Here, we introduce a new approach to survey cultural assets using imaging spectroscopy. Our study is expected to bring a new perspective on the background of these cultural assets.

A-10

CONTROLLING EXCITONS IN COLLOIDAL NANOMATERIALS

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Abstract.

Colloidal nanomaterials with appealing emission characteristics of nanostructures, stability of inorganic semiconductors and solution processability have found their way from lab curiosities to consumer electronics in shopping centers. Engineering the light emission properties is always a demand for various applications. In this talk, I present our recent works on excitonic modulation in colloidal nanomaterials for practical optoelectronic applications. Exciton hoping by Förster resonance energy transfer (FRET) in a long chain of well-aligned nanoplatelets is demonstrated to tune emission color on demand for lighting and display applications [1]. We also demonstrate an all-optical approach to control the exciton flow back and forth between the donor-acceptor pair through modulated FRET by stimulated emission [2, 3]. Finally, we reveal that the negative trion (an excessive electron with a single exciton) can be utilized to enhance the excitonic gain performance [4]. The electric field is employed to fine-tune the charge density inside the CQDs to promote population inversion and therefore reduce the threshold for optical gain. The electrical control in a capacitor device makes it preferable for practical applications, proposing a possible way to achieve long-sought practical devices: full-color single-material lasers [5, 6].

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A-11

DESIGN OF CPV MODULE FOR CAR-ROOF APPLICATION

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Abstract.

As the popularity of electric vehicles grows exponentially, charging electric vehicle batteries is an important issue. As the number of electric vehicles in operation increases to more than 100.000 units per day, if the charging stations are not installed enough, they will cause a supply crisis. To solve this problem, many research groups have researched on electric vehicles that charge with other energy sources, typically solar energy. In this presentation, we would like to introduce two methods of solar power generation for electric vehicles conducted in our laboratory. One is to use the planar Concentrator Photovoltaic (CPV) method, and the other is to use the static Compound Parabolic Concentrator (CPC).

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A-12

THEORETICAL STUDY OF DYNAMIC STARK-INDUCED DEGENERATE VIBRONIC STATE BY TWO NON-RESONANT SHIFT-UP LASERS

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Abstract.

In the past it was commonly accepted that the coherent π-electron rotation could not be generated in low symmetry aromatic ring molecules, which have no degenerate electronic excited state. Recently we demonstrated by that the unidirectional π-electron rotation can be generated even in low symmetry aromatic ring molecules using the two linearly polarized lasers with a relative phase [1]. The key point of the mechanism of the coherent π-electron rotation originates from the degenerate electronic state of two quasi-degenerate electronic excited states by applying two non-resonant lasers. Here, vibrational degrees of freedom have not been taken into account. In our recent work [2] we have taken into account the nuclear vibrational effects on the unidirectional π-electron rotation in the adiabatic approximation, where a weak coupling model of two electronic states with a few vibrational states is adopted [2], where the two lowest vibronic states in two electronic excited states were set to be degenerate by two lasers (Dynamic Stark induced-Degenerate vibronic state DSIDVS). Here vibrational states in the electronic excited state 1 are shifted up by the laser *a*, and the lowest vibrational state in the electronic excited state 2 is shifted down by the laser *b*, on the other hand the other vibrational states in the electronic excited state 2 are shifted up by the laser *b*. Such opposite behaviours in the level shift of the vibronic states in the electronic excited state 2 make it complicate to describe the behaviours of dynamic Stark-induced vibronic states. In this work we propose an alternative method using the two non-resonant shift-up lasers to avoid the complication mentioned above.

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A-13

ULTRAFAST SPIN DYNAMICS IN FERROMAGNETIC AND ANTIFERROMAGNETIC THIN FILMS STUDIED BY X-RAY AND LASER

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Abstract.

Control of spin states by ultrafast laser has attracted considerable attention. We have studied spin dynamics in magnetic thin films in a pump-probe setup, where the pump is 800-nm laser, and the probe is X-ray. I will also talk about our time-resolved magneto-optical Kerr effect microscope.

A-14

FEMTOSECOND SPECTROSCOPY OF TRANSIENT ABSORPTION IN Ag_2S AND CdS QDs

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Abstract.

Interest in the creation of plasmon-exciton nanostructures from quantum dots and metal nanoparticles is determined by the prospects for obtaining new materials with known linear and nonlinear optical, electrical properties. However, the effective application of such structures is determined by a detailed understanding of the photoprocesses occurring in individual components. From this point of view, the unique components are QDs of nonstoichiometric compounds, which are characterized by a developed system of trap states. Among them, cadmium sulfide and silver sulfide should be distinguished. This paper presents the results of studying the decay dynamics of electronic excitations for Ag_2S and CdS colloidal quantum dots (QDs) by the method of transient absorption spectroscopy with femtosecond resolution. For Ag_2S QDs, the formation of a wide structureless induced absorption band in the region of 500 - 1000 nm is shown, which decays on a time scale of hundreds of picoseconds (Fig. 1, left). It is assumed that trap states of levels of Ag_2S structural defects, including the center of trap-state luminescence, are involved in the process of nonlinear absorption. It is concluded that the induced absorption signal is determined by a fast (within a fraction of picoseconds) process of charge carrier capture to trap states, including the states of luminescence centers. For CdS QDs, the formation of an exciton bleaching band (Fig. 1, right) is shown, which decays in a few nanoseconds. It is found that holes are captured in fractions of a picosecond by luminescence centers, which suppresses the exciton emission.

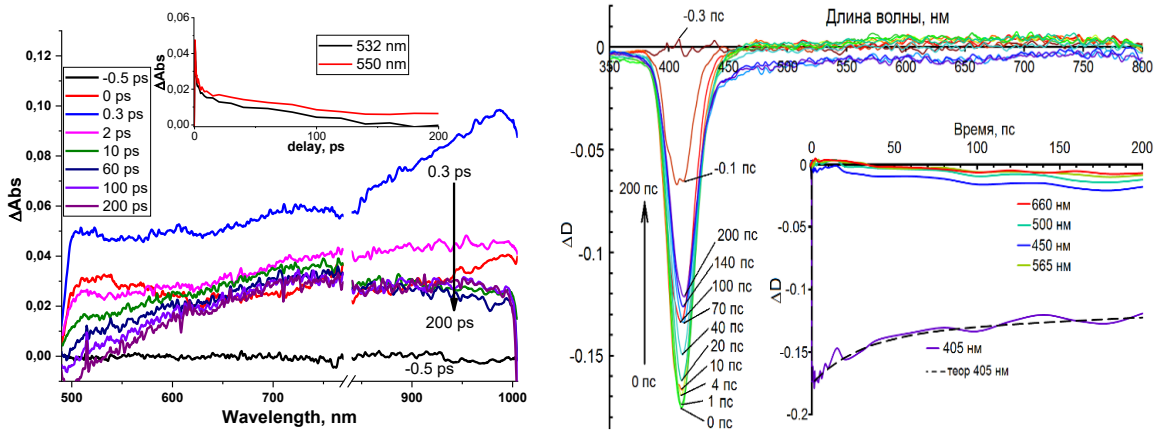

Fig. 1. *Induced absorption spectra of colloidal Ag_2S (left) and CdS (right) QDs and induced absorption relaxation kinetics for some wavelengths.*

The work was supported by the grant of BRFFR F20EA-006, RFFR 20-52-81005, VAST (No. QTRU05.02/21-23).

A-15

DEVELOPMENT OF A MINIATURE TIME-OF-FLIGHT MASS ANALYZER FOR COMBINATION WITH A HIGHLY-REPETITIVE FEMTOSECOND LASER SOURCE AND A TIME-CORRELATED SINGLE ION COUNTING SYSTEM

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Abstract.

A molecular ion is observed in femtosecond laser ionization mass spectrometry in most cases. Then, it provides information concerning the molecular weight of the analyte. In current works, a Ti:sapphire laser has been utilized for the ionization of the analyte. However, it is expensive and requires special skills for operation and maintenance. Accordingly, it is difficult to apply this technique for practical trace analysis. In this speech, we report on the development of a small time-of-flight mass analyzer consisting of a short flight tube (65 mm) (see Fig. 1), which was combined with a small highly-repetitive (120 kHz) femtosecond Yb laser and a time-correlated single ion counting system [1, 2]. Moreover, this analytical system was coupled with a gas chromatograph for trace analysis of a complicated sample mixture.

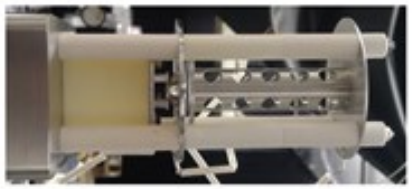

Fig. 1. *Photograph of the time-of-flight mass analyzer.*

The wavelength of the fundamental beam (1030 nm) was converted into the ultraviolet region at 343 (third), 257 (fourth), and 206 nm (fifth harmonic emission), which was used as an ionization source for efficient two-photon ionization. A mass resolution was measured using chlorobenzene, and the value was 670 for a molecular ion signal. The minimum time for measuring a mass spectrum was 0.1 s and can be extended to 1 h for more sensitive detection. This mass spectrometer was employed in the on-site real-time monitoring. In fact, the combustion products of plastics, e.g., styrofoam and polycarbonate film, were measured in this study. Moreover, nerve agent analogs and an explosive in the air were measured in an interval of 1 s. The interference from nitrogen and oxygen in the air was examined and was found to be suppressed, since nonresonant four- and three-photon ionizations were needed for ionization, respectively. This mass spectrometer was further combined with a gas chromatograph for the comprehensive analysis of carcinogenic compounds such as polycyclic aromatic hydrocarbons. As demonstrated, the analytical instrument developed was useful for practical trace analysis of organic compounds in the environmental and forensic sciences.

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A-16

GENERATION OF AN ULTRASHORT OPTICAL PULSE IN THE NEAR-INFRARED AND VACUUM-ULTRAVIOLET REGIONS FOR USE AS THE IONIZATION SOURCE IN MASS SPECTROMETRY

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Abstract.

We generated an octave-spanning (600-1400 nm) nearly-monocycle (1.1 cycle) optical pulse (3.2 fs) in the near-infrared region by a Fourier synthesis of two pulses at 800 and 1200 nm, the bandwidth of which were expanded by self phase modulation and compressed by a pair of chirp mirrors [1]. This optical pulse was used as an ionization source in mass spectrometry. As a result, the signal intensity was increased significantly for pentachlorobenzene, an environmental pollutant listed in the Stockholm Convention. The spectral properties obtained by quantum chemical calculations suggest that the present method is potentially useful for the detection of Novichok, which was suspected to be used a chemical warfare agent in a terrorist attack.

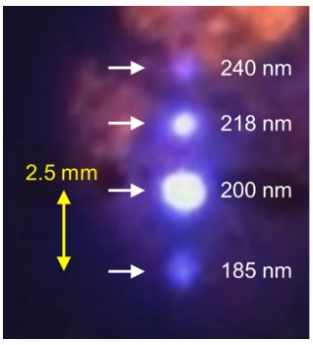

Fig. 1. *Spectrograph of the Raman sidebands.*

The wavelength of a femtosecond Ti:sapphire laser (TS, 800 nm) was converted into the ultraviolet region (UV, 200 nm) using three BBO crystals for frequency doubling and subsequent mixing. This UV pulse was further converted into the vacuum ultraviolet region (VUV, 185 nm) based on four-wave Raman mixing (Fig. 1): a two-color pump beam consisting of the fundamental beam (800 nm) and the signal beam of an optical parametric amplifier (1200 nm) was focused into a hydrogen gas for molecular phase modulation and then the single-color UV probe beam (200 nm) was introduced for frequency modulation to generate Stokes and anti-Stokes Raman sidebands [2]. The ionization energy was calculated for thirteen amino polycyclic aromatic hydrocarbons, occupational bladder cancers. The values calculated were 6.41 - 7.35 eV (194-169 nm). A sample containing a mixture of 9-aminoanthracene, 3-aminofluoranthene, and 1-aminopyrene was separated by gas chromatography (GC), and the eluents from the capillary for separation were ionized using the VUV pulse in mass spectrometry (MS). The analytes were measured on a two-dimensional display (GC/MS), and the limit of detection (LOD) observed for 3-aminofluoranthene was 1 ng/μL. This result suggests potential advantage of this technique not only for basic studies of photoionization but also for practical trace analyses in environmental and forensic sciences.

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A-17

INVESTIGATION OF CHARGE PHOTOACCUMULATION IN PHOTOCATALYTIC SYSTEMS FOR CO_2 REDUCTION

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Abstract.

Performing photocatalytic reactions to produce solar fuels requires the coupling of multiple photoinduced one-electron transfer steps with multielectronic catalysis. First, we investigated the elementary steps of light-induced two-electron accumulation on a mixture constituted of three archetypal molecular system commonly used in photophysical studies, $[Ru(bpy_3]^{2+}$ as photosensitizer, ascorbate as a reversible electron donor and naphthalene diimide as a two-electron acceptor. Remarkably, accumulative charge separation was observed both in single-pulse and double-pulse experiments in a reversible manner, indicating a very high efficiency of charge transfer reactions. The doubly reduced state exhibiting a ~ 100 µs lifetime was obtained with a formation yield of 4.2 %. Rate constants of all elementary steps in the formation and the relaxation of the doubly reduced state were determined with the aid of a newly developed numerical simulation method for this photosystem. To the best of our knowledge, this is the first investigation of charge accumulation with only a single-pulse excitation in a multicomponent system. Then photoinduced charge accumulation was investigated in several iron porphyrin based catalysts in the presence of ruthenium tribipyridine as photosensitizer. Using the same technique, we were able to detect the accumulation of two electrons at the catalytic site for the first time. Understanding the light-driven charge accumulation in photocatalytic systems is of pivotal importance in the optimization process of photocatalytic systems.

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A-18

PROPAGATION OF ELEKTROMAGNETIC PULSES IN NONLINEAR MEDIA: APPLICATION IN SUPERCOTINUUM GENERATION

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Abstract.

Nonlinear Schroedinger Equation for propagation of electromagnetic pulses in photonic crystal fibers is introduced and presented in detail with application to so-called supercontinuum generation in photonic crystal fibers.

Since beginning of recent century, the subject of our research with prof. Marek Trippenbach from Warsaw University, among others, is nonlinear optics. In particular, we dealt with a situation often encountered in experiments: the passage of an impulse through any nonlinear medium. We derived together the propagation equation of this impulse using a strict mathematical approach, limited to the second order of nonlinearities, called the nonlinear Schroedinger equation (NLSE). It is a nonlinear partial differential equation that has played a very important role in the development of physics even since the times of Landau and Gilzburg, so much so that we like to say in lectures to students that "to understand physics you need to know three things: Gaussian function, oscillator and nonlinear Schroedinger equation".

In collaboration with the group of prof. Ryszard Buczyński from Warsaw University, we numerically simulated the supercontinuum generation process described by the short pulse propagation equation in a non-linear Kerr type medium. A research program on the use of liquids as strong nonlinear media for the generation of supercontinuum has been developed in the last time. The use of these liquids as cores in photonic fibers made it possible to obtain a medium with a strong localization of light in a medium with high non-linearity over long sections. The research work was initially theoretical, but after mastering the methods of controlled liquid introduction into the hollow core of photonic fibers, it was confirmed by experimental studies. From 2016 until now, the Polish-Vietnamese international research group has published nearly 20 research papers in this domain.

A-19

PROGRESS IN TIME-RESOLVED MEASUREMENTS IN X-RAY FREE-ELECTRON LASER SACLA

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Abstract.

XFELs are promising sources of femtosecond X-ray pulses. One of the most active areas of XFEL application is to investigate ultrafast dynamics of chemical reactions and phase transitions with structural changes on a fs to ns time scale by using a pump-probe technique. Significant progress in the pomp-probe experiments has been produced in SACLA.

A-20

234 NM DEEP ULTRAVIOLET SECOND HARMONIC GENERATION FROM SRB4O7 MICROCAVITY

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Abstract.

We have successfully demonstrated 234 nm deep-ultraviolet second harmonic generation from an ultracompact microcavity using low-birefringence paraelectric SrB_4O_7 crystal, the material which had never used for wavelength conversion. Our demonstration represents a milestone in nonlinear optics and opens routes to all-solid-state ultracompact coherent light sources covering the vacuum ultraviolet region.

A-21

GENERATION AND APPLICATION OF FOUR-WAVE MIXING IN COLLINEAR HIGH HARMONIC GENERATION

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Abstract.

Four-wave-mixing (FWM) spectroscopy in the extreme ultraviolet (XUV) and X-ray regimes has become a powerful tool to investigate ultrafast dynamics in atoms and molecules as well as other material samples [1]. Free electron laser (FEL) and high harmonic generation (HHG) which can produce XUV pulses can be acted as light sources for such FWM spectroscopies [2-6]. HHG pulses have a relatively low intensity, which makes them more difficult to use in nonlinear spectroscopy, but in terms of stability and coherence their quality is higher than free-electron laser pulses [7]. By combining HHG radiation with moderately intense femtosecond pulses, nonlinear four-wave mixing signals involving the XUV field and the femtosecond laser fields can be spectrally filtered [4-6].

In this paper we demonstrate a nonlinear four-wave mixing scheme in the XUV region for studying ultrafast electron wave-packet dynamics. Besides the phase matched HHG spectrum generated by an 800-nm laser (driving field), noninteger order wave-mixing spectra are produced when the driving field and the control field (either at 560 nm, 1400 nm or 1860 nm) are collinearly focused into a gas medium. Moreover, the simultaneous presence of three laser fields generates resolvable four-wave mixing (FWM) frequencies that clearly reveal the contribution of each control field. Since the output spectrum in the presence of the control laser field is different from that of the phase-matched HHG fields, a background-free FWM measurement can be realized. We also show that the four-wave mixing emission using a delayed optical pulse can lead to the determination of the interaction pathways of real dipole-allowed transitions and virtual transitions in the XUV.

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A-22

HYBRID PLASMONIC NANOSTRUCTURES FOR PHOTONIC APPLICATIONS

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Abstract.

Plasmonic modes arising from noble metals (such as gold or silver) offer lots of potential for photonic applications. The Surface Plasmon Polariton (SPP) along a metal-dielectric interface can propagate over 10µm in the visible range and the Localized Plasmon Resonance (LRSP) arising from nanoparticles can be tuned in the visible and near-infrared with a huge intensity enhancement. Despise their losses, the structuration of the metal can be easily patterned to design specific properties such as nanoantennas, surface guiding, single photon emission and lasers [1]. The key point is to design a structure that confines the electromagnetic energy in a nanometric volume with reduced losses.

In this presentation, we will focus on alternative structuration to overcome some drawbacks of surface plasmons. When two plasmons resonances with the same energies interact, they can enter in a strong coupling regime. Two new modes arise similar to bonding and antibonding links. On one hand SPP-SPP hybridization will be investigated to achieve long range propagation. The device is composed of a very thin metallic layer between two identical dielectric layers. New plasmon modes will be created with an increase of 10 times of the propagation length [2]. The geometry of the designed structure will also allow the existence of waveguided modes in the dielectric layers. Their competition will be analyzed with the help of luminescent Quantum Dots as a probe of the local optical modes. On the other hand, SPP-LRSP hybridization is promising for the design of gap antennas. We obtained very recent results with single gold bipyramid (AuBP) placed in the vicinity of a gold mirror. The role of the AuBP orientation [3] will be discussed and the ability to launch SPP on the gold mirror will be deeply investigated. The geometry of this new antenna makes it easy to fabricate and is a robust platform for emission enhancement and redirection of local nanosources such as Graphene Quantum Dots. This work is supported by the USTH consortium and the French Région Auvergne-Rhône Alpes (PAI n 21PACK-LAV).

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A-23

CROSS-PHASE MODULATION BETWEEN PULSE MATCHED LIGHTS IN OPTICAL LOOP SYSTEM

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Abstract.

We will discuss about the observed conditional cross-phase modulation (C-XPM) applicable to quantum phase gate. Combinations of two probe field's polarizations conditioned XPM of two probe fields in the corresponding nonlinear optical system. With optimized parameters of multi-photon transition, we could increase C-XPM more than 1 rad. with small probe absorption. Group velocity matching ratio between probe pulses was estimated to 1.2 in the optical loop system. Because multi-photon interference depends on the ratio between the Rabi frequencies of the probe fields, not the individual intensity, we expect the same phase shift between few photons level's probe pulses in our scheme.

A-24

PREPARATION OF DEFECT-LESS PEROVSKITE QUANTUM DOTS AND LIGHT-EMITTING DIODE (LED) APPLICATIONS

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Abstract.

Perovskite quantum dots (QDs) have considered as candidate emissive materials for next generation display due to their outstanding opto-electrical properties. However, unfortunately, structural instability under environmental conditions is weakness of perovskite QDs and must be solved for commercialization. In this work, highly stable perovskite QDs were produced by introducing (1) UV-crosslinking ligand[1], (2) core-shell structure[2] and (3) alkali metal doping. These methods significantly enhanced environmental stabilities of perovskite QDs by minimizing ligand dissociation and defect generation.[3]

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A-25

LASING ACTION IN THE BOUND STATE IN THE CONTINUUM ORIGINATED FROM DESTRUCTIVE INTERFERENCE OF OPTICAL MULTIPOLE RESONANCES

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Abstract.

Dielectric nanoparticles supporting Mie-resonances at visible wavelengths have recently received significant attention from the nanophotonic community due to their lossless nature and the possibility of tailoring novel functionalities and tunability.[1] In this talk, I will discuss the formation of the bound state in the continuum (BIC) in two-dimensional periodic arrays of dielectric nanopillars by destructive interference of multipole resonances. Three types of BICs originating from vertical magnetic dipole (MD), vertical electric dipole (ED), and magnetic quadrupole (MQ) were observed experimentally and confirmed by Finite Element Method simulations and multi-decomposition analysis. In addition, by incorporating CdSe/CdxZn1-xS core-shell nanoplatelets or GaAs as a gain medium into these dielectric nanostructures, optically pumped lasing actions from these BIC modes were also demonstrated.[2,3] This study suggests a novel way to design laser cavities that may be useful in many optoelectronic applications.

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A-26

MANAGEMENT OF POLARIZATION PROPERTIES IN NANOSTRUCTURED OPTICAL FIBERS

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A-27

WAVE SHAPING IN SECOND HARMONIC GENERATION IN NONLINEAR PHOTONIC CRYSTALS

Wieslaw Krolikowski

Texas A&M University at Qatar, Qatar

A-28

FUNCTIONAL OPTICAL IMAGING WITH NOVEL WAVELENGTH RANGE AND IMAGE ENHANCEMENT USING MACHINE LEARNING METHOD

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Abstract.

We have imaged the control tendon tissue and monitored the changes of the tendon subjected to minor blade cutting using novel wavelength range laser source. The optical imaging modality with novel wavelength light source enable to obtain the selective and multi-functional information. Image processing was performed to obtain specific indicators (retardation, dichroism sensitivity) from the acquired optical images, and compared with the recovery index used in clinical practice based on the histological images. In here, 1500 nm photo-acoustic and 1700 nm optical coherence tomography imaging were introduced with the recent research results. Additionally, machine learning techniques were used to solve the complexity of the 1700 nm wavelength band OCT imaging system. Polarization characteristics were extracted from the 1700 nm OCT intensity image and the polarization sensitive OCT images were reconstructed.

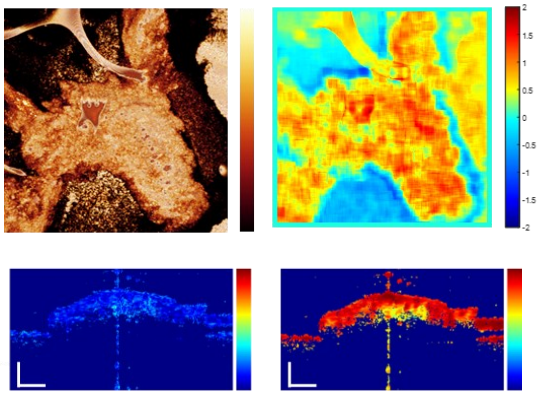

Figure 1. *Spectroscopic and polarization sensitive OCT with 1700 nm swept source.*

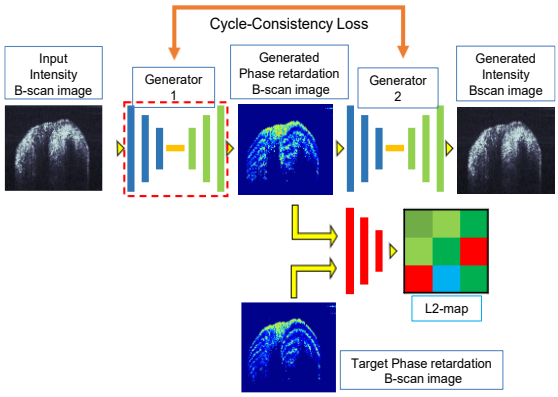

Figure 2. *Anisotropic image reconstruction based on machine learning.*

A-29

DEVELOPMENT OF NOVEL CRYSTALLINE MATERIALS AND TECHNOLOGIES AT THE UNIVERSITY AND THEIR SOCIAL IMPLEMENTATION THROUGH ACADEMIC START-UPS

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Abstract.

Functional single crystals such as semiconductor (Si, GaAs, GaN, SiC), piezoelectric crystals (LN, LT), laser crystals (α-Al_2O_3, YAG), and scintillator (LYSO, GAGG) are important materials that support the convenience of our society. To improve their functionality, it is important to study the material design and develop crystal growth technology.

In this talk, I will introduce our research on single crystals.

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SESSION B

OPTICS AND SPECTROSCOPY

B-01

MICROLASER BASED NATURAL MATERIALS FOR BIOLOGICAL APPLICATIONS

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Abstract.

In this work, we demonstrate a simple approach to fabricate a high-performance microlaser based natural materials for biological applications. By using a simple but effective fabrication process, rhodamine B doped bovine serum albumen microspheres and rhodamine B doped natural photonic crystal of Artemia eggshells were fabricated. Under optical pulse excitation, these dye-doped microstructures emitted lasing emissions with relatively low thresholds of and high Q factors. The lasing mechanisms were investigated and ascribed to whispering gallery mode (WGM) and to random scattering conditions. Interestingly, by encapsulating magnetic nanoparticles in the microlasers, they can manipulate the transportable actuation of the magnetic microlasers while maintaining their good lasing emission characteristics. Furthermore, the microbiolasers could operate in different biological and chemical environments which makes them promising materials for laser-based biological and chemical applications.

B-02

INFLUENCE OF A COMPRESSIVE STRAIN ON THE HIGH-TEMPERATURE THERMOELECTRIC(TE) PROPERTIES OF EUROPIUM ORTHOFERRITE

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Abstract.

Promising high temperature thermoelectric potential of europium orthoferrite (Eu-FeO_3) is investigated in this work, wherein the focus is on the influence of a -3% compressive strain on scattering rates and transport properties. Using Boltzmann transport theory, transport properties such as Seebeck coefficient, electrical conductivity, electronic thermal conductivity and power factor are obtained with appropriate regard on the prevailing scattering mechanisms in the materials that affect its electronic transport. Here, we find that polar optical phonon scattering is the dominant scattering potential affecting the TE properties of $EuFeO_3$ for temperatures from 900 K to 1500 K. The incorporation of a -3% compressive strain suppresses the POP scattering, as evidenced by the decrease in its scattering rates. This result consequently enhances the lattice thermal conductivity, which negatively impacts the TE efficiency. Nevertheless, we find that the strain largely improves the electrical conductivity and the power factor.

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B-03

COLLABORATIVE RESEARCH EFFORTS BETWEEN NIP-UPD AND IOP-VAST ON THE DEVELOPMENT OF NANOSTRUCTURED SILICON FOR TERAHERTZ APPLICATIONS

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Abstract.

In this talk, I will be presenting the collaborative research efforts between the National Institute of Physics, University of the Philippines Diliman and the Institute of Physics, Vietnam Academy of Science and Technology. The collaboration mainly focuses on developing nanostructured silicon for terahertz optoelectronic applications. First, I will give a background and history of the partnership. Next, I will be highlighting our recent results on the investigation of carrier dynamics and transport properties of porous silicon and silicon nanowires. Lastly, I will discuss perspectives for future research thrusts and new possible topics of interest.

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B-04

FAST-RESPONSE SCINTILLATORS THROUGH CROSS LUMINESCENCE IN WIDE BAND GAP FLUORIDE CRYSTALS

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Abstract.

Vacuum-ultraviolet (VUV) fluorescence from $KMgF_3$ and $BaLiF_3$ crystals excited by an extreme ultraviolet free electron laser (EUV-FEL) with 61-nm emission wavelength is studied. Cross-luminescence (CL) peaks at 8.5 eV with decay time of 290 ps and 7.5 eV with decay time of 270 ps, due to the recombination of electron from the valence band to the core band in $KMgF_3$. On the other hand, $BaLiF_3$ exhibited a fluorescence peak at 7.75 eV with the decay time of 300 ps. The band gap energy of $BaLiF_3$ is estimated from its absorption spectrum to be around 8.41 eV [1]. By the calculation, we identify the specific valence-to-core band transition that result to the experimentally observed CL emission at 148 nm (8.38 eV) and 170 nm (7.29 eV) wavelengths for $KMgF_3$ crystal. Uniform volume compression through hydrostatic high-pressure application could decrease the energy gap between the valence and core bands, potentially shifting the CL emission wavelength to the ultraviolet (UV) region from 200 nm (6.2 eV) to 300 nm (4.1 eV) [2]. The ability to tune and shift the CL emission to UV wavelengths allows the detection of the CL emission using UV-sensitive photodetectors in ambient atmosphere instead of highly specialized vacuum UV detectors operating in vacuum while maintaining the intrinsically fast CL decay times.

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B-05

ELECTRIC CIRCUIT MODELS OF LIGHTNING AND OPTICAL BREAKDOWN BASED ON PERCOLATION

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Abstract.

Coarse-grained models of a 1D air column and a 2D optical material were developed to simulate the stochastic and critical behavior of breakdown. The material is represented as a system of discrete cells, each consists of a resistor and capacitor to model a typical electric circuit. The cells are either an insulator or a conductor. Depending on probability and percolation rate, transition from insulator to conductor determines the onset of breakdown at some critical threshold. Cells form a contiguous cluster characterized by a current path between cell boundaries. In a 1D circuit model of an air column, the critical threshold for breakdown was determined by the initial charge distribution. A tripole structure of the electric field in a thundercloud was reproduced by the presence of current sources. Breakdown occurs as the electric field within the cells exceeds the dielectric strength of air, producing high current that leads to a resistor to short. The direction reveals the path of the lightning discharge. Our model has revealed the role of precipitation in the tripole structure via the redistribution of charge from high altitude to the ground to reproduce the phenomenon of discharge. In the 2D circuit, we reproduced the evolution of optical damage via the generation of free electrons from multi-photon absorption, followed by an insulator-to-conductor transition on the irradiated surface of a thin film. Subsequent increase in the local temperature can cause melting leading to damage. Here, we present our model and initial results of the critical behavior of the damage threshold showing dependence on the excitation fluence and laser pulse duration.

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B-06

FABRICATION OF TRIANGULAR SILVER NANOPARTICLES DECORATED ON TIN DIOXIDE FOR NITROGEN OXIDE REMOVAL

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Abstract.

In this study, we developed the triangular silver nanoparticles (Ag NPs) decorated on tin dioxide (SnO_2) by a photoreduction method. The characteristics of Ag/SnO_2 materials were determined by XRD patterns, FTIR spectra, DRS spectra, and SEM-EDX mapping observation. Besides, the NO photocatalytic ability of Ag/SnO_2 is superior to the purity SnO_2. The photocatalytic mechanism for NO degradation of Ag/SnO_2 has been investigated and proposed in this study.

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B-07

FORMATION OF FOCUSED OPTICAL VORTEX BEAMS IN LIQUID MEDIA USING FIBER-BASED MICROPROBE WITH NANOSTRUCTURED ALL-GLASS COMPONENTS

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Abstract.

Flexible control and generation of stable optical vortex beams (OVBs) can yield doughnut-shaped intensity profiles and phase singularities associated with orbital angular momentums [1]. This property has promising applications in particle manipulation, optical communications, high-resolution imaging, and micro-machining [2-3]. Previously we reported fiber microprobes as an alternative replacement of a bulky setup of disparate elements for OVB generation [4]. However, the created OVB strongly diverges in propagation. From a practical point of view, it is beneficial that the OVBs is as collimated as possible. Here we report the development of a compact and robust fiber-based micro-optical system to generate high-quality focused optical vortices without using additional external optical devices. It consists of two nanostructured gradient-index micro-optical components integrated onto the fiber tip - vortex phase mask (nVPM) and lens (nGRIN lens). These nanostructured components can be readily fabricated using a modified stack-and-draw technique [5]. Both numerical and experimental results of the optical performance of such an integrated micro-optical system verified the generation of a focused OVB in free space. Indeed, we obtained beams with a doughnut shape and a clear zero-intensity center. The topological charge value of the vortex beam value $l=1$ is confirmed by astigmatic transformation and interference in Mach-Zehnder configurations. In addition, we also experimentally proved that the generated OVB with charge 1 is preserved in several transparent liquid media like water and ethanol. That means our new integrated micro-optical system can be used in different transparent external media without degradation of optical performance.

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B-08

DISPERSION CONTROL IN LEAD-BISMUTH GALLATE GLASS PHOTONIC CRYSTAL FIBERS INFILTRATED WITH OLIVE OIL

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Abstract.

We present a new design study of photonic crystal fiber (PCF) made of lead-bismuth-gallate glass, with olive oil infiltrated in the cladding. Guiding properties of the proposed fiber in terms of characteristic dispersion, mode area, and attenuation of the fundamental mode were studied numerically. As results, the possibility of controlling the lattice constant Λ and the diameter of air-holes in the cladding allows for precise shaping of dispersion characteristics in a wide range of wavelengths. The fiber could achieve near zero ultra-flat normal dispersion as small as 0 ± 1.0 ps/nm/km for broad wavelength range of 1300 nm. The optimized PCF has been targeted for flat broadband spectrum supercontinuum generation for mid-infrared applications.

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B-09

BIOIMAGING AND BIOSENSING STRUCTURAL DEVICES USING NEAR-INFRARED METAL-DIELECTRIC-METAL PLASMONIC METASURFACES: 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 the metal-dielectric-metal (MDM) plasmonic metasurfaces toward the realization of the fluorescent bioimaging and refractive index biosensing devices. The MDM plasmonic metasurfaces working at the near-infrared range are formed by stacking up the noble metallic (Ag and Au) subwavelength disk arrays on thin silica (SiO_2) spacing layer and metallic film (acting as a reflector) on a silicon (Si) substrate. The MDM plasmonic metasurfaces with various structural parameters are designed and numerically investigated using the finite-difference time-domain (FDTD) method. The successful fabrication of the near-infrared plasmonic metasurfaces have been achieved by electron beam lithography and the lift-off technique, its reflection experiments are in good agreement with the simulation results. In the near-infrared range, the proposed MDM plasmonic metasurface has low Ohmic loss and shows the high fluorescent emitting enhancement and directivity of about 16 times and 625.0, respectively. In addition, the refractive index biosensor based on that provides the figure-of-merit (FOM) to have the contrast and selectivity higher than that of other established MDM plasmonic biosensors. The average sensitivity of 430 nm/RIU according to FOM of 4.4, which correspond to the vapor and liquid sensors, respectively, have been achieved. Thus making MDM plasmonic metasurfaces the impressive approach for near-infrared fluorescent bioimaging and refractive index biosensing devices.

Keywords: *Metal-dielectric-metal plasmonic metasurfaces, surface plasmon resonances, array directivity, near-infrared fluorescent bioimaging and biosensing devices.*

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B-10

g-JITTER EFFECT ON HEAT AND MASS TRANSFER OF THREE-DIMENSIONAL STAGNATION POINT NANOFLUID FLOW

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Abstract.

The studies of fluid motion which is one of the subdiscipline in fluid mechanics provide an important platform that could be adapted in most engineering application. The advancement of technology increases the challenges in producing better machinery product in supporting the demand. Fundamental studies based on physical law and principal on fluid motion could be done by formulating the mathematical modelling of the fluid flow problem. Effects based on thermal energy such as heat source and heat sink together with its transferring mode can also being formulated into mathematical system. Due to this reason, a boundary layer nanofluid flow near a stagnation point region of three-dimensional body is studied in this thesis. Nanofluid with water as base fluid containing copper nanoparticles are considered. In addition, microgravitational field environment known as g-jitter is also considered. The main purpose of this study is to investigate the fluid characteristic, heat transfer behaviour and concentration distribution of the fluid system that affected by thermal radiation and heat generation. The study starts with the formulation of the mathematical models that governed the fluid flow, which consists of continuity, momentum, energy and concentration equations. The governing nonlinear equations in the form of partial differential equations are reduced into dimensionless system of equations using appropriate similarity transformation. The resulting systems of dimensionless equations are then solved numerically using Keller box method. The numerical values of the skin friction coefficients, Nusselt number and Sherwood number as well as the velocity, temperature and concentration profiles are obtained for various values of the curvature ratio, amplitude of modulation, frequency of oscillation, nanoparticle volume fraction, heat generation parameter and thermal radiation parameter. All results obtained, are displayed graphically subjected to the dependent parameter. The comparisons of results with previous studies are made to validate the results. Result shows that the curvature parameter significantly influenced the skin friction coefficient where the plane and axisymmetric stagnation point flow are occurs on specific range of this parameter. The increases of amplitude of modulation on the other hand producing a fluctuating behaviour on all physical quantities studied where the physical quantities was reduced as larger size frequency of oscillation are induced. Additional of small amount of copper nanoparticle also found enhance the thermal conductivity at the heat flux as presented by Nusselt number result. Besides that, the internal heat generation effect increases the temperature profile of the flow system but decreases the heat flux on the wall of the system. It is also found that thermal radiation enhances the heat transferring properties where the heat is emitted through an electrometric charge.

B-11

COLOUR FADING EFFECT OF DENIM FABRIC DURING WASH IN CREATING WHISKERS BY CO_2 LASER

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Abstract.

Garment wash is an important process of creating appealing, modern, and energetic effects of jeans [1-3]. Mechanical rubbing is a common method for creating the Whiskers effect, whereas using CO_2 laser as an alternative is state-of-the-art and unusual in Vietnam. Currently, there have been very few research on the CO_2 laser technology applied to Whiskers creation.[4] In this study, the conventional method was replaced by this CO_2 laser method, and various parameters were selected as a variable: intensity of the laser, radiation time, radiation duration, resolution, radiation angle [5, 6].

The results showed that the fading effect of denim changed with respect to intensity, radiation time, radiation duration, resolution; however, it was not correlated with radiation angle. The fading areas were then quantified and verified with color-comparison method using Chroma CS100A of Konica Minolta. It can be concluded that the products were improved with better quality and had real texture, which are similar to those designed by the conventional method.

Keywords: *Laser CO_2, whiskers & handsand, denim garments, intensity, radiating times, radiating duration, color properties.*

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B-12

SMART BIOLOGICAL MICROLASERS AND THEIR POTENTIAL APPLICATIONS

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Abstract.

Biological microlasers are tiny lasers made of natural or biocompatible materials. These lasers have attracted great interest due to their simple fabrication, biocompatibility, and biodegradability. Research on biological microlasers has recently achieved a milestone in which lasers can be employed as integrated biosensors down to the level of single cells. Therefore, they are called smart or intelligent lasers. This talk reviews the recent developments and prospects of biological microlasers. Firstly, laser structure, mechanisms and materials are introduced. Then, several fabrication techniques and the potential applications of biological microlasers are presented. Finally, the outlook and challenge of this emerging research field are discussed.

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B-13

PREPARATION OF SERS SUBSTRATES BY USING LASER ABLATION METHOD AND APPLICATIONS

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Abstract.

This is a review of our research results in laser application. We designed and built a laser ablation system using a Q-switched Nd: YAG pulsed laser (Quanta Ray Pro 230 - USA) to prepare metallic nanostructures for surface enhanced Raman scattering (SERS) applications. Gold (Au) and silver (Ag) nanoparticles were fabricated by pulsed laser ablation (PLA) in distilled water and ethanol. Nanostructured cooper (Cu) and silicon (Si) surfaces were prepared by PLA in water for SERS templates. The parameters of laser ablation system including the laser power and laser irradiation time were determined to create a suitable ablated surface for SERS. Au/Ag nanoparticles (NPs) were deposited on the ablated surfaces to produce SERS substrates (denoted by AuNPs/aCu, AgNPs/aCu and AgNP/aSi substrates). Malachite Green was used as a test analyte to determine the enhancement factor (EF) of the SERS substrates. The ablated Cu surface without Au/Ag NPs can give a SERS EF of 8×10^4. The AuNPs/aCu, AgNPs/aCu and AgNP/aSi substrates have SERS EF of 1.2×10^6, 6×10^6 and 10^7 respectively. The applications of the SERS substrates for antibiotic detection at low concentrations in food security were investigated. A procedure of Tetracycline residue detection in shrimp has been proposed and developed. This simple and quick method can detect Tetracycline with concentrations as low as 0.1 ppm in shrimp.

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B-14

SOLUTION-BASED PROCESS OF REDUCED GRAPHENE OXIDE/β–Ga_2O_3 NANORODS HETEROJUNCTION FOR ULTRAVIOLET PHOTODETECTOR APPLICATION

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Abstract.
Photodetectors, one of the most crucial optoelectronic components, are able to detect electromagnetic radiation ranging from the ultraviolet to infrared range. Devices for detection of ultraviolet are of utmost importance and have recently drawn considerable attention for their promising applications in military surveillance, target detection and acquisition, missile launch detection and other fields. These applications are in stark contrast to those of visible and infrared light photodetectors. Due to its unique characteristics, including its wide bandgap of 4.9 eV, high melting point of 1900 °C, strong electrical conductivity, and photoluminescence, the β–Ga_2O_3–based semiconductor is now one of the most promising materials for ultraviolet detection [1]. Additionally, because of their large surface-to-volume ratio, small size, light confinement, and high gain in photoconductivity, researchers have become more interested in the manufacturing of low-dimensional β–Ga_2O_3 nanorods and nanowires. Many groups have attempted to create heterojunction device by integrating Ga_2O_3 with other semiconductor materials such as GaN [2], SnO_2 [3] and ZnO [4] in an effort to improve the device performance of β–Ga_2O_3 based nanostructures photodetectors. Inspired by the aforementioned study, herein, using a solution-based technique, we created reduced graphene oxide/β–Ga_2O_3 nanorods heterojunction for an ultraviolet photodetector. It was found that the as-fabricated reduced graphene oxide/β–Ga_2O_3 nanorods heterojunction device exhibited obvious sensitivity to ultraviolet light illumination. This result along with the low cost and facile fabrication process signify that the reduced graphene oxide/β–Ga_2O_3 nanorods heterojunction platform may find potential applications in future optoelectronic devices.

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B-15

OPTICAL PROPERTIES OF NANOPHOSPHORS CONTAINNING RARE EARTH IONS Ce, Tb, Eu, Er, Yb and Gd APPLICATION POTENTIAL IN BIOMEDICIN AND SECURITY PRINTING

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Abstract.

Luminescent properties of rare earth nanophosphors including Y_2O_3, Gd_2O_3, YVO_4, $CePO_4$ doped Rare Earth ions such as Ce, Tb, Eu, Er. Yb and Gd were detail study by photoluminescence spectra excited by violet soures and upconversion luminescent spectra excited by 975 nm infrared laser. Some applications in biomedicin and security printing will be presented through our papers.

Keywords: *Nanophosphors, Y_2O_3, Gd_2O_3 ,YVO_4 $CePO_4$, Eu,Tb,Er, Yb, Gd.*

B-16

RETRIEVING TERAHERTZ TIME DOMAIN BY ODD-EVEN HIGH ORDER HARMONIC GENERATION

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Abstract.

Known as a gap in electromagnetic spectra for a long time, terahertz (THz) radiation has overcome the limits in generation and has recently been intensively applied in many applications. Generating THz pulse is essential for such applications, so time-domain THz detecting is needed. In common, based on the idea of using pump-probe pulses, most current time-domain detecting THz methods treat THz pulse as the pump to stimulate the physical properties of targets and an infrared or another THz pulse to probe these stimulated properties. However, the validation of these detecting methods is governed by the working range of these targets in the THz field. As a sequence, improving the available methods and finding new methods to detect time-domain THz pulse is a recent hot topic.

In this report, we propose a method to extract the time domain THz pulse by using the high-order harmonic generation (HHG) emitted by the atoms in a combination of an infrared intense laser pulse and a THz pulse. HHG can be understood as the emission of photons with the frequency of multiple numbers of incident laser's frequency. Contrary to the symmetric laser-target system, whose HHG contains only odd harmonics, the HHG of this system adds the even ones due to the symmetry breaking caused by the THz pulse. It suggests utilizing the even harmonics, in particular, the even-to-odd ratio (the ratio between intensities of even harmonics and the adjacent odd one), to probe the electric field of the THz pulse.

To achieve this goal, we generate HHG by numerically solving the time-dependent Schrodinger equation of atoms in the combined infrared and THz laser pulses. Investigating the HHG comprehensively from different targets and laser pulses, we find out a universal dependence of the even-to-odd ratio on the THz's electric field. Then the quantum orbit theory is performed to prove this universality analytically. Finally, we apply this universal THz-dependence even-to-odd ratio as a tool to extract the THz time domain. The accuracy and validation of the method are also discussed in detail.

B-17

ELECTRON SPIN RESONANCE AND PHOTOLUMINESCENCE OF OF DOPED/UNDOPED ZnO NANOPARTICLES

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Abstract.

ZnO nanoparticle doped transition ion Mn^{2+}/Cr^{3+} was synthesized by a solgel method. The nature of the point defect of dopants was analyzed by electron spin resonance (ESR) and photoluminescence (PL) emission which revealed the role and the site distribution of ions in the enhancement of the photocatalytic activity. In general, when the dopant content was increased, the PL intensity was sharply reduced. The result indicated the longer life time of excited carriers which was due to the formation of a heterojunction between the dopant ions and ZnO. In ZnO:Cr^{3+} samples, the typical ESR signal with a g-factor ~1.96 was completely passivated, indicating the diffusion of electrons near the conduction band into the dopant ions. The doped Cr^{3+} ion acts as an electron trap in the ZnO crystal. In ZnO:Mn^{2+}, characteristic ESR signals from ion Mn in crystal were indicated site distribution of the dopant such as substitutional, interstitial, and cluster sites.

Keywords: *ZnO, point defect, electron spin resonance, photoluminescence, transition metal ions.*

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B-18

INDUSTRIAL LASER APPLICATIONS

Do Quoc Khanh

TRUMPF Vietnam Co. Ltd.

B-19

TEMPERATURE AND TIME MODIFICATION IN SYNTHETIZATION OF ALPHA NANO HEMATITE α-Fe_2O_3 USING CHEMICAL PRECIPITATION METHOD FOR GLASS FABRICATION

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Abstract.

Nanostructure material has been an interesting field of study as it offers changes of fundamental properties of nanostructured materials for examples magnetic resistance, high surface area per volume, superparamagnetism, large coercivity, and lower Curie and Néel temperature. One of the most interesting materials for broad applications of nano-tech devices is iron oxide compound of hematite. With limited discussions of alpha nano hematite synthetizations method and peraparations, numerous studies have revealed the importance of the nano-hematite in terms of nanostructure and magnetism characterizations for versatile applications. This work aims to discuss the exploitation in temperature and time for synthesize an alpha nano hematite α-Fe_2O_3 using chemical precipitation method that is by varying temperature and calcination time to investigate their impacts on α-Fe_2O_3 synthesis. Synthesis of α-Fe_2O_3 of 69.09 nm size has been achieved from 0.4 M solution of $FeCl_3.6H_2O$ in 100 ml of deoxygenated distilled water using 2 M solution of KOH. The size, shape and morphology of the synthesized α-Fe_2O_3 was characterized by X-ray diffraction (XRD), Fourier transform infra-red spectroscopy (FTIR) and Field emission scanning electron microscope (FE-SEM). The obtained result from XRD analysis shows very thin peaks, suggesting a fine particle with a small crystallite size. The analysis is based on crystallite peaks which were observed at 2θ ranges of 24.16°; 33.16°; 35.61°; 40.84°; 49.45°; 54.08°; and 57.42° which suggested that it is in the form of pure α −hematite nanoparticles. Scherer's relation indicated that the average of crystalline size was calculated to be at 69.09 nm with a pure rhombohedral crystal structure of lattice parameter; $a = b$ =5.430 Å, c = 1.375 nm and a space group: R-3C (167) confirmed by Match Software for phase identification. According to the results, $\gamma -$ Fe_2O_3 was transformed into $\alpha -$$Fe_2O_3$ during the calcination process at 750 °C. In FE-SEM, the structure was confirmed to be spherical shape of different sizes with a range from 26.7 to 88.2 nm and the average of crystalline size of the particles confirmed by OriginPro software were found to be as similar to the 69.09 nm from Scherer's relation. Analyzing the nanoparticles with an FTIR confirmed their purity in phase. From the study, we found that raising calcination temperature up to 750 °C for 4 hours 30 minutes in synthetization of alpha nano hematite α-Fe_2O_3 reduced the particle size to 69.09 nm as compared to other previous work [1]. In other words, by increasing the calcination time, temperature, and decreasing in molar concentrations of the precursor, the modifications offers improvement to the nanometer size of the synthesized hematite as a result of minimising the density of nucleation centers.

B-20

STUDY OF STRUCTURE AND PHOTOLUMINESCENCE OF TITANIUM OXIDE NANOTUBE HYBRIDIZED WITH Ag NANOPARTICLE

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Abstract.

This work shows a two-step fabrication of homogeneous hydrothermal titanate nanotubes (TNTs) hybridized with Ag nanoparticles (NPs) and elucidated the role of Ag NPs on local surface plasmonic resonance, surface-enhanced Raman scattering, and the enhanced photocatalytic activity of TNT/Ag nanocomposite. TEM micrographs showed that Ag NPs were well dispersed on the walls of the nanotubes. XRD patterns and Raman spectra indicated that the TNTs were in the monoclinic structure of $H_2Ti_3O_7$. Furthermore, Raman active modes of the TNTs were significantly enhanced in the TNT/Ag sample, which was attributed to surface-enhanced Raman spectroscopy. The enhanced photocatalytic activity of the TNT/Ag sample was explained by UV-vis diffuse reflectance spectroscopy and photoluminescence emission spectroscopy, which showed local surface plasmonic resonance-induced visible light absorption enhancement and effective charge separation, respectively.

Keywords: *Titanate nanotube, hydrothermal, photoluminescence, Ag NPs.*

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B-21

NGHIÊN CỨU CHẾ TẠO NANO BẠC/VÀNG TRÊN SỢI QUANG SỬ DỤNG PHƯƠNG PHÁP QUANG HÓA CÓ TRỢ GIÚP BẰNG CHÙM LASER ĐỂ PHÂN TÍCH DƯ LƯỢNG THUỐC BẢO VỆ THỰC VẬT BẰNG KỸ THUẬT SERS

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Tóm tắt.

Báo cáo trình bày phương pháp quang hóa có trợ giúp bằng chùm laser để tổng hợp nano bạc và tổ hợp nano bạc/vàng trên sợi quang có điều khiển hình thái học của vật liệu nano bằng bước sóng và cường độ laser, nồng độ tiền chất và thời gian phản ứng. Nano bạc/vàng lắng đọng trên đầu sợi quang với các cấu trúc khác nhau được sử dụng như đế SERS có cộng hưởng Raman với tần số kích thích rộng để phân tích dư lượng một số thuốc bảo vệ thực vật với nồng độ thấp đến bậc ppb. Phương pháp quang hóa có trợ giúp bằng chùm laser là phương pháp mới rất hiệu quả để tổng hợp nano Ag/Au trên các loại đế SERS, đã được cấp bằng sáng chế độc quyền và kết quả đo SERS đã được công bố trên nhiều bài báo quốc tế có chỉ số ảnh hưởng cao.

B-22

BAND GAP ENGINEERING AND THERMOELECTRIC PROPERTY OF TWO-DIMENSIONAL MOLYBDENUM CARBON FLUORIDE

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Abstract.

In this work, the electronic band structure and thermoelectric property from monolayer to multilayer of molybdenum carbon fluoride Mo_2CF_2 are studied using first-principles calculations combined with the Boltzmann transport equation within a constant relaxation-time approximation. It has an indirect band gap of 0.269 eV for monolayer structure. The bandgap energy decreases to 0.251 eV and 0.236 eV for bilayer and trilayer, respectively. Mo_2CF_2 possess a positive Seebeck coefficients near the band edges suggesting that the material is of p-type semiconductor. Comparing between monolayer and multilayer Mo_2CF_2 at different temperature in the range of 100-600K, the increase in the number of layers makes significant improvement to the electrical and thermal conductivity by over 30% [1]. This enhancement is mainly attributed to the appearance of intense, sharp peaks at the bottom of conduction band contributed by the d states of transition-metals. The results indicate potential application of this material in the field of electronic and photovoltage devices.

Keywords: *band gap engineering, two-dimensional materials, electronic band structure, thermoelectric property*.

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B-23

ORDERED Ag NANOSTRUCTURE GENERATING SURFACE PLASMON EFFECT AT NEAR-INFRARED REGION: THEORY, SIMULATION AND EXPERIMENTAL FABRICATION

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Abstract.

This paper presents the research results on the ordered Ag nanostructures creating the near-infrared surface plasmon resonance effect. The theory of localized and delocalized surface plasmon resonances [1-2] is introduced. The Finite Difference Time Domain (FDTD) method [3] was used to simulate the optical properties of the ordered Ag nanostructures. The fabrication process of Ag nanostructures by 3D direct laser writing combined with sputtering is presented in this report. Some numerical results are introduced and analyzed. At the same time, some suggestions to enhance the optical properties of the structure (reflectivity, transmittance, absorption) have been proposed.

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B-24

PREDICTION OF REFINED LINE SHAPE PARAMETERS OF CO BROADENED BY N_2 USING THE CLASSICAL MOLECULAR DYNAMICS SIMULATIONS

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Abstract.

In this work, the refined spectroscopic parameters of CO diluted in N_2 including the speed dependence of Lorentzian broadening coefficient, the Dicke narrowing and the line-mixing coefficients have been predicted using the Classical Molecular Dynamics Simulations. For that, the absorption spectra have been directly deduced using The Fourier-Laplace transform of the auto-correlation functions of the CO dipole moment. Calculations were computed for 1atm of CO/N_2 mixtures and for various values of the ratio between the Doppler and Lorentzian widths. The obtained spectra were then fitted with the Voigt profile including the first-order line mixing using a multi-spectrum fitting procedure. Comparisons with values determined from room temperature measurements in the 3←0 band of CO by using the same profile [*Cross et al, Journal of Molecular Structure 695–696 (2004) 269–286*] show that our retrieved line broadening coefficients are overestimated by about several percent. The difference between the measured and predicted line broadening coefficients was used to empirically correct the CMDS auto-correlation functions and thus the corresponding absorption spectra. These latter were then fitted with the speed-dependent Voigt, and the speed-dependent Nelkin-Ghatak profiles, all of them being associated with the first-order line-mixing approximation, providing the refined line-shape parameters for lines up rotational quantum number to $j'' \leq 20$. The results show a very good agreement with available experimental data for all the considered refined parameters.

Keys words: *Carbon monoxide, Speed dependence, Dicke narrowing effect.*

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B-25

OPTIMIZATION OF THE ULTRA-FLATTENED NORMAL DISPERSION PHOTONIC CRYSTAL FIBERS INFILTRATED WITH TETRACHLOROETHYLENE FOR SUPERCONTINUUM GENERATION

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Abstract.

This paper reports new results of chromatic dispersion in tellurite glass photonic crystal fiber (PCF), having its air holes infiltrated with tetrachloroethylene. The possibility of changing the lattice constant Λ and adjusting the diameter of holes in three subsequent rows enables fine tailoring of the dispersion characteristics. Our proposed structure can be implemented for both ultra-low and ultra-flattened dispersion over a wide wavelength range. As result, the optimization processes permit us to achieve an ultra-flat normal dispersion in the range of over 870 nm within the wavelength range from 2864 nm to 3734 nm. The proposed PCF structure could be very helpful in investigating the supercontinuum generation in the mid-infrared region which has many potential applications in various promising areas such as spectroscopy, sensor, medical diagnostics, etc.

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B-26

GREEN SYNTHESIS OF CuO NANOPARTICLES USING TEA EXTRACT AND THE FIRST OBSERVATION OF ITS ANTI-STAPHYLOCOCCUS AUREUS ACTIVITY BY SEM

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Abstract.

Biofabrication of copper oxide nanoparticles was conducted with copper (II) sulfate using tea leaf extract. As-prepared CuO NPs characteristics were determined by Scanning Electron Microscope (SEM), Energy Dispersive Spectroscopy (EDX), and UV-visible. SEM images of formed CuO NPs revealed the formation of NPs with a size smaller than 50 nm. The composition of elements obtained from the EDX spectrum demonstrated that the bio-synthesized NPs contained only Cu and O elements. UV-vis spectroscopy showed an electronic transition from 258 to 266 nm once again successfully confirming the formation of CuO NPs. The antibacterial behavior of CuO NPs was evaluated on gram-positive *Staphylococcus aureus*, and bacterial destruction has been observed by SEM. The obtained results allowed us to draw conclusions that CuO NPs could be against bacteria. The main reason considered here is the existence of a large amount of ROS (superoxide anions) production by the surface defect states in CuO NPs which causes the increase of cell permittivity and results in an uncontrolled transport of CuO particles through the cytoplasmic membrane. These results would help to utilize CuO-NPs effectively in the future green synthesis concern.

B-27

NGHIÊN CỨU CÔNG NGHỆ MÀI THẤU KÍNH CẦU VẬT LIỆU CaF_2

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Tóm tắt.

Đơn tinh thể CaF_2 là vật liệu quang học có nhiều đặc tính rất giá trị: truyền qua ánh sáng tốt trong dải phổ rộng từ vùng tử ngoại 120 nm đến hồng ngoại 12 μm, chiết suất thấp (~1,43@ 4μm), hệ số hấp thụ nhỏ, độ bền cơ cao, ổn định hóa học, bền vững trong môi trường khí quyển bình thường. Vì vậy, CaF_2 đã được ứng dụng để chế tạo các linh kiện quang học, đặc biệt là các thấu kính cho nhiều thiết bị quang học tiên tiến, hoạt động trong vùng tử ngoại (UV) và hồng ngoại (IR). Ví dụ, thiết bị quang khắc vùng DUV, hệ quang học cho laser Excimer công suất cao, thiết bị quang học vùng hồng ngoại.

Bài báo này giới thiệu kết quả bước đầu việc ứng dụng công nghệ mài tinh và mài bóng trên máy mài quang học tốc độ cao, sử dụng bột mài kim cương, để gia công thấu kính cầu vật liệu CaF2. Đối với quá trình mài tinh, bột mài kim cương được gắn trên dụng cụ mài (nấm/bát mài) bằng liên kết kim loại hoặc liên kết nhựa. Đối với quá trình mài bóng, bột mài kim cương được cấp dưới dạng dung dịch vào giữa bề mặt nghiền của thấu kính với nấm/bát mài nhựa.

Thấu kính CaF_2 đường kính 18 mm có một mặt cầu lồi và một mặt cầu lõm, đã được gia công. Các thông số cơ bản của thấu kính cầu: độ chính xác bán kính cong mặt cầu lồi/lõm, độ chính xác biên dạng mặt cầu lồi/lõm (số vòng quang), chiều dày đỉnh của thấu kính, được đo kiểm bằng các phương pháp tiêu chuẩn trong gia công quang học. Kết quả cho thấy qui trình công nghệ đã thiết lập, đáp ứng yêu cầu gia công chính xác thấu kính cầu vật liệu CaF_2.

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B-28

CONTROL OF PULSE PROPAGATION IN A FIVE-LEVEL ATOMIC MEDIUM

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Abstract.

Controlling light by light is one of the important and interesting research topics in quantum and nonlinear optics because of its potential application in quantum computers and quantum information. Recently, the advent of electromagnetically induced transparency (EIT) [1] has opened up an excellent route in photonic technology, such as the enhancement of Kerr nonlinearity [2, 3], the formation of optical solitons [4], optical bistability (OB), and all-optical switching (AOS) [5-9]. Atomic all-optical switching has favorable advantages such as high response speed, low-intensity thresholds, and controllable switching characteristics.

This paper proposes an efficient scheme to manipulate the EIT windows in a cold atomic medium with a five-level configuration. By solving the Maxwell-Bloch equation systems in a stationary state with a density matrix, optical characteristics of the medium are determined in terms of absorption and dispersion. Moreover, it is shown that adjusting the frequency and intensity of the controlling laser fields can establish the location and the range of different EIT windows at any desired probe frequency. For more practical applications, pulse propagation and all-optical switching is investigated in this scheme. These results can be potentially applied to the investigation of EIT materials and optical communication, especially all-optical switching, using multiple laser fields with different frequencies.

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B-29

STUDY OF PARAMETERS AFFECTING FARICATION PROCESS OF PDMS MICROLENSES BASED ON PHOTORESIST MOLD

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Abstract.

The dimension of microlenses can be precisely defined by using molds, however, to take advantages into forming the microlenses with the designed focus lenghth, the laterial dimension and the height of PDMS semi-sphere need to be precisely controlled. The laterial dimension and the height of PDMS semi-sphere depend on the height of mold, the valume of PDMS fluidic drop, annealing temperature, and annealing time. In this work, we report on invesigations of the parameters affecting the farication process of PDMS microlenses based on photoresist mold.

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POSTER SESSION

POSTER I

PI-01

RAMAN FREQUENCY CONVERSION OF SPECTRALLY TUNABLE LASER RADIATION ON COHERENTLY DRIVEN MOLECULAR VIBRATIONS IN HIGH-PRESSURE HYDROGEN

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Abstract.

Raman down-frequency conversion in low-molecular-mass gases is traditionally used to expand spectral tunability of dye and Ti:Sa lasers, workhorses for experiments in optical spectroscopy. The technique is well established for the near infrared region via the 1st and 2nd-order Stokes generation. However, higher-order Stokes generation in the mid- and far-infrared regions is challenging as Raman gain coefficient decreases with wavelength [1]. Several solutions have been proposed to enhance the gain, e.g. by making use of hollow waveguides [2], capillaries [3], photonic crystal fibers [4], high-finesse Raman cavity [5] and resonant stimulated Raman scattering (SRS) [6]. Nevertheless, they are not widely applied for spectrally tunable light generation.

We have developed a theoretical model describing the generation of the Stokes components in two-frequency pumping field, taking into account the effects of diffraction, wave mismatch and non-collinear propagation of exciting radiation beams. Within the framework of this model, the calculations of the energy and spatial characteristics of the transformed radiation for SRS in compressed hydrogen are performed. The experimental studies were carried out for the conditions corresponding to the theoretical model. We have developed a light source using Raman-mediated 4-wave mixing. A frequency-doubled output of that laser optically pumps a dye laser. The dye laser beam is frequency converted owing to the parametric coupling with the Nd:YAG laser and its Raman-shifted sidebands. It has been found that the use of two-wave pumping makes it possible to reduce the threshold of excitation of SRS by more than 2 times compared with single-frequency pumping. Using dye laser radiation tunable in the range of 563-685 nm, the generation of spectrally tunable radiation was obtained in the wavelength ranges of 355-365, 367-376, 417-447, 503-550, 865-1015, 1315-1740, and 3100-5865 nm with the average pulse energy values from 0.5 mJ (anti-stokes region) to 7 mJ. Increasing the tuning range of the dye laser to 735 nm or using a sapphire-titanium laser will allow one to obtain continuously tunable radiation in the range from 355 nm to about 8 μm.

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PI-02

MULTIFREQUENCY STIMULATED RAMAN SCATTERING OF PICOSECOND PULSES IN A POLYCRYSTALLINE SOLID MIXTURE OF LITHIUM COMPOUNDS

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Abstract.

The processes of multicomponent stimulated Raman scattering (SRS) in a polycrystal consisting of the products of the interaction of LiD with molecules contained in air have been studied. The resulting solid polycrystalline mixture consisted of LiOH, LiOD, $LiOH \cdot H_2O$, and Li_2CO_3. Excitation of the sample under study by the third and second harmonics of a picosecond repetitively pulsed YAG:Nd^{3+} laser made it possible to convert picosecond radiation with wavelengths of 355 and 532 nm into eight spectral components, in the range from 282 to 691 nm.

The use of high-power pulsed lasers makes it possible to excite the SRS process in Raman-active media. During SRS in a dielectric medium, as a rule, only the highest quality vibrational mode is observed, into which laser radiation is most efficiently converted. An advantage of LiOH and LiOD crystals is a high frequency shift, which, during SRS, makes it possible to obtain laser radiation in a wide spectral range [1].

When the sample under study was excited by the radiation of the third harmonic of a picosecond laser, three Stokes and two anti-Stokes SRS components with a Raman frequency ν = 3660 cm^{-1} corresponding to the breathing mode of the OH^- ion were recorded in the scattered radiation spectrum. It was found that the excitation threshold of the second Stokes component was approximately equal to the excitation threshold of the first SRS Stokes component. The intensity of the second Stokes component was higher and the line half-width was smaller than that of the first component. The radiation of the third Stokes component had similar characteristics. All this indicates a significant contribution of four-photon parametric processes to the generation of higher Stokes components in the 3660 cm^{-1} vibrational mode. Excitation of SRS by picosecond radiation with a wavelength of 532 nm made it possible to register two Stokes and one anti-Stokes components at the 3660 cm^{-1} vibration. The decrease in the number of components is due to a decrease in the gain of the SRS with an increase in the wavelength of the exciting radiation [2].

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PI-03

MULTIFREQUENCY PICOSECOND RANDOM RAMAN LASING IN POWDERS OF POTASSIUM, SODIUM, AND STRONTIUM NITRATES

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Abstract.

Random lasers are a developing class of laser light sources that utilize a highly disordered gain medium [1]. In such materials, the optical path is considerably longer than in solid materials, and, therefore, the light amplification can be reached which is sufficient for laser generation. The traditional Random lasers generate the broad bands of radiation. In Random lasers based on stimulated Raman scattering (SRS), the generation can be obtained in spectrally narrow bands which are defined by the physical characteristics of the used Raman active materials [2]. In the present work, we studied the possibility of obtaining the multi-frequency spectrally narrowed generation of the picosecond radiation in random Raman lasers in a wide spectral region. The powder samples (5-10 μm) of the potassium, sodium, and strontium nitrates were used as Raman active media. These samples have the intensive spectrally narrowed (the spectral width is not more than 2 cm^{-1}) lines of spontaneous Raman scattering and high Raman gain coefficients (40-50 cm/GW). The picosecond laser radiation pulses at 532 nm (pulsewidth is 60 ps) and 355 nm (50 ps) were used for exciting the samples. The measurements showed that SRS threshold was equal to about 250 GW/cm^2 (at 532 nm) and 150 GW/cm^2 (at 355 nm). In all cases, SRS was excited at the internal fully symmetrical mode of nitrate ion $(NO_3)^-$. At exciting the SRS at 532 nm, Raman generation was obtained for all crystals at the wavelengths of the first anti-Stokes and three Stokes components with Raman shifts 1050 (potassium nitrate), 1069 (sodium nitrate), and 1057 cm^{-1} (strontium nitrate). In the case of exciting at 355 nm, the Raman generation was obtained at three Stokes components in all powders. In general, random Raman laser generated the narrowed band radiation at 21 spectral components in the region of 342-641 nm with the duration of the frequency shifted pulses not more than 50 ps.

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PI-04

NUMERICAL SIMULATION AND EXPERIMENTAL STUDY OF THE PULSED RING KTP-OPO GENERATING EYE-SAFE RADIATION

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Abstract.
The pulsed laser systems generating the radiation in the eye-safe range (1.5 – 1.8 μm) are widely used in practice. It is promising to use the optical parametric oscillator (OPO) with ring three mirrors cavity based on $KTiOPO_4$ (KTP) crystals for obtaining the powerful pulsed eye-safe radiation [1,2]. In our previous experiments, we observed a damage of the output face of the KTP crystal located near the output mirror of the OPO resonator at high pumping levels. In present report, a detailed calculation of the intensity of exciting radiation field, as well as the signal and idle waves in KTP-OPO crystals, is performed versus the length of the crystals and the cavity Q-factor, the transverse distribution of pumping radiation and the duration of its pulses. It is allowed one to determine the conditions for achieving the high generation efficiency without optical damage of crystals, i. e. to establish the conditions for ensuring the long-term and highly efficient KTP-OPO operation. The theoretical description of OPO process is based on the standard equations [3]. It was assumed that the pumping pulse had Gaussian temporal profile, and the pumping beam – Gaussian or super-Gaussian distribution in the cross-section [4]. As a result, we have established:

1. The main reason of optical breakdown of KTP crystals is OPO cavity link on signal wave. The conditions have been determined which ensure the highly efficient regime of OPO operation without the damage of the crystals.

2. It is possible to reach the generation efficiency on signal wave of about 40 % in the real experimental conditions due to optimal choice of OPO cavity Q-factor, the length of the crystals, and the parameters of the pumping radiation.

In the specially performed experiments, the generation efficiency was reached to 32 % at the output pulse energy of 48 mJ, the divergence of the radiation of 6 mrad, and the pulse repetition rate of 10 Hz. In the test regime, KTP-OPO ensured the continuous operation to generate more than 10^5 pulses without degradation of the output parameters.

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PI-05

MULTIFREQUENCY PICOSECOND INFRARED STIMULATED RAMAN SCATTERING IN KGW AND LEAD TUNGSTATE CRYSTALS

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Abstract.

Stimulated Raman scattering (SRS) in crystals is very promising for the frequency shifting of the laser radiation. The special interest is obtaining the infrared (IR) radiation using SRS in Raman crystals. For this aim, one can apply such crystals as KGW and lead tungstate ($PbWO_4$). These crystals are characterized by very large band of optical transparency (from 330 to 5500 nm), and have strong Raman modes (KGW – 901, 768 cm^{-1}, and low-frequency mode near 90 cm^{-1}; $PbWO_4$ – 901 and 323 cm^{-1}), and rather large Raman gain coefficients [1,2]. In this work, we have studied picosecond SRS in KGW and $PbWO_4$ crystals in the IR range. The crystals were excited by the focused (focal length of the focusing lens is 25 cm) picosecond (80 ps pulses at 1064 nm, 15 Hz) radiation beam. SRS spectra were registered using M150 spectrometer (Solar LS) equipped with CCD line (the range of registration is about 1000 - 2500 nm). After optimizing the SRS process in the crystals, we have obtained the multi-frequency SRS spectra in both crystals in the range from 850 nm to 3000 nm for the different orientations of the crystal axes in comparison with the excited radiation polarization. In KGW, four Stokes and one anti-Stokes components were generated at different Raman modes. For $PbWO_4$ crystal, several Stokes and one anti-Stokes components were obtained. New Raman lines have been observed in the range from 2000 to 2700 nm in both crystals. The obtained results can be used for creating the efficient picosecond Raman lasers in the IR region.

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PI-06

HYBRID ASSOCIATES AND DYNAMICS OF ELECTRONIC EXCITATIONS IN THEM

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Abstract.

The creation of plasmon-exciton (plexiton) nanostructures based on colloidal quantum dots (QDs) opens up fundamentally new possibilities for controlling photoprocesses in QDs, which provide control over the luminescence parameters of QDs (quantum yield, lifetime, blinking of single QDs, etc.) [1,2]. The practical usage of plexiton effects in modern applications of nanophotonics requires a detailed understanding of the conditions for their manifestation in the luminescence of QD ensembles.

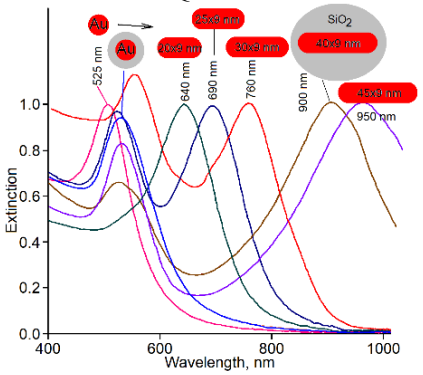

Fig. 1. *Extinction spectra of plasmonic Au nanoparticles.*

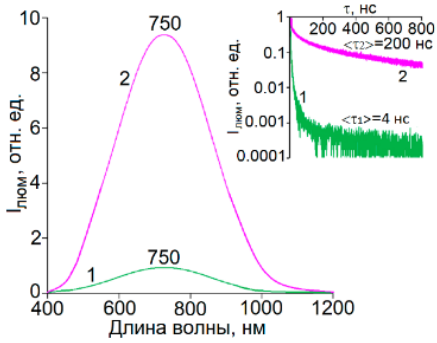

Fig. 2. *Luminescence spectra of Ag_2S/SiO_2 QDs – 1 and $Ag_2S/SiO_2/Au$ QDs – 2. Luminescence decay kinetics of Ag_2S/SiO_2 QDs – 1 and $Ag_2S/SiO_2/Au$ QDs – 2 (insert).*

The synthesis of spherical Au nanoparticles (NPs) was carried out by the Turkevich method. A solution of sodium citrate ($Na_3C_6H_5O_7$) was injected into a boiling solution of $HAuCl_4$. The synthesis of nanorods was carried out in the presence of CTAB. For the synthesis of SiO_2 shells, MPTMS and Na_2SiO_3 were used. Ag_2S QDs were synthesized by mixing a solution of $AgNO_3$, TGA, and Na_2S at pH = 8. It has been found that the formation of a plasmon-exciton $Ag_2S/SiO_2/Au$ nanostructure increases the luminescence quantum yield from 1 to 10% and the luminescence decay time. It is concluded that the dynamics of nonequilibrium charge carriers changes due to the polarization effects of Au NPs, which affect the properties of shallow traps.

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PI-07

ELECTRONIC ENERGY TRANSFER BETWEEN A CYANINE-BASED MOLECULAR ROTORS SYBR GREEN INTERCALATED IN DNA

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Abstract.

For DNA analysis, SYBR Green (SG) and PicoGreen (PG) molecules have recently begun to be used, which differ from known intercalators by a significant (up to 1000 times) increase in fluorescence intensity upon intercalation with the dsDNA double helix. SG and PG molecules are molecular rotors in which charge donors and acceptors are connected by a bridge and can undergo ultrafast rotation in low-viscosity media [1,2]. The effect of a sharp increase in intensity is associated with their inhibition as a result of intercalation in DNA. It was recently shown [2], that PG molecules can be highly sensitive sensors in medicine when they are embedded in amyloid fibrils.

Quantum-chemical calculations of the equilibrium configuration of the SG molecule in the ground state, the energy of the excited electronic state S_1, and the orientation of the dipole moment of the S_0-S_1 transition were performed using the Gaussian 09 program using DFT and TD-DFT methods. The equilibrium configuration is optimized for the cationic form with +2 charge in vacuum and without a counterion with the B3LYP functional and the 6-311G (d, p) basis set of functions, which agrees with the results of PG [3].

A series of experiments was carried out to measure the dependence of fluorescence intensity and anisotropy on the concentration of SG in DNA, as well as on temperature and viscosity for SG molecules intercalated into double-stranded DNA. A disproportionate increase in the dye fluorescence intensity with increasing dye concentration indicates the presence of processes of self-quenching of the fluorescence of intercalated SG. There is a sharp decrease in the fluorescence anisotropy of the SG/dsDNA complex depending on the SG concentration, which is due to nonradiative transitions between the intercalator molecules according to the Homo-FRET mechanism.

A generalized model for calculating the orientation factor and kinetics of fluorescence anisotropy in the dipole-dipole transfer of electronic excitation energy between a pair of fluorophores intercalated into molecular systems has been developed, taking into account both their overall and internal rotations. The proposed model made it possible to universally explain the obtained experimental dependences for the fluorescence anisotropy during energy transfer in a pair of SG molecules intercalated in dsDNA with 10 bases during their rotational diffusion in buffer solutions for various dye/DNA ratios.

The work was supported by the grant of BRFFR F22V-009, VAST (No. QTBY01.06/22-23).

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PI-08

TWISTED INTRAMOLECULAR CHARGE TRANSFER IN BENZOTHIAZOLE-ANILINE MOLECULAR ROTORS

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Abstract.

Photoinduced processes of charge transfer and structural rearrangements in molecules underlie the mechanisms of several important photobiological processes including photosynthesis [1] and photoreception [2]. Dynamics of these processes can approach femtosecond range, and their investigation requires ultrafast time-resolved spectroscopy methods.

Cationic benzothiazole-aniline dyes, having electron donor (aniline) and acceptor (benzothiazole) groups within the molecule, may serve as a convenient model to study dynamics of twisted intramolecular charge transfer (TICT) process in the excited state. A defining feature of these dyes, also called fluorescent molecular rotors, is viscosity-dependent fluorescence due to TICT reaction in the excited state converting emissive locally-excited (LE) state of the molecule to an intermediate non-emissive TICT-state. One of the representatives of the benzothiazole-aniline dyes is Thioflavin T – fluorescent sensor for amyloid fibrils (Fig. 1) – whose quantum yield of emission can be changed by 3 orders of magnitude depending on microviscosity [3].

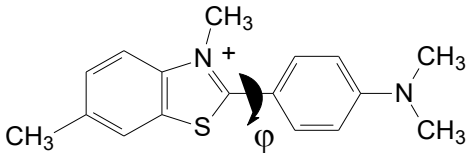

Figure 1. *Structure of Thioflavin T.*

Effect of microenvironment parameters of polar solutions (viscosity, polar and protic properties) on TICT dynamics in the excited state of benzothiazole-aniline dyes was studied using transient absorption spectroscopy with femtosecond resolution. We found that depending on the ratio of characteristic times of solvation and intramolecular structural relaxation in the dye molecule two modes of TICT dynamics were observed [4]. Introducing substituents in molecular structure of benzothiazole-aniline dyes we were able to change the rate of TICT reaction by ~30 times, tuning sensor properties of the dyes fluorescence for different viscosity ranges.

The work was supported by the grant of BRFFR F22V-009, VAST (No. QTBY01.06/22-23).

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PI-09

SPECTRAL-LUMINESCENT PROPERTIES OF HYBRID PLASMON NANOSTRUCTURES AG-R6G AND AG-RC

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Abstract.

Modern technologies are aimed at miniaturization of the developed elements and devices. One of the important tasks in this case is, for example, the creation of nanolasers [1-2], including those based on the use of localized electromagnetic fields inherent in plasmon systems [3]. In this regard, it is very relevant to study the spectral-luminescent properties of various nanomaterials that are promising for applications as laser components. We studied thin films of rhodamines 6G and C, as well as Ag-R6G and Ag-RC hybrid systems. Samples were made using colloidal silver particles.

The maxima of the electron absorption bands of R6G and RC films with a thickness of ~ 50 nm are located at wavelengths of 515 and 582 nm, respectively. The presence of silver nanoparticles in the hybrid nanostructure leads to a significant increase in its optical density in the region of the electronic absorption band of the organic component, which is related to an increase in the field near the surface of plasmon particles.

It is established that the luminescence band of the R6G film when excited at a wavelength of λ = 480 nm is structured and has 2 main maxima at 615 and 675 nm. In compare with the luminescence band of the R6G film, the luminescence band of the Ag-R6G hybrid structure is significantly narrowed, and its maximum is located at a wavelength of λ = 615 nm and coincides with the short-wave maximum of the luminescence band of the R6G film. The maximum of the luminescence band for the RC film at λ_{exe}= 510 nm is located at a wavelength of λ = 600 nm. For the Ag-RC hybrid structure, the maximum optical density is at the same wavelength as the maximum absorption band of the RC film, and the maximum of the luminescence band is shifted by 10 nm into the long-wavelength region relative to the maximum of the luminescence band of the RC film and coincides in frequency with the maximum of the luminescence band of the Ag-R6G hybrid structure.

The presence of plasmon nanoparticles in the hybrid structure leads to a considerable increase in luminescence. For the Ag-RC system, the intensity at the maximum of the luminescence band increased by more than 3 times compared to the RC film with the same construction parameters. The luminescence intensification effect is more evident for the Ag-R6G system, where at a wavelength of λ = 615 nm, an increase in the luminescence intensity is achieved by 5 times compared to the R6G film with similar parameters.

The work was supported by the grant of BRFFR F20EA-006, RFFR 20-52-81005, VANT (No. QTRU05.02/21-23).

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PI-10

AN AUTO-TRACKING COMPOUND MICRO-OPTICAL MEASUREMENT SYSTEM FOR FORM AND ROUGHNESS OF OPTICAL FREEFORM SURFACES WITHOUT DATUMN

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Abstract.

Optical freeform surfaces usually need a high-precision topographic measurement of form and roughness in order to achieve expected optical performance. However, there is often no positioning datum reference for optical freeform surfaces, which limits automatic measurement using micro-optical measurement methods. In this paper, a compound micro-optical measuring system is established based on the integration of white light interference and optical defocus astigmatism. An auto-tracking strategy is designed to measure optical freeform without precision positioning datum reference instead of planning a measurement path advanced. An auto focus scanning (AFS) method is developed to get the focus point of the defocused astigmatism without the calibration of the focus error signal (FES) and the angle adjustment of the probe is auto-tracked along a slope direction. The integrated white light interferometry sensor of the measuring system can identify the measuring area and readjusted position to realize the automatic measurement using low-frequency form topography. Finally, a freeform prism with about 22 mm × 13 mm × 0.5 mm and max slope angle of 11.0197° in optical is measured using the proposed method. Results show that the peak-to-valley deviation of the prism is about 6 μm. the roughness of different regions is between 15.1 nm and 20.7 nm, indicating the feasibility of the automatic optical measurement.

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PI-11

STUDYING THE NONLINEAR OPTICAL PROPERTIES OF Ce:LiCAF CRYSTAL IN THE ULTRAVIOLET WAVELENGTH REGION

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Abstract.
Ce:LiCAF crystal has previously been demonstrated as successful laser medium in the ultraviolet wavelength region with ultrashort, high-peak-power lasers application. However, the nonlinear optical properties such as self-focusing, self phase modulation, and nonlinear absorption of the Ce:LiCAF crystal in this wavelength region have not been investigated yet. In this work, the nonlinear optical properties of Ce:LiCAF crystal are studied by numerical simulation when it is used as a gain medium in high-power, ultrashort pulse laser oscillator and amplifier systems. Results elucidate the self-focusing and self phase modulation of Ce:LiCAF crystal. Moreover, saturable absorption of the Ce:LiCAF crystals is demonstrated making it an ideal a new solid-state saturable absorber in the ultraviolet region.

Keywords: *Ce:LiCAF crystal, nonlinear optical, self-focusing, self phase modulation, nonlinear absorption.*

PI-12

DYNAMICS OF ULTRAVIOLET LASER PULSE AMPLIFICATION USING Ce:LiCAF CRYSTAL AS A BROADBAND, SOLID-STATE GAIN MEDIUM

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Abstract.

Cerium-doped lithium calcium aluminum fluoride (Ce:LiCAF) crystal has been recognized as an efficient amplification medium in the ultraviolet wavelength region. However, spectral characteristics in the multipass amplification process have not yet been studied theoretically. This work investigates spectral effects including gain narrowing and spectral shifting by using the chromatic Frantz-Nodvik model to simulate the amplification of broadband Ce:LiCAF pulses. From the simulation results, gain narrowing of Ce:LiCAF amplifier pulses from 3.50 nm to 2.71 nm and spectral shifting from 290 nm to 289.31 nm are illustrated. Furthermore, 5.5 mJ amplified pulses can be obtained using a 4-pass amplifier with 0.7 mJ, 3 ns injection centered at 288.5 nm wavelength.

Keywords: *Ce:LiCAF crystals, multipass amplifier, gain narrowing, spectral shifting.*

PI-13

MULTIPASS AMPLIFIER OF ULTRAVIOLET AND NARROWBAND LASER PULSES USING A CE:LICAF CRYSTAL

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Abstract.

Narrow linewidth laser light sources operating in the ultraviolet spectral region play a crucial role in science and technology, with an ever-increasing number of applications, covering remote sensing with Lidar, medicinal and biological applications, and spectroscopy. However, these sources often have low energies below the threshold for many applications. In this paper, a 4-pass amplifier of ultraviolet and narrowband pulses using Ce:LiCAF crystal is developed. The seed pulses generated from a Littrow configuration have a full width at half maximum of 0.2 nm. From the experimental results, 5 mJ amplified pulses can be obtained using a 4-pass amplifier with 0.5 mJ, 3 ns at 288.5 nm injection.

Keywords: *Ce:LiCAF crystals, multipass amplifier, Littrow configuration.*

PI-14

OPTIMIZATION OF DISPERSIONS IN GERMANIUM-DOPED PHOTONIC CRYSTAL FIBERS WITH SQUARE LATTICE

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Abstract.

Germanium doped photonic crystal fibers with differences in the air holes diameters of the layers in the cladding is presented to obtain flat dispersion, small effective mode area, and low attenuation property for supercontinuum generation applications. The flatness and small value of the dispersion depend on the lattice geometry when the fibers have the same germanium doping concentration. The dispersion of the square lattice fibers is flatter and smaller value at the pump wavelength than the circular lattice fibers. Square lattice fibers with Λ = 0.9 μm; d_1/Λ = 0.4 and Λ = 1.0 μm; d_1/Λ = 0.45 are proposed for supercontinuum generation which have anomalous and all-normal dispersion respectively. Their small dispersion values of 0.449 ps /nm.km and −1.096 ps /nm.km are suitable for broad spectrum supercontinuum generation. The small effective mode area and low attenuation of the two fibers of 3.221 μm^2, 2.361 μm^2 and 1.805×10^{-7} dB/m; 1.322×10^{-15} dB/m respectively are favorable conditions for choosing a laser pump source with low peak power.

Keywords: *Photonic crystal fibers, Germanium, Flat dispersion, Small effective area, Low attenuation.*

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PI-15

GREEN SYNTHESIS OF SILVER NANOPARTICLES USING TEA LEAF EXTRACT (CAMELLIA SINENSIS) FOR PHOTOCATALYST EFFECT

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Abstract.

Silver nanoparticles (C. AgNPs) were synthesized by the biological reduction method using extracts from green tea leaves (Camellia Sinensis) collected from tea hills at an altitude of 100 m above the ground. The chemicals present in the tea leaf extract act as reducing agents used to reduce Ag^+ ions to silver atoms to form silver nanoparticles in the solution. Silver nanoparticles obtained about 25 nm - 55 nm in diameter were dispersed in biological media. The influence of tea leaf extract concentration, reaction time, and properties of the obtained silver nanoparticles was investigated through UV-VIS absorption spectroscopy, TEM transmission electron microscopy, and spectroscopy X-ray. The synthesized silver nanoparticles were used to treat methylene blue by photocatalytic effect within a VIS radiation range. The results show that C.AgNPs are capable of degrading MB pigment concentration of 10 ppm in a short time of about 1.5 hours with photodegradation efficiency up to 90 %.

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PI-16

CREATION OF RANDOM OPTICAL SIGNALS USING SEMI - NONLINEAR DIRECTION COUPLER

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Abstract.

The semi-nonlinear direction coupler is characted by nonlinearity output-input dependence of intensities. It is used to split an optical signal into two different amplitude signals or to reshape a signal series. In this paper, by the numerical calculation we show that a optical encoded-carrie signal can be spllited into two random signals by semi- nonlinear direction coupler. Obtained results gives the opportunity to design random optical generator for.

Keywords: *for Information security. Encoded-carrie signal.*

PI-17

NUMERICAL INVESTIGATION ON SILICA MICROSPHERES COUPLED SILICON NITRIDE WAVEGUIDES

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Abstract.

We report here a combined structure consisting of a silica microsphere and a sub-wavelength silicon nitride (SiN_x) waveguide working in the near infra-red wavelength range. In this system, the whispering gallery mode (WGM) inside the silica microsphere can be excited by the guided mode of the SiN_x waveguide. The mechanism of this coupled system has been presented and the coupling strength has been investigated numerically. The transmission spectrum has been calculated and the field distribution of the integrated system at resonance has been extracted using 3D Finite-difference Time-domain method. The coupled structure shows potentials for various applications based on light-matter interaction such as lasing, lab-on-a-chip sensors.

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PI-18

FABRICATION OF FLEXIBLE SERS SUBSTRATE BASED ON POLYDIMETHYLSILOXANE AND SILVER NANOPARTICLES

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Abstract.

Surface-enhanced Raman spectroscopy (SERS) is a powerful oscillatory spectroscopy technique that enables highly sensitive structural detection of low-concentration analytes through the existence of local spots with high electromagnetic fields[1-3]. The sensitivity of SERS strongly depends on the surface morphology of the SERS substrate which can be controlled via the metal nanostructures and the substrate preparation process[4]. A flexible SERS substrate can cover any form of the sample surface thus the sampling process can be easily done by sticking the substrate to the sample. The flexible SERS substrates can be obtained by the usage of cellulose papers, textiles, thin films, polymers, and adhesive tapes[5]. In this study, we promote a quick and simple organic/water interfacial self-assembly method. A layer of pre-synthesized silver nanoparticles (AgNPs) is prepared at the interface between the phase separation region of the two solutions, e.g. water and cyclohexane. Polydimethylsiloxane (PDMS) is injected into the middle of these liquid layers. During the polymerization, the AgNPs are directly retrieved onto the PDMS thin film. The uniformity after self-assembly of silver particles will be investigated through a scanning electron microscope (SEM) and UV-vis spectroscopy. The flexible AgNPs loaded PDMS substrates are used to analyze the Raman spectrum of the methylene blue (MB) solution at various concentrations. The limit of detection (LOD) is defined in the range of 10^{-10} M/l.

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PI-19

OPTIMIZATION FOR SPATIALLY OFFSET RAMAN SPECTROSCOPY (SORS) UNDER RING EXCITATION CONFIGURATION

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Abstract.

Spatially offset Raman spectroscopy (SORS) is used to study the Raman spectrum of subsurface samples[1]. The key parameter of the technique is the offset distance from the excitation point to the signal collection position. Because of the different diffusion paths, the Rayleigh photons and the Raman signal originating from the surface layer and the sample arrive at the collection point at different efficiencies. Optimization of the excitation and collection configuration can increase the ratio of the sample signal over the signal of the surface. Various theoretical and experimental studies have been done based on the conventional point-excite configuration[2,3,4]. The SORS signal is collected at an offset distance out of the optical axis. In this study, we present the simulation for a variation of SORS in which, an axicon pair is used to reshape a Gaussian beam to a ring-shaped excitation beam. The SORS signal is now collected at the optical axis while the excitation beam at the surface is spread out under a donut form. Because collecting the Raman signals follows the conventional way, i.e. at the center, thus the experiment setup is simpler than the point-exciting configuration. The simulation results suggest that under ring-excite configuration, the distance between the objective and the cover layer should be kept as small as possible.

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PI-20

INVESTIGATION OF OPTICAL PROPERTIES OF OF CIRCULAR LATTICE PHOTONIC CRYSTAL FIBERS BASED ON GeO_2-SiO_2 Glasses

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Abstract.

In this paper, we design SiO_2-based photonic crystal fibers with cores replaced by $85\%SiO_2{-}15\%GeO_2$ glasses to improve dispersion and nonlinear properties of the fibers. Based on numerical simulation results, two optimal structures are proposed with flat all-normal and anomalous dispersion. The dispersion value as small as 0.298 ps/nm.km, small effective area of 2.76 μm^2, and low attenuation of 3.681×10^{-7} dB/m at the pump wavelength are favorable conditions to guide the application of supercontinuum generation with low-cost all-fiber laser sources.

Keywords: *Photonic crystal fibers, SiO_2-GeO_2 glasses, flat dispersion, small effective area, low attenuation.*

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PI-21
SYNTHESIS AND CHARACTERIZATION OF ZnSe/CdS CORE/SHELL TYPE-II AND ZnSe/CdS/ZnS CORE/SHELL/SHELL TYPE-II/TYPE-I NANOCRYSTALS

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Abstract.

ZnSe core, ZnSe/CdS type-II core/shell and ZnSe/CdS/ZnS type-II/type-I core/shell/shell nanocrystals (NCs) with a dot shape were successfully synthesized in noncoordinating solvents (1-octadecene (ODE)). X-ray diffraction (XRD) studies demonstrated single-phase NCs crystallized in the zincblende structure. The formation of type-II core/shell and type-II/type-I core/shell/shell nanostructures was proved by transmission electron microscopy (TEM), UV–vis absorption, photoluminescence (PL) and Raman spectroscopy (RS). By varying the thickness of of the CdS shell, the PL peaks of the ZnSe/CdS type-II NCs can span from 539 to 615 nm. The redshift in the emission spectra of ZnSe/CdS type-II NCs compared to the ZnSe core NCs is due to recombination of the indirect exciton through the core/shell adjacent layer. An additional ZnS shell was grown up on ZnSe/CdS NCs to form the ZnSe/CdS/ZnS type-II/type-I core/shell/shell nanostructure. The ZnS shell with a much larger bandgap completely confines the excitons in the ZnSe/CdS NCs, enhances quantum yield (QY), minimizes the toxicity of Cd ions and significantly improves the optical stability of the nanostructure. With the typical optical properties of type-II nanostructure, ZnSe/CdS and ZnSe/CdS/ZnS NCs have many potential applications such as photovoltaic, optical amplifier and laser.

Keywords: *ZnSe/CdS type-II core/shell, ZnSe/CdS/ZnS type-II/type-I core/shell/shell, optical properties.*

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PI-22

SCATTERING SPECTRA OF SINGLE GOLD NANOCRESCENT

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Abstract.

Efforts to measure the scattering spectra of single metal nanoparticles are still strong challenges [1-3]. Here, we propose to use gold semi-coated magnetic (florescence) nanoparticles, called gold nanocrescents, to both access the local properties of such complex systems and perturb them at the nanoscale. These particles are produced by evaporating a 30 nm layer of gold on randomly deposited magnetic nanoparticles of 160 nm. The frequency and angular dependences of their scattering spectrum are characterized. In this study, we present scattering spectra of a single gold nanocrescent measured by a dark-field microscope which based on an upright optical configuration. By changing the size of the core template or the thickness of the gold shell, their scattering spectra change. Results showed that scattering spectra shift to longer wavelength when its size increase, which agree with Mie's theory.

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PI-23

SURFACE-ENHANCED RAMAN SCATTERING SPECTROSCOPY FOR PROBING METHYL RED ON ZNO DECORATED Ag NANOPARTICLES DUE TO THE SYNERGISTIC EFFECT

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Abstract.

The noble metal and semiconductor nanostructures have recently shown significant Raman enhancement associated with the turntable localized surface plasmon resonance (LSPR) of the metal, as well as the induced charge transfer effect at the semiconductor/ metal interface [1]. A system composed of ZnO nanoplates decorated with Ag nanoparticles (denoted as ZnO@Ag) was fabricated through hydrothermal processes [2]. In this study, by using surface-enhanced Raman spectroscopy (SERS), the ZnO@Ag surface was prepared to probe methyl red molecules. Based on the combination of density functional theory (DFT) calculations, SERS spectra under different excitation wavelengths (532 and 785 nm), the SERS mechanism of ZnO@Ag surface versus Ag surface on monitoring MR has been clarified. Thereby, using 532 nm laser excitation, the formation of a synergistic effect on the interface layer mainly resulted in an enhancement of electromagnetic contribution on ZnO@Ag surface. On the contrary, the charge transfer mechanism plays an essential role on the Ag surface. These results have been advocated by estimating each mechanism's contribution using selection and simple selection rules.

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PI-24

TEMPERATURE DEPENDENCE OF THE MASS DIFFUSION FOR H_2O DILUTED IN N_2 USING THE CLASSICAL MOLECULAR DYNAMIC SIMULATION

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Abstract.

Accurate knowledge of the mass diffusion coefficients (D) of water vapor in Nitrogen has important role for atmospheric remote sensing application. In this work, the auto-correlation function of center of mass velocity has been used to predict the mass diffusion of water diluted in nitrogen using the Classical Molecular Dynamics Simulations (CMDS). The calculations have been performed at three various temperatures (296 K, 350 K and 400 K) for six mixtures of H_2O in N_2, with 5%; 10%; 15%; 20%; 25% and 30% of H_2O. All calculations have been performed using a site-site potential for a large number of molecules (10^7 molecules). The time decay of the auto-correlation function has been used to predict the mass diffusion coefficient. The comparison between the CMDS results and experimental one shows a good agreement.

Keywords: *water vapor, temperature dependence, the mass diffusion coefficient.*

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PI-25

SPATIAL DISTRIBUTION OF SIGNALS OF RANGE-GATED VIEWING SYSTEM AT DIFFERENT ILLUMINATION ANGLES

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Abstract.

To find optimal observation conditions, one needs to know the spatial-energy profile (SEP) of signals of range-gated viewing system (RGVS). SEP is the dependence of the recorded energy of the reflected pulse on the distance at a fixed delay time. The reflected pulse energy is proportional to the illumination of the reflecting object. In the absence of atmospheric attenuation there are two reasons for the illumination changes with the distance: the divergence of the illuminating radiation and the incident angle changing. In the known experiments on the registration of SEP, a panel installed at different distances and oriented perpendicular to the optical axis of the RGVS is using as a diffuse reflector. The orientation of the reflecting surface relative to the direction of the incident radiation remains unchanged with the distance and the illumination of the reflecting object changes only because of the divergence of the illuminating radiation. Another situation takes place when the underlying surface is illuminated obliquely with the help of an elevated RGVS installed, for example, on a vehicle. The elements of the underlying surface located at different distances from the illumination source have different orientations relative to the direction of the incident radiation. This circumstance affects their illumination and the shape of SEP signals. For the first time, the effect of the illumination angle on the SEP in diffuse reflection from a homogeneous underlying surface was considered in [1,2]. In this paper, we focus on comparative analysis of these two cases when the illumination angles depend and do not depend on the range. An analytical approach to the problem was used. The position of the signal maximum was found depending on the delay distance (on the registration delay time multiplied by half the speed of light) at arbitrary ratios between pulse and gate durations. It has been shown that there are three delay distance intervals for these two cases, where the position of the SEP maximum obeys different laws. The first interval is characterized by delay distances less than half the pulse length. In this case, the largest value of the recorded energy is located directly in front of the device, regardless of the delay distance value. The first interval is followed by an intermediate interval, where the coordinate of signal maximum increases noticeably faster than the delay distance. At long delay distances (at the third interval) the maximum signal position coincides with the delay distance up to the constant. The main difference between the two considered cases takes place in the intermediate interval.

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PI-26

NGHIÊN CỨU, XÂY DỰNG HỆ ĐO CÁC THÔNG SỐ QUANG HỌC LỐI RA CỦA LASER DIODE BƠM VÀ LASER SỢI QUANG CÔNG SUẤT 1KW

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Tóm tắt.

Đo kiểm, đánh giá chất lượng nguồn laser diode (LD) công suất cao sử dụng bơm quang học cho laser sợi quang công suất cao là rất cần thiết. Độ ổn định cường độ laser tương đối của nguồn bơm (LD) là một tham số ảnh hưởng trực tiếp đến chất lượng laser sợi quang lối ra cần phải được đo định kỳ. Nghiên cứu này trình bày một hệ đo các thông số quang học lối ra của laser diode bơm có độ nhạy cao sử dụng cảm biến quang điện được kiểm soát nhiệt độ chính xác và bộ phân tích tín hiệu điện ESA. Giá trị đo thông số quang học của laser diode bơm được kiểm chứng với thông số quang học của laser sợi quang công suất 1 KW. Kết quả thực nghiệm việc đo thông số quang học lối ra của laser diode bơm làm cơ sở nâng cao chất lượng nguồn bơm quang học cho laser sợi công suất cao.

Từ khóa*: Relative laser Intensity Noise, PID controller, fiber laser.*

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PI-27

COMPARISON OF DISPERSION CHARACTERISTICS OF CIRCULAR AND SQUARE PHOTONIC CRYSTAL FIBER WITH CORE-FILLED CS_2

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Abstract.

In this paper, we compare the dispersion characteristics of pured silica PCF, hollow-core permeable Carbon disulfide (CS_2) circular lattice with hollow core PCF permeable Carbon disulfide square lattice with the variation of air-hole diameter in the first ring near the core, the fill factor of the first round d_1/Λ varies from 0.3 to 0.85 for lattice constants (Λ) 1.0 μm; 1.5 μm; 1.8 μm and 2.0 μm. On the basis of the analysis of simulated results, we compare dispersion graphs of two types of PCF, thereby proposing two optimal structures for each type of network. For circular network PCF: ≠ CF_1 (Λ = 1,0 μm; d_1/Λ = 0,65); ≠ CF_2 (Λ = 1,5 μm; d_1/Λ = 0,3) and PCF square network: ≠ SF_1 (Λ = 1,0 μm; d_1/Λ = 0,8); ≠ SF_2 (Λ = 1,5 μm; d_1/Λ = 0,3). The dispersion value of ≠CF_1 fiber (Λ = 1.0 μm; d1/Λ = 0.65) at 1.25 μm pump wavelength is -1.20 ps/nm/km, of ≠ SF_1 fiber (Λ = 1.0 μm; d1/Λ = 0.8) at 1.30 μm pump wavelength equals -16.87 ps/nm/km. The #CF_2 and #SF_2 structures both have anomalous dispersion and intersect the zero dispersion line at one point, where the #SF_2 structure has lower dispersion. Obviously, we see the same CS_2 permeation, but the optimal fiber dispersion value of circular network PCF is superior to square lattice PCF. This is a very important factor for the application of super continuous transmission in the near-infrared region of PCF.

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PI-28

COMPARISON OF EFFECTIVE MODE AREA AND NONLINEAR COEFFICIENT CHARACTERISTICS OF CIRCULAR AND RECTANGULAR PHOTONIC CRYSTAL FIBER WITH HOLLOW-CORE INFILTRATED CARBON DISULFIDE

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Abstract.

In this paper, we simulate and compared the effective mode area and the nonlinear coefficient of circular and rectangular lattices photonic crystal fibers (PCFs) structures when infiltrating carbon disulfide (CS_2). By changing the lattice constant Λ = 1.0 μm; 1.5 μm; 1.8 μm, and 2.0 μm with the filling factor d_1/Λ from 0.3 to 0.8 to change the core diameter D_c ($D_c = 2\Lambda - 1.2d_1$, there d_1 is the first ring diameter), we have selected 02 structures of the circular lattice of fibers #CF_1 (Λ = 1.0 μm, d_1/Λ = 0.75, D_c = 1.1 μm), #CF_2 (Λ = 1.0 μm, d_1/Λ = 0.8, D_c = 1.04 μm) and 02 structures of the rectangular lattice of fibers # F_1 (Λ = 1.0 μm, d_1/Λ = 0.75, D_c = 1.1 μm), and #RF_2 (Λ = 1.0 μm, d_1/Λ = 0.8, D_c = 1.04 μm). When comparing the effective mode area and nonlinear coefficient of these optimal structures, we found that at the same structural parameters with the same pump wavelength of 1.55 μm, the #CF_1 fiber has an effective mode area smaller by 0.137 μm^2 and the nonlinear coefficient is higher by 5170 $W^{-1}.km^{-1}$ than the #RF_1; these results correspond to 0.138 μm^2 and 2820 $W^{-1}.km^{-1}$ when comparing two fibers #CF_2 and #RF_2. From this, we show that when CS_2 is infiltrated into the core, we have found the optimal PCF fibers with a small effective mode area and high nonlinear coefficient there the circular lattices are more optimal than the rectangular lattices. The structures we propose are very suitable for the study of supercontinuum generation in the near-infrared region.

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PI-29

FABRICATION OF ALUMINUM-DOPED ZINC OXIDE THIN FILMS WITH SILVER NANOPARTICLES SERS SUBSTRATES TO DETECT RHODAMINE 6G

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Abstract.

In this paper, Zinc Oxide (ZnO) thin films were produced by a simple and low-cost sol-gel dip-coating method. The films were dip-coated and heated at 250 ^{o}C for 45 minutes. The deposition process was repeated from 1 to 6 times to obtain ZnO films with various thicknesses. Following that, ZnO films were annealed at 500 ^{o}C in different duration (30 mins, 90 mins, 120 mins, and 150 mins). The effect of different film thicknesses and annealing time on surface morphology, structure, and optical properties of ZnO thin films were investigated by scanning electron microscopy (SEM), Raman spectroscopy, and ultraviolet-visible spectroscopy (UV-Vis). The results indicated that the films with 6 layers and annealed in 120 mins showed the best behavior in crystallinity and surface roughness. Ultimately, The Aluminum doped zinc oxide (ZnO:Al) thin films were fabricated with dopant concentrations varied from 1.0 wt.% to 2.5wt.%. Finally, silver nanoparticles were deposited onto the surface to make the SERS substrate by sputtering to detect Rhodamine (R6G). According to the Raman signal, with a concentration of 2.0 wt.%, the sample exhibited the highest SERS enhancement factor (EF) of more than 10^6 for R6G.

PI-30

FLUOROALUMINATE GLASSES WITH LOW $Ba(PO_3)_2$ CONTENT: PROMISING MATERIAL FOR PHOSPHORS AND THERMOMETRY

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Abstract.

As fluoride crystals doped with RE^{3+} ions [1], fluoride glasses are good up-conversion (UC) materials due to lower phonon energy compared with those of the oxide hosts, which contribute to a reduction in the non-radiative loss by multi-phonon relaxation. The addition of some mol.% $Ba(PO_3)_2$ to fluoroaluminate glass appreciably increases its resistance to crystallization, which simplifies the glass technology [2]. Spectral and luminescent properties these glasses are close to fluoride one [3]. It is shown such glasses with Er^{3+}/Yb^{3+} ions are the promising materials for optical temperature sensors owing to their high thermal sensitivity of (27 - 43) × 10^{-4} K^{-1} in 300 - 700 K [4, 5]. We report the experimental research of UC properties of such glasses in dependence on Er^{3+} and Yb^{3+} ions concentration aimed at their applications as indicators and temperature sensitive elements for distributed optical thermometer without intermediate amplification. Decrease of Er^{3+} ions content in glass results in change of light color (yellow-blue) (fig. 1) due to different UC processes. Increase of pump power and duration of excitation is followed by variation of UC luminescence spectra (Fig. 2) due to glass heating. Conditions of UC excitation without heating are chosen for each Yb^{3+} concentration in them (Table).
Investigations are partly supported by projects BRFFR № F22-036 and № F22V-008.

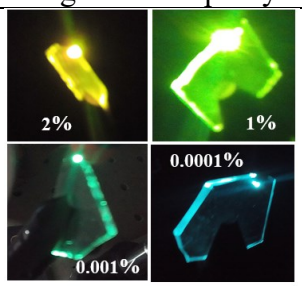

Fig. 1. *Phosphors color at various ErF_3 content.*

$C_{Er/Yb}$, mol%	P, kW/cm^2	t_{acc}, ms	T_{exc}, s
0.1/10	0.85	10	600
0.1/8	1	20	600
0.1/5	1.4	50	600
0.1/4	1.4	50	600
0.1/2	1	100	600

Table 1. *Conditions of UC excitation by 975 nm diode laser.*

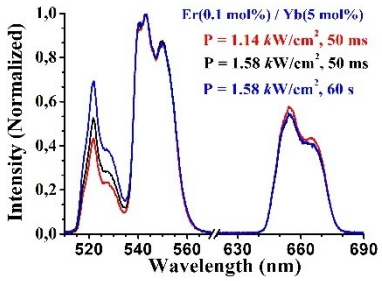

Fig. 2. *UC spectra of 0.1Er/5Yb glass at sundry conditions of excitation.*

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PI-31

COOPERATIVE ENERGY TRANSFER AS A PROBE OF Yb-Yb* CLUSTERS IN RE^{3+}-Yb^{3+} DOPED FLUOROALUMINATE GLASSES WITH LOW PHOSPHATE CONTENT

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Abstract.

Yb^{3+} ions are an efficient sensitizer for other Re^{3+} ions due to unique $^4f_{13}$ configuration with two manifolds ($^2F_{5/2}$, $^2F_{7/2}$) and their relatively large absorption cross-section at 980 nm [1, 2]. In Yb^{3+} doped mediums can appear Yb-Yb* clusters (dimers), when distances between neighboring Yb^{3+} ions is short (3 - 4 Å). The excited clusters can emit the green up-conversion (UC) luminescence, called cooperative luminescence (CL), and can intensify the UC luminescence process by cooperative energy transfer (CET) (Fig. 1). Both CL and CET represent the processes of simultaneous depopulation of two excited Yb^{3+} ions, emitting as one photon with doubled energy or transferring of doubled energy to Re^{3+} ions [3]. These processes are proposed as a sign of Yb-Yb* clusters formation [2, 3]. We report experimental study of UC luminescence in fluoroaluminophosphate glasses with content of YbF_3 from 0.5 to 10 mol%, as well as Tm^{3+} and Er^{3+} ions in the 10^{-2} - 10^{-5} mol% range. It is shown, that observation of a weak CL (Fig. 2) and a high UC intensity of Tm^{3+} ions impurities (Fig. 3) is associated with excited Yb-Yb* dimers existing in glass. The values of the n-parameter of UC luminescence at 475 nm ($^1G_4$), being approximately equals to 2 at an increase in the pump power density (Fig. 3), point to CET process from clusters to Tm^{3+} ions impurities.

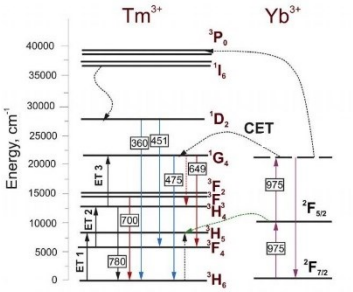

Fig. 1. *Energy transfer diagram from Yb^{3+} to Tm^{3+} ions'.*

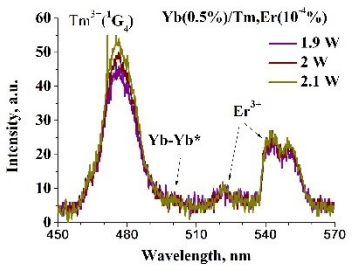

Fig. 2. *UC spectrum of Tm^{3+} and Er^{3+} impurities with weak clusters CL.*

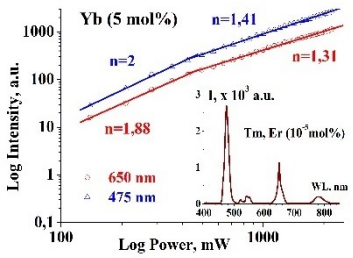

Fig. 3. *Log-Log dependence of UC intensity on pump power. Insert 1 UC spectrum at 1.2 W pumping.*

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PI-32

INVESTIGATION OF C_{60} FULLERENE SOLUTIONS IN THE TOLUENE–XYLENE SOLVENT SYSTEM

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Abstract.

Presently, solutions of carbon nanoparticles, in particular fullerenes C_n (n=60, 70,…), have increasingly attracting the attention of physicists and chemists as natural models of self-organizing systems. The ability to control self-organizing systems by controlling the type and number of used solvents, solute concentration and external conditions (ambient temperature, solution preparation method, etc.) were shown in the works of Makhmanov et al [1] and Nagorna et al [2]. The aim of this work is to experimentally study the optical, dimensional, structural and refractive properties of fullerene C_{60} (purity ≥ 99.8%, Sigma Aldrich, USA) in binary mixtures of solvents "hexane+toluene" at room temperature (T≈24 °C). The main features of intermolecular interactions of fullerene C_{60} in binary mixtures of solvents "hexane+toluene" at various concentrations of the components were studied by refractometry, UV-visible spectroscopy, electron microscopy, and dynamic light scattering (DLS). Experiments on measuring the exact values of the refractive indices (n) of the hexane/toluene and C_{60}/hexane/toluene systems at various solvent concentrations (0 ÷ 1.0 mole fraction) were carried out at the wavelength of the D_1 line of the sodium atom (~589.3 nm). It was found that with an increase in the concentration of fullerene C_{60} and the volume fraction of toluene in a solution of C_{60}/hexane/toluene, the values of the refractive index of the solution increase. This is due to the fact that an increase in the number of bonds formed between the molecules "C_{60}-C_{60}" and "C_{60}-solvents" causes more interactions with photons and leads to an increase in the refractive index of the medium. The experimental results presented in this work are important for the controlled synthesis of various C_{60} nanostructures in one- and two-component solvents, as well as for evaluating the composition of dispersed solutions.

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PI-33

ROLE OF THE CHARGE OF ANALYTE MOLECULES ADSORBED ON THE HYDROXYAPATITE/SILVER NANOPARTICLES ON THE SERS SIGNAL KINETICS

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Abstract.

Surface-enhanced Raman scattering (SERS) has potential application in various fields such as chemistry, biology, medical diagnostics, environmental monitoring, and food testing due to its high sensitivity. Advance in the SERS efficiency through modifications of plasmonic surface improving the hot spot regions and uniformity resulting in stable Raman signal is primary for the widespread realization and practical applications of the SERS methods.

Recently, we reported the fabrication and study of composite nanostructures consisting of hydroxyapatite (HA) grains decorated with silver nanoparticles (AgNPs) [1]. The plasmonic films based on this nanocomposite exhibited high SERS activity. Of interest is the unusual effect of a significant increase in signal intensity during recording of the SERS spectrum, which was observed for cationic CuTMpyP4 adsorbed on the surface of HA/AgNPs nanocomposite. The nature of this effect has not yet been elucidated.

In the present work, we studied the evolution of SERS signal enhancement with HA/AgNPs as a function of the time of spectrum registration for analytes with different charge. Nanocomposite HA/AgNPs were synthesized using glucose as a reducing agent. Furthermore, bare AgNPs were used for comparison. The analytes were cationic and anionic porphyrins CuTMpyP4 and CuTSPP4, as well as Rh 6G, having a charge of 4+, 4-, and 1+, respectively.

For these compounds, the kinetics of changes of the integrated intensity of their SERS spectra during acquisition by different excitation powers were measured and analyzed. It has been established that the effect of an increase in the intensity of the SERS signal is observed for both positively and negatively charged compounds. However, the magnitude of intensity growth for each analyte is different, and its maximum depends on the excitation power. An explanation is proposed for the different amplification efficiencies of the SERS signal of differently charged analytes on the surface of the HA/AgNPs nanocomposite.

This work was supported in parts by the Belarusian State Research Program ”Photonics and electronics for innovations” (task № 1.4.01), the Belarusian Foundation for Fundamental Research (grant № F22UZB-012), and the Czech Science Foundation (18-10897S).

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PI-34

LIGHT-ACTIVATED MEDICINAL PLANTS EXTRACTS: A GREEN APPROACH TO ANTIMICROBIAL PHOTODYNAMIC THERAPY

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Abstract.

Our study was aimed to assess the photophysical and photodynamic properties of some medicinal plants extracts as photosensitizers for antimicrobial photodynamic therapy (APDT). The following medicinal plants extracts were studied: extract from a mixture of flowers of *Matricaria chamomilla* and *Calendula officinalis*, *Achilléa millefólium* herb (commercial name "Rotatit"); extract from *Hypéricum perforátum* herb; extract from *Eucalypti viminalis folia*. The composition of extracts was analyzed using absorbance and fluorescence spectroscopy. Generation of singlet oxygen upon photoexcitation of extracts was directly detected by measurement of its luminescence in the region of 1270 nm. The effects of photodynamic inactivation on Gram-negative (*P. aeruginosa* ATCC 15442) and Gram-positive (*S. aureus* ATCC 6538) bacteria as well as on polymicrobial consortium composed of mentioned bacteria in the presence of extracts were examined by colony-forming units (CFU) assay. Using absorbance and fluorescence spectroscopy, the active compounds of chlorophyll and hypericin nature with characteristic peaks in absorption and fluorescence spectra were identified in the extracts. Excitation of extracts with light correspondent to their absorption spectra induced generation of singlet oxygen. Quantum yields of singlet oxygen generation under excitation of extracts with light of λ = 665 nm are 0.64 ("Rotatit"), 0.48 (*Eucalypti viminalis foli*a), 0.40 (*Hypéricum perforátum*). All bacterial species were susceptible to the medicinal plants extract-induced APDT. Photosensitization using extract from *Hypéricum perforátum* herb and 405 nm light at irradiance of 100 mW/cm^2 and exposure time of 5 min was able to completely reduce the viable colonies of *P. aeruginosa* cells while application of other wavelengths (590 nm and 660 nm) with the same extract and parameters of optical radiation gave about 2 log CFU reduction. We suppose that higher efficacy upon excitation with blue light deals with the mechanisms involving excitation both of endogenous and exogenous photosensitizers [1]. Eradication of Gram-positive bacteria, pretreated with extracts, upon exposure to light with mentioned wavelengths (405, 590 and 660 nm) was also reached. In case of polymicrobial consortium (*P. aeruginosa* + *S. aureus)*, the different sensitivity of two types of bacterial species to the combined treatment of light and extract was demonstrated.

We believe that major mechanism of photodynamic inactivation of bacteria involves generation of singlet oxygen. This work was financially supported by Belarusian Republican Foundation for Fundamental Research, Project F21VTNG-001 (Ф21ВТНГ-001) and by the Ministry of Science and Technology of Vietnam, Project Grant Number NĐT/BY/22/03.

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PI-35

THIẾT KẾ HỆ QUANG SỬA DẠNG CHÙM RA LASER BÁN DẪN TIẾT DIỆN LỚN (BALs)

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Tóm tắt.

Laser bán dẫn tiết diện lớn (BALs) có chùm ra dạng ellip và thường được sửa thành dạng tròn gần đúng Gauss với độ loạn thị thấp và chuẩn trực tốt để ứng dụng trong đo lường quang học ở khoảng cách lớn. Báo cáo này trình bày thiết kế một hệ quang sửa dạng chùm ra của một BAL (λ_o=1550 nm) sử dụng 4 thấu kính biến trường dạng hình trụ làm từ vật liệu N-SF5, đường kính các thấu kính 6 mm, đường kính đồng tử vào 4 mm trên cả hai mặt phẳng XZ (NA_{XZ} = 0.19) và YZ (NA_{YZ} = 0.32), chiều dài toàn hệ là 18,8 mm. Hệ quang được thiết kế ngược và tối ưu trên ZEMAX có các thông số phù hợp với yêu cầu.

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PI-36
APPLICATION OF NIR SPECTROSCOPY, PRINCIPAL COMPONENT ANALYSIS AND CLASSIFICATION TREES FOR PLASTIC SORTING

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Abstract.

At the moment, the problem of recycling plastic is acute in the world. Unrecycled plastic turns into a toxic and dangerous microplastic. It is already found in water, food and World Ocean. Only about 15 % of plastic is recycled, which is associated with difficulties in sorting. The most commonly used characteristics for polymer waste sorting are melting point, density and chemical properties, but they do not allow for unambiguous classification of some polymers and require long-term and expensive procedures.

The purpose of this work is an attempt to improve the quality of classification of plastic waste by preprocessing NIR spectra and using multivariate methods PCA (principal component analysis) [1] and CART (classification and regression trees) [2].

82 transparent and colored samples of various thicknesses of 6 widely spread types of plastic waste have been studies: polyethylene terephthalate (denoted by the abbreviation PET or the number 1), high-density polyethylene (HDPE or 2), low-density polyethylene (LDPE or 4), polypropylene (PP or 5), polystyrene (PS or 6) and the type indicated by the number 7 and combining other types of plastics. The spectra of optical density of samples were measured on the Shimadzu PC–3101 spectrophotometer in the range of 1500 to 3100 nm with an interval of 2 nm, the resolution of the spectrophotometer is 0.1 nm, the slit width was 1 nm.

The spectral data were combined into an 82 by 801 matrix, where 801 is the number of spectral variables. The following methods of spectrum preprocessing were considered: p-norm, infinity norm, scale by standard deviation, scale by median absolute deviation, scale by first element of data and scale by interquartile range. The best results were obtained for the p-norm normalization (p=3) that effectively remove the difference in plastics samples thickness.

Using CART method the dependence of the classification error of plastic types on the dimension of the principal component space was investigated up to ten principal components. The classification error decreases to the fourth component, and then begins to increase. It follows that the optimal number of principal components for classification tree is four.

Thus, it was shown that the 3-norm normalization of the optical density spectra of plastic waste is optimal and allows achieving 87 % classification accuracy with PCA and CART methods. This approach is applicable in practice for improving the sorting of plastics waste for recycling.

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PI-37

MULTIVARIATE CALIBRATION OF CONCENTRATION OF THE MAIN ALLOYING ADDITIVES IN LOW-ALLOY STEELS BY LOW RESOLUTION LASER INDUCED BREAKDOWN SPECTROSCOPY

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Abstract.

Quantitative analysis for determining the concentration of alloying additives and technological impurities are essential for the sorting or classification of steels. Laser induced breakdown spectroscopy (LIBS) method is attractive for this purpose due to the unique possibility of rapid multi-element analysis in the open air and the comparative cheapness of the practical implementation. But today LIBS is still considered as semi-quantitative method [1].

In this paper multivariate models were developed on the base of low-resolution LIBS spectra of reference samples of low-alloy steels for calibration of the concentrations of six chemical elements (C, Mn, Si, Cr, Ni and Cu), which are the main technological and alloying additives. A feature of the model, in contrast to our previous work [2], is the use of preprocessing of LIBS spectra in the form of subtraction of the baseline by the adaptive iteratively reweighted penalized least squares (airPLS) algorithm [3] and normalization of spectra for the intensity of iron emission at a wavelength of 252.0609 nm, as well as the selection of spectral variables using the searching combination moving window interval partial least squares (scmwiPLS) method [4].

From 41 to 57 standard low-alloy steels with unique values of the calibrated concentration were used. The spectra were excited by double pulses of Q-switched Nd:YAG laser. Sequences of 50 spectra were

recorded in the spectral region of 190-440 nm with a resolution of 0.4 nm and a spectrum step of 0.1 nm at 5 points on the surface of the sample. The first 10 spectra used for cleaning the surface. Spectra with integral intensity differed by more than 10 % from the average value in the sequence were removed. The remaining spectra were averaged for each steel sample and the above pretreatment was performed. Root-mean square errors (RMSE) and residual predictive deviations (RPD) of the best calibration models are presented in the table. RPD values exceeding 3 indicate that calibrations are quantitative.

	RMSE for training dataset, %	RPD for training dataset	Consentration for training dataset, %	RMSE for test dataset, %	RPD for test dataset	Consentration for test dataset, %
C	0.05	4.5	0.003-0.750	0.04	4.7	0.029-0.640
Mn	0.02	25.4	0.008-1.97	0.02	24.8	0.106-1.810
Si	0.02	11.1	0.006-1.060	0.01	12.9	0.043-0.790
Cr	0.01	17.0	0.008-0.998	0.01	21.8	0.035-0.940
Ni	0.008	20.9	0.005-0.690	0.007	23.3	0.039-0.600
Cu	0.007	18.8	0.004-0.620	0.006	23.2	0.012-0.460

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PI-38

CLASSIFICATION OF SUGAR TYPES BY UV-VIS-NIR SPECTROSCOPY AND MULTIVARIATE ANALYSIS

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Abstract.

Distinguishing refined beet and cane sugars is difficult, because they contain more than 99 % sucrose. The standard method in Europe for determining the type of sugar is nuclear magnetic resonance relaxometry. It is an expensive and time-consuming method. It is advisable to find a simpler and cheaper method for determining beet and cane sugars or their falsifications.

The purpose of the research work is to build a classification tree [1] for determining the falsifications of beet and cane sugars, based on the application of the principal component analysis (PCA) [2] to UV, visible and near IR spectra of the optical density of 25 % aqueous solutions of 102 samples of sugars from 9 countries. 45 samples present beet sugars and other 57 present cane sugars. The spectra were recorded using a Shimadzu UV-3101PC spectrophotometer in the range from 365 to 1000 nm with an interval of 1 nm and a slit width of 1 nm. Thus, data matrix of sizes 102 by 635 is used for PCA, where 102 is the number of samples, and 635 is the number of spectral variables.

PCA is used here to analyze information, identify outliers, reduce data dimensionality, and find meaningful patterns in low-dimensional data. Instead of the initial set of spectral variables, the data set can be described using the first few principal components without significant data loss. In the case considered we choose up to 10 principal components that explain 99 % of total data variance. The sugar classification error was analyzed using a classification tree depending on the dimension of the principal components space used for the tree constructing. The minimum classification error (less than 2 %) was obtained for 6 principal components.

Thus, UV-VIS-NIR spectroscopy can be considered as a simple, cheap and accurate enough alternative to conventional methods for determining the type of sugars. Optical density spectra of 25 % aqueous solutions of sugars in the range of 365-1000 nm give the opportunity to determine the type of sugar (beet or cane) by the classification tree with an accuracy of 98 %. Optical spectroscopy can replace nuclear magnetic resonance relaxometry in practical purposes of determining the type of sugar.

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PI-39

CALIBRATION OF COCOA AMOUNT IN CHOCOLATE USING MULTIVARIATE METHODS IN THz SPECTROSCOPY

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Abstract.

For the quality analysis, detection of compositions or authentication of food products, much attention is currently paid to non-contact and non-destructive analysis methods. IR radiation cannot penetrate through plastic or paper packaging of a particular product, unlike THz spectroscopy, which is its undoubted advantage. In this work, using THz time domain spectroscopy and methods of multivariate data analysis, chocolate samples were calibrated with different amounts of cocoa.

The chocolate was prepared and tempered in the laboratory, by using different percentages of icing sugar and cocoa with the addition of lecithin. For the experiment, three chocolate sets were obtained for 20 different concentrations from 40% to 97% in 3% increments.

The spectra of chocolate samples 3.0 ± 0.1 mm thick were recorded using custom designed THz spectrometer in the Institute of Physics of the National Academy of Sciences of Belarus in the frequency range < 2 THz, where chocolate is sufficiently transparent. The spectra were calculated using common fast Fourier transform without special correction of the data in the time domain.

The application of the partial least squares (PLS) method [1] to the spectra of chocolate samples, the preprocessing of which consisted of smoothing with a Savitzky–Golay filter [2] with a third order polynomial, showed the following results. Root mean square error of the test datatset RMSE = 2.9% and residual predictive deviation RPD = 5.9, which indicates the stability and quantitative character of the model [3]. Since the manufacturers most often produce chocolate with 5% increments in bitterness amount, the root mean square error of the model found to be acceptable for distinguishing and quantifying the bitterness amount of chocolate on the market.

Thus, the paper shows the possibility of using time domain THz spectroscopy in combination with multivariate methods, as an analytical technique for the identification of food products.

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PI-40

COMPARATIVE EFFICACY OF THE ACCUMULATION OF ENDOGENOUS PORPHIRINS IN CANCER AND NON-TRANSFORMED CELLS AND MECHANISMS OF THEIR SELF-SENSITIZED INACTIVATION

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Abstract.

The aim of this study was to investigate the accumulation of endogenous porphyrins possessing sensitizing properties in cancer cells (C6 rat glioma cells; HeLa cervical epithelioid carcinoma cells) and non-transformed cells (BGM Green African monkey kidney cells) under in vitro conditions. In addition, comparative studies on the efficacy of self-sensitized inactivation of above cells (colorimetric MTT analysis was used) upon exposure to radiation in blue spectral region due to the excitation of endogenous compounds capable of generating reactive oxygen species were performed.

To solve mentioned tasks, spectral-fluorescent methods for the detection and identification of endogenous porphyrins in cells of various types have been developed. The solution of above tasks is complicated by strong light scattering by cells, intense luminescence of endogenous flavins (flavin mononucleotide, flavin adenine dinucleotide), extremely low concentration of tetrapyrroles ($C < 10^{-9}$ M) and relatively low quantum yield of their fluorescence (for protoporphyrin IX in aqueous solution - $\varphi < 0.01$). For this reason, in order to detect endogenous porphyrins, they were extracted with solvents (acetone, 3 M hydrochloric acid), in which porphyrins have a fairly high fluorescence quantum yield ($\varphi \approx 0.10–0.20$), and the flavin luminescence intensity is to some extent quenched. Studies have shown that metal-free porphyrins (protoporphyrin IX, coproporphyrin III, uroporphyrin III) as well as the zinc complex of protoporphyrin IX predominate among fluorescent tetrapyrrolic compounds in cells. It was found that at equal concentration of non-transformed and cancer cells in suspension (their concentration was estimated using a hemocytometer), the concentration of porphyrin photosensitizers in the supernatant of cancer cells is approximately 1.5 times higher.

It has been established that despite the low concentration of above endogenous porphyrins in cells, they are able to sensitize their (cells) inactivation upon exposure to blue light at an energy dose of 3-15 J/cm^2 (LEDs peaking at λ_{max} = 405, 440 and 465 nm were used). It was stated that upon exposure to radiation with a wavelength of λ_{max} = 405 nm and λ_{max} = 440 nm, a dose-dependent decrease in the metabolic activity of cells is observed. Upon exposure to radiation with a wavelength of λ_{max} = 465 nm at relatively low energy doses of D = 4.5 - 7.5 J/cm^2 small but statistically significant ($p < 0,05$) stimulatory effect is observed, which practically does not manifest itself when the dose is increased to D = 15 J/cm^2. At equal energy dose, the maximum inhibitory effect is observed when cells are exposed to radiation with a wavelength of λ_{max} = 405 nm, corresponding to the maximum of the Soret band of porphyrins. However, endogenous flavin photosensitizers can also contribute to the observed biological effects of blue light, which is especially pronounced upon exposure to radiation with a wavelength of λ_{max} = 440 nm, corresponding to the maximum in the absorption spectrum of flavins. It has been shown for the

first time that hydrogen peroxide but not singlet oxygen contributes mainly to the cell inactivation upon exposure to blue light. At the same time, cancer cells accumulating higher concentrations of endogenous porphyrins are also characterized by greater sensitivity to the action of blue light compared to non-transformed cells. Using the flow cytometry and propidium iodide as a fluorescent probe, it was shown that the main role in reducing the metabolic activity of cells upon exposure to blue light is played by the processes of slowing down the duration of the cell cycle, rather than the processes of cell death.

PI-41

MAIN PATTERNS AND METHODS FOR INCREASING THE EFFICACY OF THE ANTIMICROBIAL EFFECT OF BLUE LIGHT

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Abstract.

For a long time, it was believed that only short-wave ultraviolet radiation (200-300 nm), corresponding to the absorption spectrum of DNA, has an antimicrobial effect. However, studies performed in the last decade using appeared intense light sources (superbright LEDs, semiconductor lasers) convincingly indicate the ability of blue light to induce a bactericidal or bacteriostatic effect without adding external exogenous dyes-photosensitizers to irradiated microorganisms.

The studies carried out by us made it possible to find out the main patterns of the antimicrobial effect of blue light and to develop methods for increasing the efficacy of its bactericidal and bacteriostatic action.

It has been established that the exposure of suspensions of microbial cells to laser radiation in the violet and blue spectral regions on s of leads to suppression of the growth of both Gram-positive staphylococci *S. aureus* and Gram-negative *E. coli*, as well as yeast-like fungi *C. albicans*, which differ significantly in the structure of the cell membrane. There was no significant difference in photosensitivity of Gram-negative and Gram-positive bacteria to the radiation of the same wavelength. At the same time, among various cell phenotypes, types with increased resistance to the blue light are found.

It has been established that endogenous metal-free porphyrins and zinc complexes of porphyrins as well as flavin compounds, possessing photosensitizing properties, act as acceptors of optical radiation, determining the antimicrobial effect of this physical factor. The participation of above compounds in the implementation of the antimicrobial effect of laser radiation is evidenced by the registration of porphyrin and flavin fluorescence in extracts of microbial cells upon excitation by radiation used to inactivate pathogens. The contribution of porphyrin photosensitizers is most pronounced when exposed to 405 nm radiation (maximum of the Soret band of porphyrins), and flavin ones, when exposed to 445 nm radiation (maximum in the absorption spectrum of flavins and minimum in the absorption spectrum of porphyrins). The ratio between the intensity of the porphyrin and flavin components in the fluorescence emission spectrum of extracts depends on the type of microbial cells.

A characteristic feature of the action of blue light on microbial cells is an increase in the rate of their photoinactivation with an increase in the dose of the acting radiation. In our opinion, this type of dose dependence can be explained based on the multi-target photoinactivation model, assuming that each cell contains not one, but several sensitive targets important for cell life, and a certain number of these targets must be hit to inactivate the cell. Indeed, upon exposure of microbial cells to radiation of the blue spectral region, there is a violation of the integrity and loss of the most important functional characteristics of cell membranes, the release of DNA into

the extracellular environment, as well as the oxidation of intracellular DNA, depletion of the level of intracellular ATP due to inhibition of ATPase, photodamage of some enzymes, as well as a range of metabolites. When registering the protein fluorescence of the supernatant of microbial cells, a decrease in its intensity is observed as a result of preliminary exposure to blue light. All this testifies in favor of the multi-target model of cellular photoinactivation. The validity of this conclusion is also confirmed by the formation of complexes of endogenous porphyrins with enzyme macromolecules as well as DNA. It has been shown that the efficacy of the method of suppressing the growth of microorganisms upon exposure to laser radiation in the blue spectral region can be significantly enhanced by: a) the use of radiation of two wavelengths addressed to different cellular targets; b) the use of pulsed radiation, characterized by a high amplitude value of the intensity; c) selection of the optimal wavelength corresponding to the effective excitation of various cellular photosensitizers.

PI-42

STRENGTHENING THE ANTIMICROBIAL EFFECT OF NITROFURAN ANTISEPTICS DUE TO THEIR SENSITIZING PROPERTIES

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Abstract.

The development of resistance of pathogenic microflora to the antibacterial and antifungal drugs has become one of the most acute problems of modern medicine. Antimicrobial photodynamic therapy (APDT) is believed to be one of the promising alternative treatments for localized infections (including those caused by drug-resistant pathogens). However, the widespread use of APDT methods is hindered by the lack of available photosensitizers (PS) approved for use in medical practice. At the same time, the development of a technology for obtaining new PSs and their medical certification is a very lengthy, costly, and complex procedure. This prompted us to evaluate the possibility of using drugs approved for use in medical practice, but used for a different purpose, as PS.

This paper shows that nitrofuran preparations, which have been used in medicine as antiseptics and antibiotics for more than 50 years, have pronounced sensitizing properties. Photoexcitation of these drugs (with light corresponding to their absorption spectrum) allows enhance significantly their antimicrobial effect. Studies were performed using a water-soluble form of furacilin (active ingredient nitrofural) and furasol (potassium furazidin). The antimicrobial effect of light was studied against gram-positive staphylococci (*Staphylococcus aureus*; *Staphylococcus haemolyticus*), gram-negative bacteria (*Escherichia coli*), and yeast-like fungi (*Candida albicans*), which have their own anatomical, physiological and biochemical features, including structure of the cell membrane. It has been established that at concentrations of nitrofuran preparations of 0.025 mg/ml, which have a minimal dark cytotoxic effect against the above microorganisms, exposure to light from laser and LED sources with a wavelength of 405 nm at an energy dose of ~120 J/cm^2 induces a pronounced bactericidal effect on all studied microorganisms. Efficient eradication of pathogens is facilitated by their good interaction with PS, specially designed for this purpose. Photoinactivation of microorganisms involves reactive oxygen species, which is confirmed by the registration of the luminescence of singlet oxygen of aqueous solutions of antiseptics (quantum yield $\varphi_\Delta = 0.10$), as well as the registration of the chemiluminescence of microorganisms, pretreated with furacilin or furasol followed by exposure to light with a wavelength of 405 nm. Moreover, the intensity of chemiluminescence of microorganisms sensitized by nitrofurans decreases upon irradiation in the presence of sodium azide, a singlet oxygen quencher. At the same time, radical reactions also make a certain contribution to the photodynamic effect. This is evidenced by an increase in the effect of photoinactivation of cells sensitized by nitrofurans upon their irradiation with sodium azide.

PI-43

TARGETED DELIVERY OF PHYTOCHEMICAL COMPOUNDS AND PACLITAXEL ENCAPSULATED IN THERMOSENSITIVE NANOCARRIERS

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Abstract.

One of the promising and rapidly developing areas of modern pharmacology (as well as in the field of oncology) is the targeted delivery of drugs using various types of nanocarriers. The aim of this study was to develop a method for increasing the efficacy of selective death of cancer cells due to a) targeted delivery of two types of antitumor chemotherapeutic drugs, using the vector component of a nanocarrier (folate), to cells: the well-known anticancer drug Paclitaxel and one of the phytochemical compounds (curcumin, apigenin or quercetin) acting on various molecular targets; b) the ability of antitumor chemotherapeutic drugs to interact synergistically and elimination of the causes preventing an increase in the concentration of Paclitaxel in the cell; c) photodynamic destruction of cancer cells sensitized with antitumor chemotherapeutic drugs upon exposure to radiation corresponding to the absorption band of the drug.

Confocal fluorescence microscopy studies of a suspension of HeLa cancer cells showed the ability of antitumor chemotherapeutic drugs to penetrate through the cell membrane and localize in individual compartments of the cancer cell. In this case, a continuous-wave laser with λ = 457.9 nm was used to excite the fluorescence of curcumin and a femtosecond laser with λ = 745 nm and 770 nm was used to excite the fluorescence of quercetin and apigenin, respectively, for realization of two-quantum excitation. It has been shown that curcumin is predominantly localized in the area of cell membrane; quercetin is distributed throughout the cell and its predominant localization in the area of the cell membrane is not observed; apigenin is selectively localized in individual intracellular organelles, which is confirmed by the bright localized luminescence of individual areas of cells. It has been established that all studied antitumor chemotherapeutic drugs under dark conditions have an inhibitory cytotoxic effect, which manifests itself in a decrease in the metabolic activity of cells (colorimetric MTT test). The most pronounced cytotoxic effect is characterized by Paclitaxel, which provides a twofold decrease in metabolic activity at nanomolar concentrations. When curcumin, quercetin, or apigenin are added to cells, a twofold decrease in the metabolic activity of cells is observed at concentrations of dozens of μM. It has been established that among all studied antitumor chemotherapeutic drugs, only curcumin has a sensitizing effect, capable of initiating photodynamic effects through the type I and II mechanism. Using the luminescent method (registration of phosphorescence in the region of 1270 nm), the quantum yields of singlet oxygen generation in various solvents were determined. At the same time, we were unable to detect the luminescence of singlet oxygen sensitized by curcumin in aqueous media (including D_2O). It has been shown that the use of thermosensitive folate-chitosan-pluronic nanocarriers allows not only to increase the efficacy of singlet oxygen generation by curcumin, but also to

increase the efficacy of targeted delivery of antitumor chemotherapeutic drugs as well as the photodynamic effect on tumor cells.

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PI-44

ANTI-REFLECTED AND ANTI-ICING SURFACE FABRICATED ON TRANSPARENT SUBSTRATE

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Abstract.

In this work, we aim to fabricate the moth eye-mimicking structure on the surface of a transparent substrate to enhance significantly the transmittance and reduce the reflectance of incident light at the interface. The mechanism can be attributed to the unique morphology of the nanostructure. An array of uniform cone shape nanopillars facilitates the penetration of incident light in visible range through the transparent surface owing to the comparison of wavelength and nanostructure size. The such structure might act as the "bulk material" with the gradient of the reflective index increasing from the top to the bottom of the nanostructure layer, hence gradually "bending" the light through the interface instead of abruptly refracting the light. The measurement in transmittance and reflectance illustrates the advantage of mimicking structure. In addition, such a roughness structure proposes extremely high anti-icing performance in terms of adhesion strength and introduces the potential manufacturing for transparent and ice-repellent applications working outdoors.

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PI-45

ANALYSIS OF THE EFFECTIVE MODE AREA CHARACTERISTICS OF SQUARE SOLID-CORE PHOTONIC CRYSTAL FIBERS WITH As_2S_3 SUBSTRATE

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Abstract.

This paper proposes a square lattice solid-core photonic crystal fiber (PCF) with an As_2S_3 substrate. We investigate the influence of structural parameters on the nonlinear properties of photonic crystal fibers based on the finite element method. The analysis results show that the filling factor (d/Λ) and lattice constant (Λ) strongly affect the effective mode area and the nonlinear coefficient of PCF. The PCFs in this work possesses a small effective mode area and high nonlinear coefficient. We compared these results with several previous works and our results open up a good application opportunity for supercontinuum generation.

Keywords: *Photonic crystal fibers (PCFs), square lattice, the effective mode area, nonlinear coefficient.*

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PI-46

COMPARISON OF OPTICAL NONLINEAR PROPERTIES OF SQUARE AND HEXAGONAL LATTICES SOLID-CORE PHOTONIC CRYSTAL FIBER WITH $Ge_{20}Sb_5Se_{75}$ SUBSTRATE

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Abstract.

In this paper, a comparative study is performed on two solid-core photonic crystal fibers (PCFs) with a $Ge_{20}Sb_5Se_{75}$ substrate. These two new photonic crystal fibers are designed using Lumerical Mode Solution software based on the finite element method. In our analysis, the introduced structure is a novel structure of 8 air-hole rings arranged in square and hexagonal lattices. Furthermore, the difference between the air-hole diameter in the first ring compared with the remaining rings are a new feature of our work. The change of the structure parameters including the filling factor and the lattice constant affects the nonlinear coefficient value of PCF. With the same structure parameters, PCF with hexagonal lattice has a higher nonlinear coefficient value than square lattice PCF. Our results are very important in fiber optic technology development, particularly for supercontinuum generation applications.

Keywords: *Photonic crystal fibers (PCFs), high nonlinear coefficient, square lattice, hexagonal lattices.*

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PI-47

COMPARISON OF DISPERSION CHARACTERISTICS OF SOLID-CORE PHOTONIC CRYSTAL FIBERS WITH As_2S_3 AND $Ge_{20}Sb_5Se_{75}$ SUBSTRATES FOR SUPERCONTINUUM GENERATION

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Abstract.

In this work, we present two new solid-core photonic crystal fibers (PCFs) structures with As_2S_3 and $Ge_{20}Sb_5Se_{75}$ substrates, and the cladding consists of eight rings of air-holes arranged in a circular lattice. We analyze and compare the dispersion characteristics of the two structures with the change of lattice constant (Λ) and filling factor (d_1/Λ) in the first lattice ring. The PCF structures obtained dispersion characteristics diverse including all-normal dispersion and anomalous dispersion with 1 or 2 zero-dispersion wavelengths (ZDW). Flat dispersion and closeness to the zero-dispersion curve in the long wavelength range are the advantages of these structures. The circular lattice PCF structure with the As_2S_3 substrate possesses flat dispersion and is closer to the zero-dispersion curve than the structure with the $Ge_{20}Sb_5Se_{75}$ substrate. On the basis of analysis and comparison, we have proposed structures with optimal dispersion and pump wavelength suitable for supercontinuum generation with a wide, flat, and smooth spectrum.

Keywords: *Photonic crystal fibers (PCFs), dispersion, all-normal dispersion, anomalous dispersion, circular lattice.*

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PI-48

SIMULATION OF THE LENS INFLUENCE ON OPTICAL INTENSITY DISTRIBUTION FOR DESIGNING FIBER-COUPLED DIODE LASER

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Abstract.

In phototherapy, the inhomogeneous distribution of optical radiation emitting from fiber-coupled diode laser directly affects the therapeutic efficiency. Therefore, it is necessary to have a specific solution to redistribute the output radiation of the laser sources during the designing and realizing process. In this report, we present the simulation results of the influence of lens position, refractive index and laser wavelength on output optical radiation distribution. These results can provide an orientation to optimize the design and configuration of fiber-coupled laser devices.

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PI-49

OPTICAL PROPERTIES OF THE DOPED-GRAPHENE QUANTUM DOTS AND THEIR APPLICATION PROSPECTS

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Abstract.

Graphene quantum dots (GQDs) are currently attracting a great deal of research attention, due to their potential practical applications in various fields such as energy devices, sensing, photodynamic and photothermal therapy, drug delivery, and bioimaging [1], especially in biotechnology and photocatalysis. Up to now, the development of environmental-friendly and scalable preparation approaches is the primary problem of GQDs research. In this work, we will present comparative research results on optical properties of GQDs, quantum dots doped with different elements such as sulfur (S-GQDs), nitrogen (N-GQDs) and co-doping (S,N-GQDs), which are prepared by an environmentally friendly method, are hydrothermal combined with microwaves. Effects of different doped atoms on GQDs crystal lattice, doping concentration, hydrothermal environment on optical properties and quantum yield of the fabricated doped-GQDs samples also presented, along with some potential applications of doped-GQDs will also be presented in this report.

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PI-50

PHOTOTHERMAL PROPERTIES OF NANOFLUID CONTAINING METALLIC NANOPARTICLES DECORATED GRAPHENE OXIDE DIRECTLY PREPARED BY SOLUTION PLASMA EXFOLIATION TECHNIQUE

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Abstract.

Because of the high stability qualities, optical absorption properties, thermophysical properties, and excellent photothermal conversion efficiency of GO-based nanofluid have recently received a lot of attention from the scientific community. We report in this work an investigation about the preparation and photothermal properties of nanofluids including GO-metal nanoparticle hybrid material that was carried out using the solution plasma method. Characterization of the prepared samples was carried out using a variety of methods, including X-ray diffraction (XRD), scanning electron microscopy (SEM), atomic force microscopy (AFM), and Raman scattering and emission spectroscopy, among others (OES). The results that were obtained indicate that graphene has an average diameter of 1.5 microns and a thickness of around 3.5 nanometers for 8 to 11 layers. According to the results, AgNP have a diameter of around 16.5 nm on average and are securely attached to the surface of the GO. The nanofluid containing GO/AgNP hybrid material exhibits a high thermal conductivity that is noticeably higher than that of the nanofluid containing the GO material and base fluid. Especially compared to based fluid, the photothermal conversion efficiency of nanofluid shown a significant improvement.

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PI-51

NGHIÊN CỨU PHÁT TRIỂN THIẾT BỊ LASER ĐIỀU TRỊ DỰA TRÊN CÔNG NGHỆ FRACTIONAL RF-CO_2

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Tóm tắt.

Trong lĩnh vực laser y tế, laser CO_2 là một trong những loại laser được sử dụng rộng rãi nhất hiện nay. Laser CO_2 thường được sử dụng dựa trên các chế độ phát bức xạ chùm tia. Có 04 chế độ phát laser thông dụng hiện nay là chế độ phát liên tục CW (Continuous Wave), chế độ phát bình thường (phát chuỗi xung vuông), chế độ phát Quasi-CW, chế độ phát siêu xung. Dựa trên công nghệ chế tạo, người ta thường phân chia laser CO_2 thành 02 loại laser gồm DC-CO_2 laser được kích thích bằng nguồn cao áp DC trên 10 kV, thậm trí đến 20 kV và RF-CO_2 laser được kích thích bằng sóng vô tuyến RF (Radio Frequency). So với DC-CO_2 laser, RF-CO_2 laser có ưu điểm nổi bật là cho phép tạo xung nhanh nên rất hữu ích trong việc điều khiển gia nhiệt trong điều trị và có thể tạo được các siêu xung UltraPulses cỡ µs. Hơn nữa, khi được kết hợp với công nghệ Fractional, RF-CO_2 laser dễ dàng tạo được các ma trận vi điểm điều trị nhiệt MTZs (microtreatment zones of thermolysis), tại đó năng lượng của chùm tia laser được hội tụ thành các hình trụ nhỏ, xuyên vào bề mặt da từ 400 đến 1.200 µm. Việc kết hợp 02 công nghệ RF-CO_2 và Frational đang là xu hướng hiện nay trên thế giới. Công nghệ Fractional RF CO_2 được xem là công nghệ mới hứa hẹn nhất trong điều trị thẩm mỹ hiện nay. Tại Việt Nam, các thiết bị laser điều trị dựa trên công nghệ Fractional RF-CO_2 chủ yếu được nhập khẩu. Việc nghiên cứu và phát triển mới chỉ ở bước đầu.

Bài báo này trình bày việc nghiên cứu phát triển một thiết bị laser điều trị dựa trên công nghệ Fractional RF-CO_2. Kết quả thu được cho thấy thiết bị hoạt động tốt với thời gian phát xung trong dải 100 – 5000 µs; Chu kỳ lặp lại xung trong dải 0,2- 2,0 giây; Diện tích vùng điều trị: tối thiểu 1 x 1 mm, tối đa 20 x 20 mm; tần số sóng RF kích thích trong dải 10 – 100 MHz.

Từ khóa: *RF-CO_2.laser, Fractional technology.*

PI-52

A COMPACT LONG PATH DIFFERENTIAL OPTICAL ABSORPTION SPECTROSCOPY INSTRUMENT FOR CONTINUOUSLY MONITORING GASEOUS POLLUTANTS SO_2, O_3 AND NO_2

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Abstract.
Optical absorption spectroscopy offers the possibility to simultaneously detect the presence and accurately measure the concentration of trace gases in the atmosphere. In this paper we present the development of a long path (active) differential optical absorption spectroscopy instrument in the wavelength range 200 – 380 nm, allowing the detection of gaseous pollutants of interest SO_2, O_3 and NO_2. The instrument uses 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 distance of 1.4 km away and to collect the back reflected light beam. A highly sensitive portable spectrometer is used to measure the spectrum of the returned light beam. Data analysis of the measured spectra allows us to simultaneously determine the column density of molecules SO_2, O_3 and NO_2. Because the optical path length of the setup is known to be 2.8 km both way, we can convert directly the column density to the concentration of trace gases. The sensitivity of our instrument allows detection with ppb sensitivity with a time resolution of less than 2 minutes. We present some initial measurements and comparison with that obtained by monitoring instruments and discuss the variations of SO_2, O_3 and NO_2.

PI-53

THE SENSITIVE DETECTION OF NITRIC OXIDE ADDRESSING ITS STRONG ELECTRONIC BAND BY FARADAY MODULATION SPECTROSCOPY

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Abstract.

Nitric oxide (NO) has been detected by Faraday Modulation Spectrometry (FAMOS) addressing the strong electronic $X^2\Pi(v''=0)-A^2\Sigma^+(v'=0)$ band by a fully-diode-laser-based (DLB) laser system producing mW powers of ultraviolet (UV) light was used to target the overlapping $Q_{22}(21/2)$ and ${}^{Q}R_{12}(21/2)$ transitions at ~226.6 nm. The work verifies a new two-transition model of FAMOS addressing electronic transitions in NO given in an accompanying work. Although the experimental instrumentation could not address all the parameter space of the theory, including its optimum conditions, the line shapes and the pressure dependence could be verified under low-field conditions. With the present instrumentation, NO could be detected down to a partial pressure of 13 μTorr, roughly corresponding to 10 ppb·m for an atmospheric pressure sample, the experiments could demonstrate the feasibility of FAMOS for detection of NO on its strong electronic band by a DLB laser system.

Keywords: *Faraday Modulation Spectrometry (FAMOS), Magnetic Rotation Spectrometry (MRS), Nitric Oxide (NO).*

PI-54

HYBRID Q-SWITCHED LASER Nd:YVO_4 WITH A Cr:YAG SATURABLE ABSORBER AND AN ACOUSTO-OPTIC MODULATOR

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Abstract.

In this work, we study a combined passively and actively Q-switched laser Nd:YVO_4 with a Cr:YAG saturable absorber and an acousto-optic modulator (AOM). Our laser system included a passively Q-switched with a Cr:YAG saturable absorber and an actively Q-switched with an AOM at a repetition rate of 1 KHz, and the incident pump power of 40 W was used. Firstly, the laser is excited using the passively Q-switch and we got a maximum peak power of 0.1 KW with the pulse duration of 200 ns at a repetition rate of 250 KHz. Otherwise, as using the actively Q-switch, the received maximum peak power was 763 KW with the pulse duration of 16 ns. Then, by using a hybrid Q-switched with a Cr:YAG and an AOM, the maximum peak power of 1.18 MW with the minimum pulse duration of 8 ns was obtained. In conclusion, by combining Q-Switch with a Cr:YAG saturable absorber and an acousto-optic modulator, the laser system with high peak power was successfully achieved. Our research gives a direction for the development of compact laser technology in the future.

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PI-55

REDUCING THE REPETITION RATE OF MODE-LOCKED LASER WITH A PULSE PICKER USING ACOUSTO-OPTIC MODULATOR

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Abstract.

We introduce and experimentally validate a pulse picking technique based on a traveling-wave-type acousto-optic modulator (AOM) having the AOM carrier frequency synchronized to the repetition rate of the original pulse train. Consequently, from a train of short laser pulses emitted at a pulse repetition rate of 80 MHz by a pico-second mode-locked Nd:YVO_4 laser, we have successfully selected single laser pulses of 10 picoseconds at 1064 nm and a repetition rate of the order up to 40 MHz. This pulse picker has been designed to give the highest possible time of about 10 nanoseconds and select single laser pulses from a train of short laser pulses at a pulse repetition rate of up to 200 MHz. The short laser pulse selector has been successfully used for providing single short laser pulses in a short-pulse amplifier in the future.

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PI-56

SURFACE LATTICE RESONANCE AND BOUND STATE IN THE CONTINUUM IN METASURFACE

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Abstract.

Surface lattice resonances (SLRs) and Bound states in the continuum (BICs) are wave phenomena that emerge from proper structures of two-dimensional plasmonic or dielectric periodic metasurfaces. SLRs have received significant interest due to their profound applications in sensing and strong light-matter coupling. Meanwhile, BICs are considerably owing to their unique capability of confining light within the structures. We show, in this poster, our recent works on BICs in metasurfaces, exciton-polaritons with perovskite and organic molecules. We utilize finite element solver (Comsol Multiphysics) and rigorous coupled-wave analysis (RCWA). Our works provide useful insight and aid the streamlined design of nanophotonic structures in sensors, optoelectronics, and polaritonic devices.

POSTER II

PII-01

RETRIEVAL OF POLAR MOLECULE ASYMMETRICITY FROM HIGH ORDER HARMONIC GENERATION

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Abstract.

Asymmetricity is an essential property of a polar molecule embedding in many physical phenomena, such as high-order harmonic generation (HHG) when molecules interact with an ultrashort intense laser pulse. Specifically, the HHG spectrum is composed of attosecond bursts in the time domain with the time spacing of a laser half optical cycle. These attosecond bursts for polar molecules are different in phase and intensity, known as the phase difference and intensity ratio, revealing the sub-cycle asymmetricity of the polar molecules. With the advanced orientation technique, a method has been proposed to extract the phase difference between the adjacent attosecond bursts from the measured even-to-odd ratio (the ratio between the intensities of the even and adjacent odd harmonics).

This method opened a new way to access the microscopic features of polar molecules from the macroscopic measurements of HHG. However, besides the measured even-to-odd ratio as a macroscopic quantity, the method suggested also needs the pre-calculating intensity ratio between the adjacent attosecond bursts – another microscopic quantity whose accuracy is strongly governed by the theory level. Therefore, we report a parameter-free method to probe the phase difference and the intensity ratio of adjacent attosecond bursts from experimental measurements of HHG intensity and phases.

Firstly, we prove that the phase difference and intensity ratio are microscopic intrinsic properties of polar molecules, almost insensitive to the external laser parameters. Then, we provide a theoretical base for the method, constructing the time-frequency spectrogram and directly retrieving the amplitude ratio and phase difference between adjacent attosecond bursts. We also develop an analytical formulation for the method to incorporate the partial orientation of a molecular sample. Finally, using the *numerical experimental* HHG data, we check the validation of the method showing high accuracy.

PII-02

EFFECT OF SIZE ON STABILITY AND ANTI-BACTERIAL ACTIVITY OF SILVER NANOPARTICLES

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Abstract.

The stability of silver nanoparticles at average sizes: 10 nm, 30 nm and 70 nm with polyvinylpyrrolidone stabilizer was evaluated in medium high chloride ion concentrations. The antibacterial activity of these silver nanoparticles against marine cholera *Vibrio parahaemolitycus* was studied and compared with Ag^+ ion. The obtained results show that the smaller the silver nanoparticles, the higher the stability. The antibacterial ability of silver nanoparticles shows that the smaller the size, the higher the antibacterial ability and the closer it is to the antibacterial ability of Ag^+ ion. This result shows the outstanding bactericidal ability of small-sized silver nanoparticles and the potential application of this small particle in inhibiting pathogenic bacteria in aquaculture.

PII-03

FREQUENCY ANALYSIS OF AN ALL-SPIN LOGIC CIRCUIT SIMULATION

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Abstract.

Further size reduction and a performance increase of integrated chips is becoming more challenging [1]. In dealing with this, one of the promising potential solutions is spintronics [2]. In one of the varieties of spintronic circuits, all-spin logic (ASL) substitutes the intrinsic spin and magnetic moments of the electrons for the electrical charge as computational states. The study's main objective is to examine the ASL circuit by M. Alawein in Ref. [3] frequency-dependent performance. The simulation for the ASL circuit model compromises the following: (i) stochastic Landau-Lifshitz-Gilbert (sLLG) equation to capture the magnetization dynamics, (ii) spin drift-diffusion equation to describe the spin transport, and (iii) spin modified circuit analysis to formalize a schematic diagram for the ASL circuit. The ASL circuit's ability to act as a logic switch is illustrated as a logic buffer and inverter shown in Figure 1. In analyzing the frequency-dependent performance of the ASL circuit, shown in Figure 2, the operating frequency performance parameter is obtained by applying a linear fit in the decay range. This gives the critical frequency, which is found at f_c=0.3177±0.00006 GHz. This serves as an implication of a figure of merit for the ASL circuit.

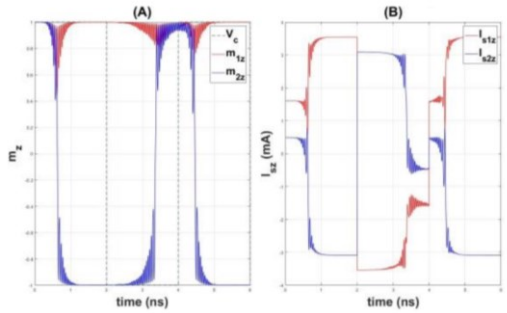

Figure 1. *The plot of (A) magnetic moment vector, m_z and (B) spin current, I_{Sz} of both input and output FMs.*

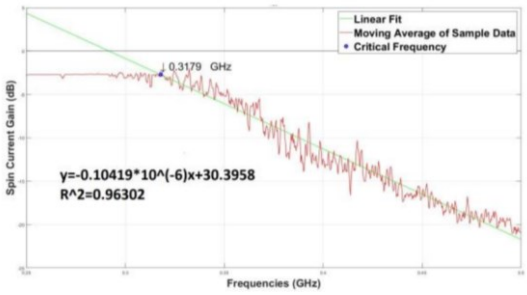

Figure 2. *Frequency Response of the ASL Circuit with the reference parameters.*

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PII-04

TERAHERTZ EMISSION FROM GAAS/ALGAAS ASYMMETRIC DOUBLE QUANTUM WELLS

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Abstract.

We study the terahertz emission properties of coupled and uncoupled GaAs/AlGaAs asymmetric double quantum wells. The GaAs/AlGaAs asymmetric double quantum wells were grown via molecular beam epitaxy. The coupled asymmetric double quantum well consists of 50 pairs of 50 Å GaAs narrow well and 90 Å GaAs wide well separated by a 25 Å AlGaAs barrier. On the other hand, the uncoupled asymmetric double quantum well consists of 50 pairs of 50 Å GaAs narrow well and 90 Å GaAs wide well separated by a 100 Å AlGaAs barrier. The structural and optical properties of the GaAs/AlGaAs asymmetric double quantum wells were studied via x-ray diffraction and photoluminescence spectroscopy, respectively. The THz emission from the GaAs/AlGaAs asymmetric double quantum wells were measured using a standard terahertz time-domain spectroscopy setup that employs a Ti:Sapphire femtosecond laser (central wavelength = 800 nm, pulse width = 100 fs, repetition rate = 80 MHz). We observe higher terahertz emission from the GaAs/AlGaAs coupled asymmetric double quantum well as compared to the uncoupled which is attributed to electron tunneling from narrow well to wide well leading to a larger dipole moment.

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PII-05

ENHANCED TERAHERTZ EMISSION FROM P-CU_XO/N-SI HETEROSTRUCTURES GROWN THROUGH THERMAL OXIDATION

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Abstract.

We investigated the terahertz (THz) emission mechanism from thermally oxidized copper oxide (Cu_xO) films on silicon (Si) substrates. Cu films with a nominal thickness of 200 nm were deposited on n-type Si (100) substrates through thermal evaporation. The Cu films were thermally oxidized for two hours in ambient air at temperatures of 150 °C, 250 °C, 350 °C, and 450 °C. Raman spectroscopy was performed to show how the oxidation phase of Cu_xO changes with temperature. An n-Si/Cu/p-Cu_2O heterostructure forms at 150 °C due to the incomplete oxidation of the Cu layer. An n-Si/Cu_2O/p-CuO stack forms at 250 °C, with Cu_2O being the dominant oxide phase [1]. The absence of Cu_2O phonon modes at temperatures of 350 °C and 450 °C indicated that the Cu/Cu_2O layer is fully converted to CuO [1]. Reflectance measurements showed how the absorbance of the p-Cu_xO/n-Si films vary with oxidation temperature. The THz emission of the p-Cu_xO/n-Si heterostructures were measured using a THz-time domain (THz-TDS) setup in the reflection geometry. The TDS spectra of the p-Cu_xO/n-Si heterostructures in indicated that the THz emission of the p-Cu_xO/n-Si heterostructure increases with temperature, with the 250 °C-oxidized sample having the strongest emission. The enhancement of the THz p-Cu_xO/n-Si sample oxidized at 250 °C is attributed to the following factors: (i) the built-in electric field at the Cu_2O/Si and CuO/Cu_2O interface, and (ii) increased optical absorption of the heterostructure due to Cu_xO [2-5]. These factors contribute to the enhancement of the THz emission from the bulk Si, Cu_2O, and CuO layers. The THz emission subsequently decreases at 350 °C and 450 °C due to the weaker built-in fields at the interface of the p-CuO/n-Si heterostructure, and less efficient optical absorption caused by the absence of the Cu_2O layer.

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PII-06

CARRIER CAPTURE DYNAMICS IN INAS/GAAS SINGLE-LAYER QUANTUM DOTS OBSERVED USING TIME-RESOLVED TERAHERTZ SPECTROSCOPY

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Abstract.

We observe the saturation of photoexcited carriers in InAs/GaAs single-layer quantum dots (QD) at high excitation fluence through an optical pump-terahertz probe (OPTP) experiment conducted at room temperature [1]. Results indicate that increasing the optical pump power leads to a higher photoexcited carrier lifetime immediately upon photoexcitation [2-6]. Calculations show that the lifetime at low pump power (0.4 mW) is 500 ps with a corresponding carrier density of 3-4 carriers per dot. Meanwhile, at 7.0 mW pump power, a carrier lifetime of 3.7 ns was determined with a density of 64-65 carriers per dot. For all optical pump powers considered, carrier lifetime decreased to about 500 ps after sufficient time. This suggests that an increase in the optical pump fluence could result to the filling of QD states due to the ultrafast carrier capture, which in turn will limit the photocarriers to recombine in the GaAs barrier instead of the InAs quantum dots [2,7]. After recombination of carriers in the dot, QDs will return to its unsaturated state and carrier capture from the GaAs barrier to the InAs QDs will proceed. These changes in the dynamical processes are reflected in the gradual decrease and convergence of lifetime back to 500 ps.

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PII-07

OXYGEN VACANCY-RELATED LUMINESCENCE PROPERTIES OF SnO_2 NANORODS AND NANOPARTICLES

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Abstract.

Tin oxide nanorods and nanoparticles were prepared by hydrothermal method. The structure and morphology of the samples was investigated by X-ray diffraction (XRD), Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM). The existence of oxygen vacancies was confirmed by Raman and EPR spectroscopy. The PL spectral results show that SnO_2 nanorods and nanoparticles exhibit photoluminescence broad peaks at 540 nm which is due to oxygen defect. Density functional theory (DFT) calculations were performed to investigate electronic structure properties of SnO_2 samples. The results indicated that SnO_2 with oxygen vacancy has a smaller band gap, and the Fermi level shift upward to the conduction band. Furthermore, oxygen vacancy would introduce a new electronic state inside the band gap compared with that of pure SnO_2.

PII-08

NUMERICAL STUDY OF LINEAR OPTICAL PROPERTIES OF AS_2S_3 GLASS PCF TAKING INTO ACCOUNT THE DIFFERENCE IN STRUCTURAL PARAMETERS

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Abstract.

This work proposes a special hexagonal lattice photonic crystal fiber (PCF) based on As_2S_3 glass with a heterogeneous structure in the micro-cladding. The linear optical characteristics of PCF including effective refractive index, chromatic dispersion, and confinement loss have been numerically analyzed over a wide wavelength range. The results show that all dispersion curves possess a zero-dispersion wavelength (ZDW) and it tends to shift towards the long wavelength as the filling factor decreases. Two fibers with a flat dispersion profile and close to the zero-dispersion line are selected as the two optimal structures and then the values of the optical properties are calculated at the corresponding pump wavelength. As a result, our PCFs obtain small dispersion and very low confinement loss. These are well-suited structures for broadband supercontinuum generation (SC) thanks to the support of pump pulses in the anomalous dispersion regime.

Keywords: *As_2S_3 glass, Linear optical properties, Different air-hole size, Flat dispersion, Low confinement loss, Hexagonal lattice.*

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PII-09

CONTROLLING EFFECTIVE MODE AREA AND CONFINEMENT LOSS OF CIRCULAR ARSENIC TRISULFIDE PHOTONIC CRYSTAL FIBERS FOR OPTICAL TECHNOLOGY APPLICATIONS

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Abstract.

We numerically investigate novel arsenic trisulfide (As_2S_3) circular lattice photonic crystal fibers (PCFs) with an effective mode area and confinement loss appropriate for each specific application. This is carried out by keeping the filling factor from the second ring onwards unchanged while that of the first one changes in a step of 0.05. The decrease of the effective mode area leads to a larger confinement loss characteristic. At 2.5 μm wavelength, most structures have very low confinement loss and their value does not exceed 10^{-17} dB/m. The fiber with lattice constant $\Lambda = 2.5$ μm and filling factor $d_1/\Lambda = 0.3$ has the highest effective mode area of 11.94 μm^2, which will be useful for high-power applications. Conversely, the minimum value of the effective mode area is observed in the case $\Lambda = 1.0$ μm and $d_1/\Lambda = 0.8$, equal to 1.16 μm^2. PCFs with a small effective mode area increase the nonlinear coefficient of the fiber and therefore have great potential in supercontinuum generation.

Keywords: *Circular lattice, Arsenic trisulfide photonic crystal fiber, Effective mode area, Confinement loss characteristic.*

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PII-10

INVESTIGATION OF NITROGEN OXIDE PHOTOCATALYTIC OXIDATION ABILITY OVER SEMICONDUCTOR/CNT HETEROJUNCTION

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Abstract.

In this study, semiconductors i.e. TiO_2, SnO_2, and ZnO are combined with CNTs to form heterogeneous structures by a ball-milling process. The X-ray diffraction pattern (XRD), Fourier transform infraed spectrum (FT-IR), high resolution tranmission electron microscopy (HR-TEM), and selected area diffraction (SAED) aremeasured to identify the as-prepared materials. The NO photocatalytic efficiency of TiO_2/CNTs, SnO_2/CNTs, and ZnO/CNTs convert to green products after 30 min under visible light illumination achieve 36.38%, 2.8%, and 8.9%, respectively. In addition, the TiO_2/CNTs nanocomposite exhibited the highest NO decomposition efficiency. Furthermore, amongst the semiconductor/CNTs, the ZnO/CNTs nanocomposite is less stability and even if this composite is more high NO_2 conversion than that of the others semiconductors/CNTs.

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PII-11

INVESTIGATE THE NONSEQUENTIAL DOUBLE IONIZATION OF ATOM BY TWO-COLOR PARALLEL LASER PULSE OF MID-INFRARED WAVELENGTH

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Abstract.

In this study, we use the classical ensemble model [1-3] to investigate the dependence of the multiple recollision process and the ionization mechanisms governing the nonsequential double ionization of the atom. The results show that the nonsequential double ionization of the argon atom depends on the relative phase of two-color parallel laser pulse of mid-infrared wavelength. Moreover, the nonsequential double ionization is dominated by recollision-induced excitation with subsequent Ionization mechanism. This has important role in studying the interaction of two electrons in the atomic shells.

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PII-12

THE INVESTIGATE MODELING OF THE EFFECT OF LOW-LEVEL LASER ON PIPER SARMENTOSUM

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Abstract.

A perennial species indigenous to Southeast Asian nations is the piper sarmentosum. This plant is widespread within our nation's provinces and cities. They are used in a variety of traditional cuisine, and locals also utilize natural herbs to treat various ailments. Aches and pains can indeed be effectively reduced, and components are found in leaves. Moreover, because of their anti-inflammatory and antibiotic-active ingredients, leaves are a powerful remedy for gynecological illnesses. In this research, we investigate plant growth by using four types of light wavelengths and exposure times. Selecting the appropriate wavelength and exposure time will create conditions enabling the environment to plant growth in a short period.

PII-13

RESTORED ALGORITHM FOR WAVEFROTN CODING TECHNIQUE IN WIDE FIELD MICROSCOPY

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Abstract.

Wavefront coding is a powerful technique which is used to extend the depth of field in incoherent imaging systems. However, the images captured camera are low quality but are not sensitive to defocus. In this paper, we present an algorithm to restore sharp images for wavefront colding technique in wide field microscopy. The experimental results are shown. The restored image of wavefront coding technique in wide field microscopy is near the diffraction image of traditional imaging system. Fig. 1 show images achieved by the experimental model. Fig. 1(a) shows the diffraction image of traditional imaging system. Fig. 1(b) illuminates the image of imaging system with wavefront coding technique. The restored image in Fig. 1(c) is obtained from the image in Fig. 1(b). The restored image in Fig. 1(c) has the better quality near the quality of the image in Fig. 1(a). The algorithm is successfully restored the low-quality image of wavefront coding system to obtain high quality.

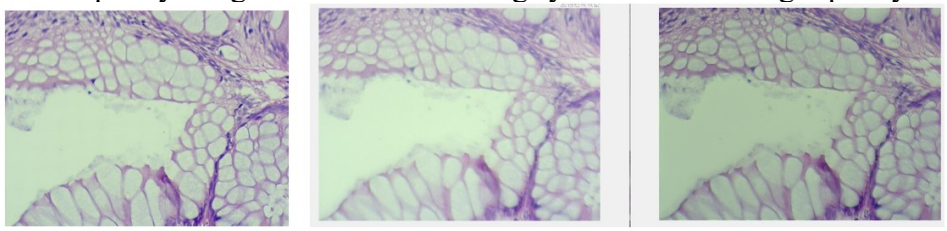

Fig. 1. *Imgaes of (a) traditioanl imaging system, (b) wavefront coding tecnique, (c) restored algorithm.*

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PII-14

QUANLITY ENHANCEMENT OF FLUORESCENCE EMISSION MICROSCOPY BY TWO SATURATED POINT SPREAD FUNCTIONS

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Abstract.

Confocal fluorescence microscopy is an effective imaging technique, but its resolution is limited by the diffraction limit. Fluorescence emission difference (FED) method is a useful way to improve the resolution of confocal fluorescence microscopy, but the negative values generated during subtraction process might cause loss of valid information. In this paper, we propose one effective method to enhance the resolution of confocal fluorescence microscopy for the further improvement of the resolution and without generating significant negative values by using the nonlinear effect. Simulations based on the saturated model of rhodamine 6G are presented to verify the capability of the proposed method. Fig. 1(a) is the original image. Fig. 1(b) shows the image of confocal fluorescence microscopy. Fig. 1(c) illuminates the image of FED. Fig. 1(d) shows the image of proposed method. Fig. 1(c) and Fig. 1(b) shows that the image-contrast of the FED is better than that of confocal microscopy. Fig. 1(d) illuminates that the image of the proposed method has the resolution and the negative reduction better than the image of the FED.

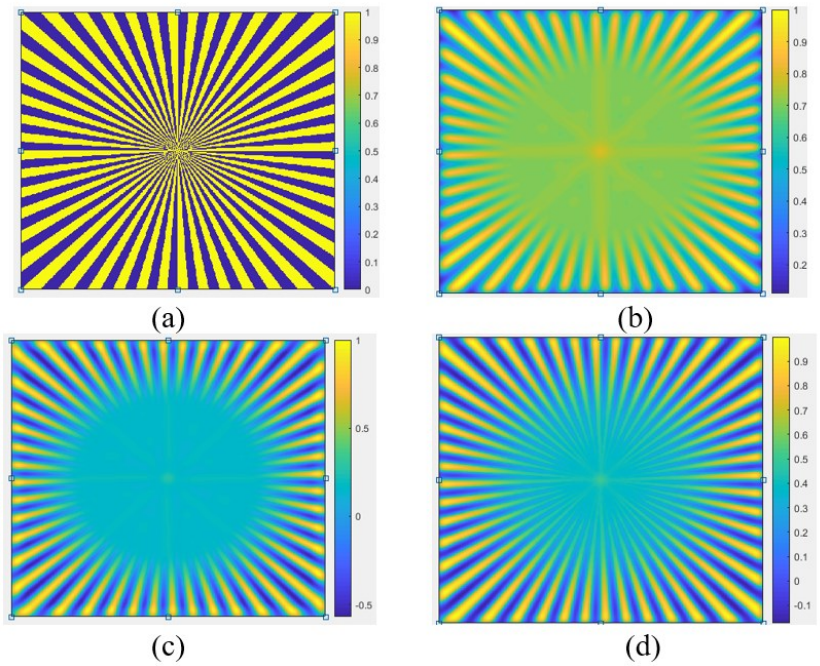

Fig. 1. *Imgaes of (a) orginal image, (b) confocal microscopy, (c) FED, (d) proposed method.*

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PII-15

FABRICATION OF SILVER NANOFLOWERS ON COPPER USING FOR SURFACE-ENHANCED RAMAN SCATTERING

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Abstract.

Surface-enhanced Raman scattering (SERS) is an increasingly widely used technique for the analysis of organic molecules at very low concentrations. The detection limit of the SERS technique depends mainly on the properties of the substrate used to perform the SERS measurement. In this report, we present a simple and efficient method to synthesize silver nanoflowers (AgNFs) on the surface of copper (Cu) plate (AgNFs/Cu) by chemical deposition method, using the deposition solution of $AgNO_3$ in ethanol at 20 °C. After deposition, an array of AgNFs with high density and roughness was formed on the surface of the Cu plate. The shape of the AgNFs changes as the concentration of $AgNO_3$ in the deposited solution changes. Fabricated AgNFs/Cu substrates showed high SERS activity when used as SERS substrates. Specifically, the AgNFs/Cu substrates allow the detection of Methylene blue in water with a limit of detection as low as 10^{-10} M and achieves a SERS enhancement factor of 10^6. These results show a great prospect for the application of the SERS method in the analysis of industrial colorants in food.

Keywords: *SERS, silver nanoflowers on copper, industrial colorants, Rhodamine 6G, chemical deposition.*

PII-16

STUDY ON FABRICATION OF TRIANGULAR SILVER NANOPLATS FOR APPLICATION AS SURFACE-ENHANCED RAMAN SCATTERING SENSORS

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Abstract.

In this study, we fabricated triangular silver nanoplats (AgNPls) for use as surface-enhanced Raman scattering (SERS) sensors. The AgNPls were simply fabricated by chemical reduction. The SERS substrate on AgNPls with triangular structure containing sharp corners and quite small size (60-80 nm) promises to provide strong enhancement of Raman signal, while providing good uniformity as well as good reproducibility. The performance of the SERS substrates was evaluated by recording the SERS spectrum of Rhodamine 6G and a detection limit of 10^{-11} M was reached. These results show that AgNPls can meet the requirements of an optical sensor in detecting toxic organic compounds at low concentrations quickly and accurately.

Keywords: *SERS, SERS substrate, triangular silver nanoplats, chemical reduction, Rhodamine 6G.*

PII-17

PHOTOLUMINESCENCE PROPERTIES OF Eu-MOF AND ITS APPLICATION FOR SENSING ATP

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Abstract.

Adenosine triphosphate (ATP) is known as energy-carrying molecule found in the cells of all living things. The ATP quantification will give the information about the total amount of microbiological content in the test sample [1-3]. The europium(III)-based metal-organic framework (Eu-MOF) with the ligand 1,4-dicarboxylic acid was applied as a luminescent probe for sensing ATP. The photoluminescence properties including excitation, emission and lifetime of Eu-MOF was investigated in the absence and presence of ATP. It was found that luminescence intensity of the Eu-MOF was quenched by ATP and the Eu-MOF could be used as a potential probe for ATP monitoring.

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PII-18

SYNTHESIS AND CHARACTERIZATION OF Fe_3O_4-Au CORE-SHELL NANOPARTICLES FOR METHYLENE BLUE DETECTION

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Abstract.

Fe_3O_4-Au core-shell nanoparticles (CSNPs) combining magnetic and plasmonic properties have received a great attention for surface enhanced Raman spectroscopy (SERS) applications. In this paper, we report the synthesis of such Fe_3O_4-Au CSNPs using a seed mediated growth in a solution. In practice, 180 nm sized spined iron oxide particles were synthesized by a one-step polyol process and functionalized with (3-aminopropy) triethoxysilane (APTES) to become positively charged for adsorbing small gold NPs on their surface. The growth of a complete Au shell on the Fe_3O_4 surface was carried out via seed-mediated growth by using polyvinyl pyrrolidone (PVP) in dimethylfomamide (DMF) as reducing agent. By varying the Fe_3O_4-Au seeds/$HAuCl_4$ precursor weight ratio, the thickness and the shape of gold coating could be varied, tuning thus the optical and magnetic properties of the final CSNPs. The resulting CSNPs exhibit a high magnetization and a rough gold surface, with branched tips, which may play the role of "hot spots" for SERS enhancement. This structure was assembled on substrates to be used for SERS detection of methylene blue, dissolved in a very diluted analyte solution. The detection limit as found to be easily decreased down to 10^{-8} M.

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PII-19

MỘT SỐ KẾT QUẢ NGHIÊN CỨU, ỨNG DỤNG ĐẦU THU QUANG ĐIỆN PHÁT HIỆN TÁC NHÂN SINH HỌC CẢNH BÁO SỚM TRONG MÔI TRƯỜNG ĐÔ THỊ

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Tóm tắt.

Trong khoảng 2 năm, cuộc khủng hoảng COVID-19 đã làm thay đổi về cách phòng chống lây lan virus ở quy mô theo vùng, quốc gia, khu vực.. Các tổ chức khủng bố dựa vào đại dịch đã có khuynh hướng rõ ràng hơn. Bài báo trình bày một số kết quả nghiên cứu ứng dụng đầu thu quang điện phát hiện tác nhân sinh học dựa trên buồng phân tán đàn hồi và buồng phân tán huỳnh quang đưa ra các tham số của tác nhân, để cảnh báo khi có tình huống xảy ra trong môi trường đô thị.

Từ khóa: *Tác nhân sinh học, khủng bố sinh học, chiến tranh sinh học, xon khí.*

SOME RESULTS OF STUDY, APPLICATION OF OPTICAL DETECTOR TO DETECT BIOLOGICAL AGENTS WARNING IN THE CITY

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Abstract.

In about 2 years, the COVID-19 crisis has changed in terms of how to combat the spread of the virus on a regional, national, regional scale. Pandemic-based terrorist organizations have tended to orient themselves. more clearly. The article reports some results showing the application of optical detector to detect biological agents based on elastic dispersion and optical dispersion, giving the agent parameters to warn when there is a province in the city environment.

Keywords: *Biological agents, biological terrorist, biological warfare, aerosols.*

PII-20

NGHIÊN CỨU CÁC TIÊU CHÍ LỰA CHỌN ROBOT CÔNG NGHIỆP ỨNG DỤNG TRONG HỆ CẮT LASER 3D

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Tóm tắt.

Công nghệ laser và công nghệ về robot đều đang phát triển nhanh chóng, với các giải pháp robot cắt laser 3D ngày càng trở nên phổ biến trong ngành công nghiệp, đặc biệt đối với ngành công nghiệp đòi hỏi độ chính xác cao như: công nghiệp ô tô, hàng không vũ trụ [1]. Giải pháp nâng cao độ chính xác gia công trong công nghiệp thường tích hợp một robot công nghiệp (có 6 trục) với đầu cắt laser gắn ở cuối cánh tay robot, được phát triển để cắt các chi tiết có biên dạng ba chiều phức tạp [2]. Nhờ có sự linh hoạt, chính xác, hoạt động đa chiều, đa góc của cánh tay robot mà đầu cắt laser có thể tiếp cận được bất kỳ điểm nào trên chi tiết. Tuy nhiên, không phải loại robot công nghiệp nào cũng phù hợp cho ứng dụng cắt laser 3D do đặc điểm kỹ thuật, cũng như các tính năng khác nhau của chúng. Hiện nay trên thị trường, các thiết bị tích hợp robot công nghiệp trong hệ cắt 3D laser xuất hiện ngày càng nhiều, nhưng chúng không khả thi cho các công ty vừa và nhỏ do có giá thành đắt, cũng như chi phí bảo trì, bảo đưỡng cao. Do đó, trong phạm vi nghiên cứu này, chúng tôi đưa ra phân tích các tiêu chí chính để lựa chọn một robot công nghiệp ứng dụng trong hệ cắt laser 3D, từ đó đề xuất một số loại robot công nghiệp phổ biến phù hợp với ứng dụng này. Kết quả nghiên cứu là tiền đề để xây dựng một hệ cắt laser 3D hoàn chỉnh tích hợp robot công nghiệp, giúp giảm giá thành mua sắm cũng như chi phí vận hành so với mua một hệ tích hợp có sẵn trên thị trường mà vẫn đảm bảo tính chính xác, ổn định khi vận hành.

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PII-21

FIRST-STEP FABRICATION AND APPLICATON OF FIBER BRAGG GRATING SENSORS IN MEASURING DEFLECTION OF THE BEAM

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Abstract.

Fiber Bragg Grating (FBG) sensors has been received a lot of attention in the field of optics and photonics for a long time due to the compact size, reliable measurement accuracy, corrosion and high temperature resistance Lee et al. [1] and Sahota et al. [2]. In our research, a series of laboratory, simulation and field tests were performed to assess the applicability of a multiplexed FBG sensor system situated along the single line of optical fiber which is capable to measure deflection of the beam. Results together with the rapid development of optical fiber sensor technology, our FBGs are expected to pioneer and commercialize in Vietnam within the following years.

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PII-22

GOLD-NANOPARTICLE/FILTER-PAPER SUBSTRATES AS HIGHLY EFFECTIVE PLATFORMS FOR SURFACE-ENHANCED RAMAN SPECTROSCOPY

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Abstract.

In this work, SERS substrates were produced by loading gold nanoparticles onto the surface of filter-paper fibers for the detection of analytes at low concentrations. The size and density of gold nanoparticles play a significant role in the amplification of the SERS signal. Spherical-shaped Au NPs were obtained using sodium citrate as a reduction agent as well as a stabilizer through the microwave heating method. The size and shapes of these synthesized nanoparticles were investigated using field emission scanning electron microscopy. Solutions containing spherical gold nanoparticles were dropped onto the filter-paper fibers. The unique three-dimensional network morphology of the cellulose matrix structure shows an important role in the gold nanoparticle distribution along the paper fibers. The SERS performance of the gold-nanoparticles/filter-paper substrates was evaluated with crystal violet (CV) as an analyte. A limit of detection for CV as low as 10^{-10} M could be achieved, with an analytical enhancement factor of ~10^8 for this specific analyte. This low-cost, easy preparation and highly sensitive paper-based SERS substrate hold considerable potential for the detection and analyses of chemical and biomolecular species.

PII-23

SYNTHESIS, CHARACTERIZATION AND OPTICAL PROPERTIES OF FLUORESCENT CdSe/CdS/SiO_2 NANOPARTICLES

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Abstract.

The fluorescent CdSe/CdS/SiO_2 nanoparticles were synthesized successfully in aqueous/ethanol solutions via the Stöber method with an initial concentration of CdSe/CdS quantum dots. The water-soluble CdSe/CdS quantum dots were prepared before with the emission of green, yellow, and red-orange colors. The CdSe/CdS/SiO_2 nanoparticles were formed with the CdSe/CdS quantum dots settled randomly in silica spheres. The obtained fluorescence emission intensity of the samples is pretty good and is not lower than the fluorescence intensity of CdSe/CdS nanoparticles without silica under the same conditions. The luminescence lifetime of CdSe/CdS/SiO_2 nanoparticles is longer than that of bare CdSe/CdS quantum dots. Due to the biocompatibility of silica materials, CdSe/CdS/SiO_2 nanoparticles show promise as valuable markers for biological experiments.

Keywords: *CdSe/CdS/SiO_2 nanoparticles, citrate, silica spheres.*

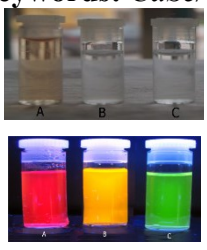
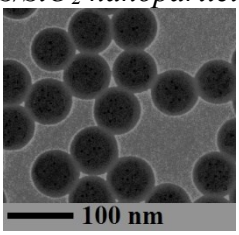
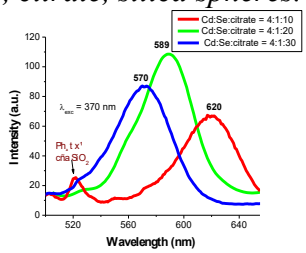


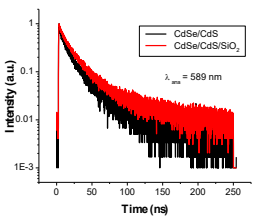
Photo image of CdSe/CdS NPs solutions under visible light (on the top) and under UV light (on the bottom) with the different concentration of citrate.



TEM image of CdSe/CdS/SiO_2 nanoparticles.



Photoluminescence spectra of CdSe/CdS/SiO_2 nanoparticles.



PL decay curves of CdSe/CdS and CdSe/CdS/SiO_2 nanoparticles.

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PII-24

OPTICAL CHARACTERIZATION OF Ce DOPED ZnS QUANTUM DOTS

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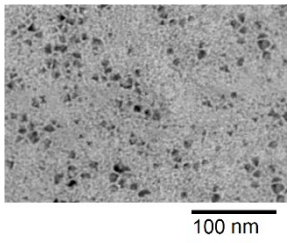
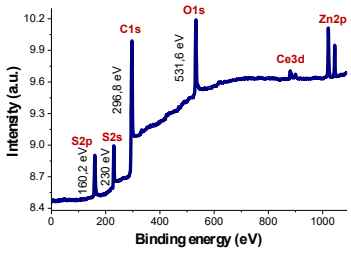
Abstract.

The Ce-doped ZnS quantum dots were fabricated successfully using TOP precursor and Oleic acid with a 3 nm size. The doping of Ce into ZnS quantum dots leads to the emission of ZnS nanoparticles in the ultraviolet region moving toward the visible light region due to the emission of Ce^{3+} ions. The vigorous emission intensity of Ce3+ ions in ZnS quantum dots shows the application possibilities of this material for preparing luminescent materials that emit in the visible light region. Doping other rare earth ions into this material with emission wavelengths more extended than Ce makes the material's emission efficiency improve because of the energy transfer from Ce ions to these ions. The luminescence lifetime of ZnS:Ce material is observed at 66 ns (longer than the luminescence lifetime of ZnS semiconductor).

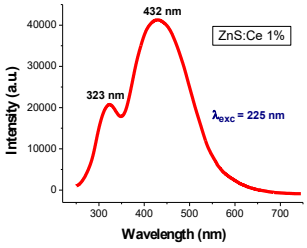
Keywords: *Ce-doped ZnS quantum dots, TOP precursor, Oleic acid, rare earth.*



TEM image of ZnS:Ce quantum dots.



XPS spectra of the ZnS:Ce quantum dots.



Photoluminescence spectra of ZnS:Ce quantum dots.

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PII-25

COMPARATIVE ANALYSIS ON PROPAGATION CHARACTERISTICS OF DOUBLE HYBRID WEDGE PLASMONIC WAVEGUIDES

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Abstract.

Hybrid plasmonic waveguide structures have showed advantages in high mode confinement and long distance propagation with low loss. Numerous types of hybrid plasmonic waveguide structures have been proposed and investigated in literature. In this paper, we present a comparative analysis on propagation characteristics of double wedge hybrid plasmonic waveguides. We used finite element method to evaluate the propagation characteristics such as propagation length and figure of merit for identical hybrid wedge plasmonic waveguides. Besides, the tunable characteristics of double wedge hybrid plasmonic waveguide have also investigated and compared to single wedge hybrid plasmonic waveguide.

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PII-26

A SIMULATION OF PHOTOCATALYTIC MATERIAL TiO_2/G-C_3N_4 USING DENSITY FUNCTIONAL THEORY

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Abstract.

TiO_2 is emerging as a promising way to make a mediated photocatalysis applied in many fields like solar fuel energy, enviroment remediation and photoelectrochemical sensor (PEC sensor) [1]. Among them, PEC sensor has many advantages over traditional electrochemical sensor such as lower cost and higher sensitivity [2]. However, the specific application of TiO_2 is severely limited because of the fast electron-hole pair coherence and broad bandgap (3.2 eV) (corresponding to energy of ultraviolet light region) [3]. Therefore, it is not suitable for photoelectrochemical sensing applications especially in biosensors. In this work, two-dimensional (2D) TiO_2/g-C_3N_4 was evaluated to improve the low visible light excitation of TiO2 and slow down photoelectric induced charge recombination on g - C_3N_4 for high performance. Density functional theory (DFT) calculation show that the heterostructure produced from the surface stable TiO_2 anatase (1 0 1) and the monolayer g-C_3N_4 has a narrow band structure (2.32eV). The calculation result shows that the heterostructure material works well in the visible light region. Furthermore, the enhanced separation of electron - hole pairs and inhibited carrier recombination in the TiO_2/g-C_3N_4 interface was analyzed based on the Bader charge analysis and charge density difference. The theoretical analysis on TiO_2 (1 0 1) surface induces the more significant charge separation, which may be the origin of enhanced photocatalytic efficiency of the TiO_2/g-C_3N_4 heterostructures. This suggests that the TiO_2/g-C_3N_4 heterostructure material is a promising photocatalyst for application as a material for photoelectrochemical sensors.

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PII-27

PHÁT TRIỂN KĨ THUẬT KHOAN-MÀI ĐỂ TẠO LỖ TRÊN THẤU KÍNH THỦY TINH QUANG HỌC

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Tóm tắt.

Quá trình gia công các lỗ dọc trục của các gương/thấu kính kích thước lớn sử dụng phương pháp khoan-mài đã được ứng dụng phổ biến trong sản xuất. Bên cạnh đó, quá trình này vẫn còn một số thách thức như: yêu cầu độ đồng tâm cao giữa lỗ khoan và trục của thấu kính đã được mài hoàn thiện; Khoan lỗ nhỏ đường kính dưới 10mm có yêu cầu dung sai nhỏ; Độ nhẵn sáng bề mặt cao với bề mặt lỗ khoan, mép lỗ không được mẻ rạn; Khoan lỗ với các vật liệu quang học mềm khó gia công,...

Nghiên cứu này trình bày một số kết quả ban đầu trong phát triển kỹ thuật khoan-mài để khoan các lỗ nhỏ trên thủy tinh quang học. Thứ nhất, một dụng cụ mài kim cương dạng ống có gắn bột kim cương nhờ hợp kim đồng và bột kim cương thiêu kết, được thiết kế và chế tạo. Thứ hai, một máy khoan chuyên dụng độ chính xác cao được xây dựng để thực hiện quá trình khoan mài.

Kết quả thí nghiệm cho thấy có thể đạt được độ chính xác hình học và kích thước của các lỗ nhỏ, đường kính tới 4mm, trên thủy tinh quang học và tinh thể quang học.

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PII-28

UV-VIS ABSORPTION AND PHOTOLUMINESCENCE CHARACTERISTICS OF Cu - DOPED $Zn_{0.6}Cd_{0.4}S$ QUANTUM DOTS

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Abstract.

This report presents the UV-Vis absorption and photoluminescence (PL) characteristics of Cu-doped $Zn_{0.6}Cd_{0.4}S$ quantum dots (QDs) with Cu contents ranging from 0 to 1.5%. The samples were prepared using the colloidal method with different reaction times, and Cu doping was performed on them. The morphology, structural properties, as well as UV-Vis absorption and PL characteristics were comparatively investigated between the doped and undoped samples. The results showed that: i) the crystal structure of both sample types transformed from zinc blende to wurtzite; and ii) both the first exciton absorption and the band edge luminescence peaks of Cu-doped $Zn_{0.6}Cd_{0.4}S$ QDs were shifted towards higher energy compared to their undoped counterparts prepared with the same reaction time, and the peaks' blue shift increased with the reaction time. This shift may be related to the simultaneous existence of two structural phases and the presence of Cu dopant in the nanocrystals.

PII-29

COMPARISON OF DIFFERENT SUBSTRATES ON PROPERTIES OF InSb THIN FILMS DEVELOPED BY PHYSICAL DEPOSITION

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Abstract.

InSb thin film based-material has the potential uses in both research and practical applications, especially in optoelectronic devices which are currently specified in military and spatial missions [1-3]. It is therefore achieving the comprehension of the developed thin film is desirable and in high demand for future InSb based-material devices. This letter will present the comparison of InSb thin film properties grown onto different types of heated substrates (sapphire and silicon crystal substrates) at ultra high vacuum or ambient atmosphere of Ar, by using Pulsed Laser Ablation (PLA) approach [4,5]. Thanks to the congruent process in PLA, the developed InSb thin films has mostly equivalent compositional elemental ratio between In and Sb as in the initial target. Films on both kinds of substrates are well crystallized, evidenced by using X-ray diffractometer (XRD), and has crystallite size at nanometric scale up to a few tens of nanometers. The structure properties derived from XRD are then correlated with microstructure and optical properties, which are examined by Scanning Electron Microscopy, Atomic Force Microscopy, and Fourier-Transform Infrared Spectroscopy characterisations, respectively. This work is dedicated to understand deeper how various substrates influence the structure, microstructure, and optical properties of fabricated InSb thin films, which could open new pathway to control properties of InSb thin films in advanced optoelectronic devices.

Keywords: *Semiconductors; A_3B_5; InSb thin film; thickness; Si substrates; Pulsed laser ablation.*

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PII-30

NGHIÊN CỨU, THIẾT KẾ BỘ KHUẾCH ĐẠI LASER MÀU TRONG VÙNG PHỔ 610 – 650 NM

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Tóm tắt.

Báo cáo này trình bày các kết quả trong việc nghiên cứu thiết kế và phát triển một bộ khuếch đại laser màu trong vùng phổ 610 nm – 650 nm. Bộ khuếch đại kết hợp tầng tiền khuếch đại sử dụng độ dày của môi trường hoạt chất 1 mm hoặc 10 mm và tầng khuếch đại công suất có độ dày 10 mm và 20 mm. Bộ khuếch đại được bơm bằng họa ba bậc hai của laser Nd:YAG phát bước sóng 532 nm, độ rộng xung là 5 ns ở tần số xung 10 Hz. Các đặc trưng về công suất, thời gian và phổ của xung được khuếch đại cũng như hệ số khuếch đại theo tần số đã được nghiên cứu và trình bày. Cấu hình khuếch đại này được sử dụng để khuếch đại các xung laze băng hẹp, điều chỉnh liên tục tần số (được phát từ một bộ dao động laze) lên đến năng lượng xung mJ hoặc công suất xung MW.

Từ khóa: *Khuếch đại, laser màu, Rhodamine.*

PII-31

ACCURATELY IDENTIFY THE CONCENTRATION OF TRACE GASES USING THE DIFFERENTIAL OPTICAL ABSORPTION SPECTROSCOPY METHOD

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Abstract.

For more than decades the Differential Optical Absorption Spectroscopy (DOAS) method has become a powerful tool for detecting and monitoring trace gases in the atmosphere either ground or from space-based platforms. The active DOAS system uses the spectrally resolved absorption features serve as finger prints to identify the presence of trace gases and measure the concentration with high sensitivity in sub-ppb range. The combination of Cavity Enhanced Absorption Spectroscopy (CEAS) with broad band light sources (Xenon, LEDs) uses itself for the application of cavity enhanced Differential Optical Absorption Spectroscopy (CE-DOAS) to perform sensitive and concentration measurements of multiple trace gases and mono pollution in single instrument. In this report, some results of identify concentration of NO_2, SO_2 using the controlled standard gas sources are presented. This active DOAS system is setting up for the first time at Institute of Physics, Hanoi, Vietnam.

PII-32

SYNTHESIS AND OPTICAL PROPERTIES OF CORE /SHELL NANOPHOSPHORS DOPED RARE EARTH IONS @ SILVER

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Abstract.

Synthesis core /shell structure Y_2O_3: Eu^{3+} @ Ag and Gd_2O_3: Er^{3+}@ Ag by chemical method. Structure and morphology of the samples were measured by XRD, TEM, FESEM. Optical properties such as Fourier Transform Infrared FTIR and photoluminescence spectra were studied in detail. Influence of Ag concentration to luminescent intensity was investigated. Application potential in biomedicin and envirement will be discussed.

Keywords: *Y_2O_3: Eu^{3+} @ Ag, Gd_2O_3: Er^{3+}@ Ag, FTIR, Photoluminescence spectra PL.*

PII-33

KHẢO SÁT CÔNG NGHỆ TÔI LASER VÀ KHẢ NĂNG ỨNG DỤNG CÔNG NGHỆ TRONG GIA CÔNG TÔI CỨNG CHI TIẾT CƠ KHÍ TẠI VIỆT NAM

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Tóm tắt.

Trong quá trình sản xuất cơ khí, nhiệt luyện là nguyên công cuối cùng và quyết định chất lượng sản phẩm. Có nhiều phương pháp nhiệt luyện như nhiệt luyện thể tích, nhiệt luyện dầu, nước và nhiệt luyện chân không. Tuy nhiên, chúng đều có những hạn chế như: có thể gây cong vênh, sai lệch kích thước, thời gian quá trình kéo dài gây lãng phí năng lượng. Phương pháp tôi laser có thể khắc phục các nhược điểm đó và có thêm ưu điểm nổi bật khác. Dưới tương tác của chùm laser với vật liệu, khi chùm tia có công suất đủ lớn quét qua, bề mặt chi tiết sẽ hình thành các tổ chức vật liệu khác nhau phụ thuộc vào trường nhiệt độ. Công nghệ tôi Laser được ứng dụng trong nhiều lĩnh vực như công nghiệp, hàng không vũ trụ, ngành y tế. Do đó, phương pháp này được lựa chọn và nghiên cứu khả năng ứng dụng công nghệ lên chi tiết cơ khí tại Việt Nam. Bài báo trình bày khảo sát công nghệ tôi laser cho mác thép SKD61, thép gió P18 và S45C. Kết quả là độ cứng bề mặt sau tôi laser lớn hơn độ cứng bề mặt bằng phương pháp tôi truyền thống (tôi thể tích).

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PII-34

ELECTRODEPOSITION OF Cu2O/MoS2 THIN FILMS ON FTO SUBSTRATE AS A HETEROJUNCTION PHOTOELECTROCHEMICAL CELL FOR WATER SPLITTING

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Abstract.

The layered structure MoS_2, an n-type conductor (bandgap of 1.9-2 eV), can be excited under irradiation with visible light. However, its valence band energy (-4.2 eV) is closed to the minimum energy required to reduce water into hydrogen (- 4.2 eV at pH = 7). The p-type semiconductor Cu_2O (a bandgap of 2 eV) has a valence band energy of - 4.0 eV, higher than that of MoS2 and therefore has potentially as photocatalytic for water splitting. In this work, the heterojunction of Cu_2O/MoS_2 is prepared on a conductive FTO-coated glass substrate by electrodeposition methods. We conduct initially the MoS2 thin film on FTO by cyclic voltammetry (CV). Then, the Cu_2O thin film is deposited on the MoS_2/FTO thin film by double-potential pulse chronoamperometric (DPPC) to form a p-n junction Cu2O/MoS2/FTO photo-electrode which play an anodic role in a photoelectrochemical cell. The structure, morphology and composition of heterojunction electrode are characterized by powder X-ray diffraction, SEM, TEM, IR, Raman spectroscopy, electrochemical impedance spectroscopy (EIS). The optical properties are determined by UV-VIS spectroscopy and Photoluminescence (PL) spectroscopy. The photoelectrochemically catalytic activity of the electrodes is performed in dark condition and light condition with 1.5 AM from a solar simulator system by Linear-sweep voltammograms and Transient photocurrent-time methods. The H2-generation yield is evaluated by gas chromatography. The effect of the structure and the composition of the Cu_2O/MoS_2 thin films on the kinetics and mechanism of the photoelectrochemical water splitting is also considered.

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PII-35

NGHIÊN CỨU HIỆU QUẢ CỦA CÔNG NGHỆ PLASMA TRONG VIỆC CHUẨN BỊ BỀ MẶT CHO PHỤC HÌNH RĂNG SỨ

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Tóm tắt.

Phụcs hình răng sứ là phương pháp nhằm phục hồi lại một hay nhiều răng đã mất hoặc phục hồi lại cấu trúc răng bị mất chất, mang lại chức năng ăn nhai và thẩm mỹ cho răng. Chuẩn bị bề mặt cho răng và vật liệu trám là bước quan trọng trong quá trình phục hình răng sứ. Chuẩn bị bề mặt tốt giúp liên kết giữa răng và sứ bền hơn, ổn định hơn. Plasma là công nghệ mới của thế kỷ 21 và có nhiều ứng dụng đa ngành. Trong báo cáo này, chúng tôi đưa công nghệ plasma vào bước chuẩn bị bề mặt cho phục hình răng sứ để đánh giá hiệu quả của plasma đến độ bền kéo của các mối ghép giữa răng và sứ. Từ đó hướng đến hoàn chỉnh quy trình sử dụng plasma trong phục hình răng sứ trong nha khoa.

Từ khóa: *phục hình răng sứ, plasma, chuẩn bị bề mặt.*

PII-36

SYNTHESIS OF HIGHLY STABLE Ag NANOSTRUCTURE FOR SERS DETECTION OF FOOD DYES

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Abstract.
In this work, the stability and repeatability of surface-enhanced Raman scattering (SERS) substrates based on Ag nanoparticles were investigated. Ag nanoparticles were deposited on a glass substrate by DC magnetron sputtering with oblique angle deposition (OAD) technique. The obtained substrate shows excellent SERS amplification due to the surface plasmon resonance effect of Ag nanoparticles with high density of "hot spots", along with high stability and uniformity. The results of the Raman measurements of the substrate for Fast Green FCF reached the limit of detection (LOD) of 0.01 ppm and the relative standard deviation (RSD) of 8.06%, indicating that the Ag NPs substrate could be a SERS detection platform for organic compounds in food with great development potential.

PII-37

ELECTROMAGNETICALLY INDUCED TRANSPARTENCY IN A FOUR-LEVEL ATOMIC LAMBDA SYSTEM: AN ANALYTICAL APPROACH

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Abstract.

In recent years, coherent effects in atomic and molecular systems are attracting considerable attention from research groups around the world. The interaction between light with atomic systems has led to a number of extraordinary quantum phenomena [1]. Among them is the phenomenon of Electromagnetically Induced Transparency (EIT) – a quantum interference effect that occurs between the transition channels inside the atom and leads to the propagation of light (probe light) is not absorbed in the presence of another light beam (cotrol light). The theoretical basis for the EIT was proposed in 1989 [2] and experimentally observed in 1991 [3]. Since then, theoretical and experimental studies of EIT have attracted the special attention of physicists [4] due to its applications in many fields, such as [4]: slow light, enhancement of Kerr nonlinearity, optical communication, optical switches, negative refrective index,...

Early studies on EIT were done in lambda, ladder, and V configurations [4]. For these three-level systems, we obtain only a transparent window on the absorption profile. However, one of the concerns when applying EIT is the ability to extend more transparency windows to perform for many different wavelengths. As has been pointed out by M.c. Gloin, for an N-level atomic system excited by N - 1 laser fields, we can obtain N - 2 EIT windows [5].

In this work, we study the EIT effect of four-level lambda-type atomic system by analytical method. By solving the system of density matrix equations, we derive analytic expressions for the absorption and dispersion coefficients and simulate the EIT spectrum of the system.

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PII-38

INFLUENCE OF SIGNAL LASER FIELD ON GROUP VELOCITY IN A FOUR-LEVEL INVERTED-Y ATOMIC SYSTEM

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Abstract.

The group velocity of light is very important in optical storage and processing, quantum computers, etc [1]. The fast or slow light propagation mode will determine the operating characteristics of the application devices. For traditional materials, the dispersion is usually constant at a certain frequency, so that the group velocity of light cannot be controlled. In recent years, researchers are always looking for ways to change the absorption and dispersion properties of materials. This can change the group index or group velocity of light.

Currently, there are a number of solutions to control the group velocity, such as, using Stimulated Brillouin Scattering [2], using Coherent Population Osillations [3], especially using Electromagnetically Induced Transparency (EIT) [4]. The advantages of EIT materials are high transparency and great dispersion in the atomic resonance domain [5]. With the extraordinary properties of such EIT materials, they have applied to control group velocity of light. Accordingly, the group velocity has been slowed down to a speed of a few m/s to several tens of mm/s [7], even stopped completely [8], or accelerated (fast light) [9]. Some recent studies show that the group velocity of light can be switched between fast light and slow light by varying the parameters of the external field (electric or magnetic field) [15,16].

Although slow light and fast light have been studied both theoretically and experimentally in three-level atomic systems, however, with three-level systems, only one EIT spectral domain is obtained, thus also there is single-frequency light corresponding to the EIT spectral domain is slowed. In order to have more EIT spectral domains and so that the group velocity of light can be controlled at multiple different frequency domains, four-, five- and even six-level atomic systems are used with multiple laser fields [11].

In this work, we study slow light and fast light in four-level inverted Y atomic system. The expressions for the absorption, dispersion and group index of light of the system are derived as a functions of the laser fields. The effect of the signal laser field on the group velocity of light is also considered.

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PII-39

INFLUENCES OF LASER FREQUENCY ON MAGNETO-OPTICAL SWITCHING BASED ON ELECTROMAGNETICALLY INDUCED TRANSPARENCY

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Abstract.

Over the last few decades, there has been a growing interest in the research of laser-field-induced coherence and interference effects in contemporary atomic physics and quantum optics for both their fundamental characters and possible applications. Among the novel phenomena, the so-called electromagnetically induced transparency (EIT) [1], which is a special case of Fano resonance, has made significant progress. EIT has potential applications in slow light [2], enhancement Kerr nonlinear [3], optical bistability (OB) and all-optical switching (AOS) [4-8], and so on. The OB and AOS are the topics that always attracts the attention of scientists because of their potential application in optical communications and quantum computers. Furthermore, OB and AOS using EIT medium have favorable advantages as high response speed, low-intensity thresholds, and controllable switching characteristics.

In this work, we considered the influences of the frequency detuning of the laser fields on magneto-optical switching in a degenerate two-level atomic system under the external magnetic field. We found that the OB thresholds and AOS rate can be controlled actively by frequency detuning of the applied fields and parameters of the system. The proposed scheme may be important for applications in developing magneto-optic switching and magneto-optic storage devices.

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PII-40

PHASE CONTROL OF TRANSIENT EVOLUTION IN A VEE-TYPE DEGENERATE ATOMIC MEDIUM

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Abstract.

Quantum coherence and interference have led to many interesting phenomena in quantum physics. One of the main phenomena that have resulted from quantum coherence and interference is electromagnetically induced transparency (EIT) [1]. There are many ways to generate quantum coherence and interference. Generally, they can be realized by coherent driving fields; the interference between different spontaneous emissions paths also can lead to the generation of a coherent superposition state. The interference effect caused by spontaneous emission is called as spontaneously generated coherence (SGC) [2, 3]. Studies have shown that atomic systems with SGC are sensitive to the relative phase of the applied fields [4, 5]. Most of the previous works related to SGC focused on the medium's steady-state response. There are several works on the transient properties of the three-level systems [6-8], but all these works did not include the effect of the external magnetic field.

In this paper, we will study the effect of the relative phase on the transient evolution of the atomic response in a degenerate two-level system with SGC under an external magnetic field. The configuration we have developed for this paper is an extension of our previous work for optical switching and bistability in a degenerate two-level atomic medium controlled by the external magnetic field [9]. The studied results show that varying values of ϕ will obviously change the transient evolution process. By modulating the relative phase of the applied fields, the absorption properties of the transient process can be dramatically changed; the transient absorption can be eliminated just by tuning the relative phase into the proper regions. In addition, we can convert from absorption to gain by changing the sign of the magnetic field.

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PII-41

HIGH SENSITIVITY NEAR-INFRARED REFRACTIVE INDEX SENSORS BASED ON METAL-DIELECTRIC-METAL PLASMONIC METASURFACES

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Abstract.

In this report, we propose the numerical study of metal-dielectric-metal (MDM) plasmonic metasurface-based refractive index sensors that have high sensitivity in the near-infrared region. The MDM plasmonic metasurface is formed by stacking up silver (Ag) subwavelength disk array on this silica (SiO_2) spacer-layer and Ag film on a silicon substrate. Two simulation methods of boundary element method and finite-difference time-domain are used to determine the optical characteristics of the designed structure. As results have shown, the strong confinement of incident light localized inside the SiO_2 spacer-layer, thus extremely low reflection closed to 0% corresponding to the absorption of up to 100% and high quality-factor (*Q*-factor). Because of operating in the near-infrared range, the proposed MDM plasmonic metasurface has low Ohmic loss, and then the refractive index biosensor based on that shows the figure-of-merit (FOM) to have the selectivity higher than that of other established MDM plasmonic biosensors.

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PII-42

APPLICATION OF UPCONVERSION $NAYF_4:YB^{3+}/ER^{3+}$ NANO FOR LABELLING OF CANCER CELLS

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Abstract.

Rare-earth (RE) doped fluorides ($NaYF_4$) compounds possessing the lowest phonon energy have currently been regarded as one of the most efficient upconversion materials. These RE ions exhibit the strong luminescence and excellent photostability. Especially, they are composed of materials that are non-toxic to biological organisms. In this report, we present the achievements in realization and testing of $NaYF_4:Yb^{3+}/Er^{3+}$ bio-nano complexes as a tool for labelling of cancer cells. The $NaYF_4:Yb^{3+}/Er^{3+}$ nanoparticles have been successfully synthesized via a hydrothermal route, and further protected with a silica shell, and then functionalized with amin groups, d-α-tocopheryl polyethylene glycol 1000 succinate (TPGS) or folic acid (FA). The upconversion optical properties are discussed in detail. The experimental results indicate that surface modification of $NaYF_4:Yb^{3+}/Er^{3+}$ nanoparticles not only improves the dispensability in physiological media but also increases their upconversion emission intensity. We also demonstrated that the $NaYF_4:Yb^{3+}/Er^{3+}$@silica-TPGS/FA could possibly probe the breast and lung cancer cells for *in vitro* experiment.

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PII-43

LUMINESCENT PROPERTIES OF MULTIFUNCTIONAL NANOMATERIALS CONTAINING $Eu(TTA)_3$, $Tb(TTA)_3$ COMPLEXES

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Abstract.

Recently, multifunctional nanomaterials that are based on magnetic and/or plasmonic nanoparticles incorporating with luminescent materials have been rapidly developed for theranostic applications. Metallic-organic complexes of europium(III) and terbium(III) ions that process excellent luminescent properties such as large Stockes shifts, long lifetime, broad excitation and narrow emission spectra have been received much attention. In this work, we focus on luminescent properties of multifunctional nanocomposites containing europium(III) and terbium(III) complexes with 3-thenoyltrifluoroacetonate (TTA). Their characterization, luminescent and magnetic properties and their applicability to biomedical fluorescence imaging and therapy were also investigated.

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PII-44

HIGH-SENSITIVITY PARTICLE SPECTROMETER FOR CLASSIFYING AND COUNTERING ATMOSPHERIC PARTICULATE MATTER CONCENTRATION

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Abstract.

Due to the adverse directly effects on human health and the environment. Over the last decades, air quality monitoring specifically particulate matter (PM) has received increased attention over in the world. Most of the research and policy actions have been focused on the development of ambient air pollution monitoring technologies and decreasing PM pollution. For these reasons, there are many methods for determining matter concentration of dust such as optical particle counters, camera-based optical devices. This paper, we present a design, structure and paremeter of optical sensor based on scattering method with a controlled air pump, a PMT H10720 of Hamamatsu as a high sensitive optical detector and a Picoscope 5444D of Optopart company with 16 bits mode as a ADC convertor and the first some results of collection dust indoor and outdoor environment at Institute of Physics 18 Hoang Quoc Viet, Hanoi, Vietnam.

Keywords: *air quality; particulate matter; air pollution; low-cost partice device; optical particle sensor; scattering techniques; image processing methods.*

PII-45

FAILURE ANALYSIS OF LOW PHOTOCURRENT ISSUE ON OPTICAL COMMUNICATION DEVICE

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Abstract.

This paper aims to report the cause of low photocurrent issue found in optic communication device that encountered in production line and need to be resolved as quickly as possible. The low photocurrent is one concern, which affected to functions and performance of device. Therefore, the failure analysis is used for the reverse traceability the problem. The connector area was inspected with optical microscopy (OM) that the images revealed the concerned unit with discoloration on facet. The connector area of concerned unit were re-investigated by field emission scanning electron microscopy (FE-SEM) that the different surface topography was found on the facet. Consequently, the cross-section technique was performed to prepare the unit for further examination by electron microscope. The electron micrographs of connector area illustrated contamination that the images corresponded to underfill material. Hence, it can be concluded that underfill material is the cause of the low photocurrent problem on optical communication device because it obscures the light entering to the detector.

PII-46
LASER DECAPSULATION GUIDELINE FOR PLASTIC PACKAGE

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Abstract.

In the last few decades [1-3], laser decapsulation has played an important role for sample preparation in failure analysis section of semiconductor package manufacturing. Typically, laser has been used in a partial decapsulation as the guidance before chemical decapsulation. However, operators must have enough skills and experiences for obtaining a good sample. To support the failure analysis, this work intends to find the optimum process parameters of laser decapsulation for the plastic leaded chip carrier (PLCC) package with 28, 44, and 68 leads that the process parameters were varied with laser power (40-90%), round times (12-16 rounds), and speed (200-600 mm/s). The packages initially investigated with X-ray inspection to scope the analysis area, before performing laser decapsulation, and then chemical decapsulation was performed. The samples were qualified under low microscope after laser and chemical decapsulation respectively. The experimental results showed that the optimum process parameters of laser decapsulation for PLCC package with various leads were verified and should be set at 40% power, 12 rounds and 200 mm/s. Therefore, the guideline for laser decapsulation process parameters is set and can be implemented before the chemical decapsulation step, leading to the faster and higher quality decapsulation.

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PII-47

MODE CHARACTERISTICS OF TUNABLE WEDGE PLASMONIC WAVEGUIDE

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Abstract.

Wedge plasmonic waveguides are interested for various applications such as light signal guiding far beyond the diffraction limit and biosensors due to an excellent capability in tight mode confinement. In this work, we present the investigated results on the modal characteristics of wedge plasmonic waveguide. The waveguide is composed of a silver layer deposited onto the surface of a wedge-shaped dielectric waveguide. The progation characteristics of surface plasmon waveguide depending on the refractive index of dielectric waveguide is numerically investigated. The mode characteristics of the wedge plasmonic waveguide are also investigated and presented.

Keywords: *Plasmonnic waveguide, evanescent field, refractive index.*

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PII-48

TUNING THE INDEX OF SILICON WAVEGUIDES BY PERTURBING EVANESCENT FIELD

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Abstract.
Tuning the index of dielectric waveguide is interested in building tunable optical devices. In this work, we report investigations on tuning the index of silicon waveguide. The evanescent field of silicon waveguide is tuned by a closely suspended tuning waveguide. The change of effective refractive index of silicon waveguide as a function of the tuning waveguide dimensions and the gap distance between the two waveguides are studied. In addition, the mode characteristics of the silicon waveguide are also investigated and presented.

Keywords: *Plasmonnic waveguide, evanescent field, refractive index.*

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PII-49

PDMS MICROLENSES FORMED BY PATTERN TRANSFER PROCESS

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Abstract.

In this work, we report a pattern transfer process for fabricating PDMS microlenses. PDMS microlenses have semispherical shapes. The radius of sphere can be modified in the range from 1.5 mm to 3 mm. Using the PDMS lens material, the microlenses with the focus length from 2 to 4 mm can be fabricated. We investigate the dependence of the pattern transfer process on parameters such as the thickness and initial annealing temperature of master mould and time and temperature of PDMS lens annealing.

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PII-50

OPTICAL PROPERTIES OF CQDs/Ag HYBRID NANO PARTICLES PREPARED BY SOLUTION INTERACTIVE PLASMA METHOD

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Abstract.
The report presents the results of the synthesis of hybrid carbon quantum dots and silver (Ag) nanoparticles by the solution-interaction plasma method. The optical, functional and morphological properties of the prepared samples were examined using UV-VIS visible spectroscopy, scanning electron microscopy (SEM) and transmission electron microscopy (TEM), corresponding. The nanoparticle size is fabricated below 20 nm, silver particles are coated onto the array structure of carbonschị dạy quantum dots. Fluorescence spectra of carbon-Ag hybrid nanoparticles with emission spectral region from 450 to 650 nm and two spectral peaks at 480 nm and 540 nm. Fluorescence quenching for the carbon–Ag hybrid nanosample was also observed. The dependence of emission spectrum and fluorescence lifetime of carbon-Ag hybrid nanoparticles has also been shown.
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Keyswords: *CQDs, hybird nano particler, nano carbon, solution-interactive plasma.*

PII-51

ĐỘNG HỌC PHÁT XẠ BĂNG RỘNG, ĐƠN XUNG PICO GIÂY CHO LASER TỬ NGOẠI Ce:LiCAF

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Tóm tắt.

Báo cáo trình bày các kết quả nghiên cứu động học cho laser tử ngoại Ce:LiCAF phát xạ băng rộng sử dụng hai gương phẳng, hướng tới việc phát các đơn xung ngắn, bơm gần ngưỡng. Sự ảnh hưởng của các thông số như: năng lượng laser bơm, hệ số phản xạ gương ra và chiều dài BCH lên động học phát xạ và độ rộng xung laser lối ra đã được đánh giá. Sử dụng phương pháp quá độ BCH, hệ số phản xạ gương R_1 = 25%, R_2 = 14%, chiều dài buồng cộng hưởng 20 mm, việc tối ưu năng lượng laser bơm để phát đơn xung ngắn nhất đã được thực hiện. Độ rộng xung laser tử ngoại Ce:LiCAF nhận được là 267 ps tại năng lượng laser bơm E_b = 10,4 mJ.

Từ khóa: *laser tử ngoại, Ce:LiCAF, động học băng rộng, đơn xung ngắn*.

PII-52

ĐỘNG HỌC PHÁT XẠ BĂNG HẸP, ĐIỀU CHỈNH BƯỚC SÓNG CHO LASER TỬ NGOẠI Ce:LiCAF SỬ DỤNG CÁCH TỬ LITTROW

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Tóm tắt.

Báo cáo trình bày các kết quả nghiên cứu động học phát xạ băng hẹp, điều chỉnh bước sóng cho laser tử ngoại Ce:LiCAF với cấu hình BCH sử dụng cách tử Littrow làm yếu tố lọc lựa và điều chỉnh. Độ rộng phổ băng hẹp thu được là 30 pm tại bước sóng đỉnh phổ 288,5 nm với năng lượng laser bơm 9,5 mJ. Vùng điều chỉnh bước sóng đã được khảo sát, phát xạ trong vùng 278 nm đến 302 nm tại năng lượng laser bơm 15 mJ. Sử dụng cách tử Littrow 2400 vạch/mm, hệ số phản xạ xấp xỉ 30%, gương ra 14%, hệ laser tử ngoại sử dụng cách tử Littrow có khả năng phát các xung 300 ps tại bước sóng đỉnh phổ phát xạ bằng phương pháp quá độ BCH. Ảnh hưởng của các thông số như năng lượng laser bơm, chiều dài BCH, hệ số phản xạ gương ra lên sự tương quan giữa độ rộng phổ băng hẹp và độ rộng xung laser lối ra cũng đã được chỉ ra.

Từ khóa: *laser tử ngoại, Ce:LiCAF, phát băng hẹp, điều chỉnh bước sóng.*

PII-53

ĐẶC TRƯNG QUANG HỌC CỦA HẠT NANO MoS_2 ĐƯỢC CHẾ TẠO BẰNG PHƯƠNG PHÁP TAN MÒN LASER

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Tóm tắt.

Báo cáo trình bày kết quả phát triển hệ laser tan mòn chế tạo các hạt nano sử dụng nguồn laser xung nano giây, bước sóng 532 nm với đối tượng là bột MoS_2 trong dung dịch hữu cơ (metanol). Các tính chất cấu trúc, hóa học và quang học của hạt nano MoS_2 được đặc trưng bởi hình ảnh kính hiển vi quang học, kính hiển vi điện tử quét, kính hiển vi điện tử truyền qua, nhiễu xạ tia X và kỹ thuật quang phổ hấp thụ hồng ngoại gần Raman và UV-vis. Sự ảnh hưởng của các thông số chế tạo: năng lượng laser, mật độ năng lượng, thời gian lên kích thước và hình thái của hạt nano MoS_2 cũng đã được khảo sát. Kết quả được định hướng trong việc chế tạo các cấu trúc màng mỏng đối với vật liệu này.

Từ khóa: *tan mòn laser, chế tạo hạt nano, MoS_2.*

PII-54

FABRICATION CARBON NANO QUANTUM DOTS BY SOLUTION-INTERACTION MICROPLASMA METHOD

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Abstract.

Carbon quantum dots are a new class of nanomaterials that are particularly suitable for biological applications due to their excellent characteristic such as non-toxicity, high biocompatibility, and elemental and group abundances. In this paper, we present the results of synthesizing carbon quantum dots by the solution-interaction microplasma method at atmospheric pressure. The carbon nano quantum dot is less than 10 nm in size, and the fluorescence spectrum exhibits an excitation dependence in the excitation wavelength range from 350 to 650 nm. Morphological and structural features and the influence of fabrication conditions on the optical characteristics of carbon quantum dots have been performed.

This research was funded by the project under the Physics Program at the Vietnam Academy of Science and Technology (Project No. KHCBVL.05/21-22).

Keywords: *nano carbon quantum dots, solution-interaction microplasma method.*

PII-55

CẤU TRÚC ĐIỆN TỬ VÀ TÍNH CHẤT QUANG HỌC CỦA NANO TINH THỂ CADMI SELENIDE TỪ TÍNH TOÁN NGUYÊN LÝ BAN ĐẦU

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Abstract.

Cấu trúc điện tử và tính chất quang của nano tinh thể CdSe (NC) đã được khảo sát bằng phương pháp nguyên lý ban đầu dựa trên lý thuyết hàm mật độ trong phép tính gần đúng gradient tổng quát (GGA) của PerdewBurke-Ernzerhof (PBE) [1]. Cấu trúc NCs được tối ưu hóa trên cơ sở hằng số mạng phù hợp kết quả thực nghiệm [2]. Cấu trúc vùng, mật độ trạng thái của NC đã được phân tích một cách chi tiết. Kết quả cho thấy CdSe NC có vùng cấm thẳng và độ rộng vùng cấm khoảng 1,48 eV. Các đặc trưng về hàm điện môi và chỉ số khúc xạ (n) cũng được tính toán và thảo luận. Các kết quả tính toán các thông số cung cấp thông tin quan trọng cho các tiềm năng ứng dụng trong các thiết bị quang điện tử của các NC CdSe.

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