

Book of abstracts



IX International School and Conference on Photonics

PHOTONICA2023

with joint events:

Understanding interaction light - biological surfaces: possibility for new electronic materials and devices

&

Biological and bioinspired structures for multispectral surveillance

&

Quantum sensing integration within microfluidic Lab-on-a Chips for biomedical applications

&

Advanced Biophysical Methods for Soil Targeted Fungi-Based Biocontrol Agents

August 28 - September 01, 2023, Belgrade, Serbia

Editors

Jelena Potočnik, Maja Popović, Dušan Božanić

Vinča Institute of Nuclear Sciences – National Institute of the Republic of Serbia, University of Belgrade

Belgrade, 2023

ABSTRACTS OF TUTORIAL, KEYNOTE, INVITED LECTURES,
PROGRESS REPORTS AND CONTRIBUTED PAPERS

of

IX International School and Conference on Photonics

PHOTONICA2023

August 28 - September 01, 2023, Belgrade, Serbia

Editors

Jelena Potočnik, Maja Popović, Dušan Božanić

Publisher

Vinča Institute of Nuclear Sciences – National Institute of the Republic of
Serbia, University of Belgrade
Mike Petrovića Alasa 12-14
11351 Vinča, Belgrade, Serbia

Printed by

Serbian Academy of Sciences and Arts

Number of copies

200

ISBN 978-86-7306-165-8

ISBN 978-86-7306-168-9 (Online)



This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, <http://creativecommons.org/licenses/by-nc-nd/4.0/>

PHOTONICA2023 – IX International School and Conference on Photonics (www.photonica.ac.rs) is organized by Vinča Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade (www.vin.bg.ac.rs), Serbian Academy of Sciences and Arts (www.sanu.ac.rs), and Optical Society of Serbia (www.ods.org.rs).



Other institutions that helped the organization of this event are: Institute of Physics Belgrade, University of Belgrade (www.ipb.ac.rs), Faculty of Physics, University of Belgrade (www.ff.bg.ac.rs), School of Electrical Engineering, University of Belgrade (www.etf.bg.ac.rs), Institute of Chemistry, Technology and Metallurgy, University of Belgrade (www.ihtm.bg.ac.rs), Faculty of Technical Sciences, University of Novi Sad (www.ftn.uns.ac.rs), Faculty of Sciences and Mathematics, University of Niš (www.pmf.ni.ac.rs), Faculty of Biology, University of Belgrade (www.bio.bg.ac.rs) and Faculty of Sciences and Mathematics, University of Kragujevac (www.pmf.kg.ac.rs).

PHOTONICA2023 is organized under auspices and with support of the Ministry of Science, Technological Development and Innovation, Republic of Serbia (www.nitra.gov.rs). PHOTONICA2023 is supported and recognized by Optica (Formerly OSA) - The Optical Society (www.optica.org).



Committees

Scientific Committee

- Aleksandar Krmpot, Serbia
- Aleksandra Maluckov, Serbia
- Bojan Resan, Switzerland
- Boris Malomed, Israel
- Branislav Jelenković, Serbia
- Carsten Ronning, Germany
- Concita Sabilia, Italy
- Darko Zibar, Denmark
- Dmitry Budker, Germany
- Dragan Indin, United Kingdom
- Edik Rafailov, United Kingdom
- Francesco Cataliotti, Italy
- Giannis Zacharakis, Greece
- Goran Isić, Serbia
- Goran Mašanović, United Kingdom
- Ivana Vasić, Serbia
- Jasna Crnjanski, Serbia
- Jelena Radovanović, Serbia
- Jelena Stašić, Serbia
- Jerker Widengren, Sweden
- Jovan Bajić, Serbia
- Ljupčo Hadžievski, Serbia
- Luca Antonelli, United Kingdom
- Marco Canepari, France
- Marko Krstić, Serbia
- Marko Spasenović, Serbia
- Milan Kovačević, Serbia
- Milena Milošević, Serbia
- Milivoj Belić, Qatar
- Mirjana Novaković, Serbia
- Nikola Stojanović, Germany
- Nikola Vuković, Serbia
- Nikos Pleros, Greece
- Pavle Anđus, Serbia
- Petra Beličev, Serbia
- Sergei Turitsyn, United Kingdom
- Vladan Pavlović, Serbia
- Vladan Vuletić, United States of America
- Vladana Vukojević, Sweden
- Zoran Grujić, Serbia

Organizing Committee

- Dušan Božanić, Vinča Institute of Nuclear Sciences, Belgrade (Chair)
- Jelena Pajović, Faculty of Physics, University of Belgrade (Deputy Chair)
- Radovan Dojčilović, Vinča Institute of Nuclear Sciences, Belgrade (Deputy Chair)
- Maja Popović, Vinča Institute of Nuclear Sciences, Belgrade (Deputy Chair)
- Jelena Potočnik, Vinča Institute of Nuclear Sciences, Belgrade
- Goran Gligorić, Vinča Institute of Nuclear Sciences, Belgrade
- Danijela Danilović, Vinča Institute of Nuclear Sciences, Belgrade
- Kolja Bugarski, Vinča Institute of Nuclear Sciences, Belgrade
- Milica Nedić, Vinča Institute of Nuclear Sciences, Belgrade
- Miljana Piljević, Institute of Physics Belgrade
- Đorđe Trpkov, Vinča Institute of Nuclear Sciences, Belgrade
- Dragana Tošić, Vinča Institute of Nuclear Sciences, Belgrade
- Anamarija Abu el Rub, Vinča Institute of Nuclear Sciences, Belgrade
- Vanja Ralić, Vinča Institute of Nuclear Sciences, Belgrade

Technical Organizer

 **Lufthansa City Center**
Panacomp Wonderland
Travel

<http://www.panacomp.net/>

Tel: +381 21 466 075

Tel: +381 21 466 076

Tel: +381 21 466 077

Dear Colleagues, friends of photonics,

We are honored by your participation at our PHOTONICA 2023 and your contribution to the tradition of this event. It is our pleasure to host you in Belgrade and in Serbia. Welcome to the world of photonics.

The International School and Conference on Photonics, PHOTONICA, is a biennial event held in Belgrade since 2007. The first meeting in the series was called ISCOM (International School and Conference on Optics and Optical Materials), but it was later renamed to PHOTONICA to reflect more clearly the aims of the event as a forum for education of young scientists, exchanging new knowledge and ideas, and fostering collaboration between scientists working within emerging areas of photonic science and technology. A particular educational feature of the program is to enable students and young researchers to benefit from the event, by providing introductory lectures preceding most recent results in many topics covered by the regular talks. In other words, tutorial and keynote speakers will give lectures specifically designed for students and scientists starting in this field. Apart from the oral presentations PHOTONICA hosts vibrant poster sessions. A significant number of best posters will be selected and the authors will have opportunity to present their work through short oral presentations – contributed talks.

The wish of the organizers is to provide a platform for discussing new developments and concepts within various disciplines of photonics, by bringing together researchers from academia, government and industrial laboratories for scientific interaction, the showcasing of new results in the relevant fields and debate on future trends.

PHOTONICA 2023 will host three joint events: PhoBioS COST Action “Understanding interaction light - biological surfaces: possibility for new electronic materials and devices”, NATO Science for Peace and Security Program (grant G5618) workshop “Biological and bioinspired structures for multispectral surveillance”, workshop on “Quantum sensing integration within microfluidic Lab-on-a Chips for biomedical applications” and BioPhysFUN workshop “Advanced Biophysical Methods for Soil Targeted Fungi-Based Biocontrol Agents”. Following the official program, the participants will also have plenty of opportunities to mix and network outside of the lecture theatre with planned free time and social events.

This book contains 130 abstracts of all presentations at the IX International School and Conference on Photonics, PHOTONICA2023. Authors from all around the world, from all the continents, will present their work at this event. There will be 4 tutorial and 7 keynote lectures to the benefits of students and early stage researches. The most recent results in various research fields of photonics will be presented through 16 invited lectures and 8 progress reports of early-stage researchers. Within the poster sessions and a number of contributed talks, authors will present 95 presentations on their new results in a cozy atmosphere of the building of Serbian Academy of Science and Arts.

Belgrade, August 2023

Editors

Conference Topics

1. Quantum optics and ultracold systems
2. Nonlinear optics
3. Optical materials
4. Biophotonics
5. Devices and components
6. Optical communications
7. Laser spectroscopy and metrology
8. Ultrafast optical phenomena
9. Laser - material interaction
10. Optical metamaterials and plasmonics
11. Machine learning in photonics
12. Other topics in photonics

Joint Events

PhoBioS COST Action - Understanding interaction light - biological surfaces: possibility for new electronic materials and devices

NATO Science for Peace and Security Program - Biological and bioinspired structures for multispectral surveillance

Workshop - Quantum sensing integration within microfluidic Lab-on-a Chips for biomedical applications

BioPhysFUN workshop - Advanced Biophysical Methods for Soil Targeted Fungi-Based Biocontrol Agents

Table of Contents

Tutorial Lectures

T.1	Measurements beyond the Heisenberg uncertainty bound <i>E.S. Polzik</i>	2
T.2	The intelligent microscope at the nanoscale: multimodal microscopy from fluorescence to label-free <i>A. Diaspro</i>	3
T.3	Nanoplasmonics: Fundamentals & Applications <i>S.I. Bozhevolnyi</i>	4
T.4	VUV Circularly-Polarized Light as a symmetry-breaking driving force: implications for the origin of life's homochirality <i>L. Nahon</i>	5

Keynote Lectures

K.1	Recent trends in superfluid atomic gases: ferromagnetic, liquid and supersolid states <i>A. Recati</i>	7
K.2	Nonlinear optics in atomically thin materials <i>G. Soavi</i>	8
K.3	Three-dimensional imaging flow cytometry <i>A. Bassi</i>	9
K.4	From French fries to Foie Gras, turning around a synchrotron <i>F. Jamme, J. Pajovic, F. Wien and M. Réfrégiers</i>	10
K.5	Einstein-Podolsky-Rosen experiment with two Bose-Einstein condensates <i>P. Colciaghi, Y. Li, P. Treutlein and T. Zibold</i>	11
K.6	Development of table-top ultrafast soft-X spectroscopy for material science <i>C. Vozzi</i>	12
K.7	Ultrafast chirality: the road to efficient chiral measurements <i>O. Smirnova</i>	13

Invited Lectures

I.1	Optical control of topological and correlated electronic states <i>M. Hafezi</i>	15
I.2	Scanning quantum microscopy <i>F. Setzpfandt</i>	16
I.3	A single ion meets a single Rydberg atom <i>R. Löw</i>	17
I.4	Photonic Landau levels <i>M. Rechtsman</i>	18
I.5	Shape-changing microstructures for multifunctional microfluidics <i>S. Nocentini, S. Donato, D. Martella, C. Credi, C. Parmeggiani and D.S. Wiersma</i>	19
I.6	Deeper and faster: new tools for nonlinear bioimaging <i>L. Bonacina</i>	20

I.7	Polymeric SERS-fluidic platforms for the non-destructive optical analysis of liquid samples <i>C. Credi</i>	21
I.8	Rapid and sensitive cancer detection with fluorescence lifetime imaging microscopy <i>W. Su, M. Ji, J. Ma, R. Guo and L. Mi</i>	22
I.9	Photonic integrated circuits based on linearly coupled waveguide arrays <i>J. Petrovic</i>	23
I.10	Excursion of a biophysicist to the quantum world <i>A. Dér</i>	24
I.11	Light-enhanced transdermal drug delivery <i>R. Boukherroub</i>	25
I.12	Luminescent thermometry using lanthanide and transition metal-activated phosphors <i>Ž. Antić</i>	26
I.13	Black box certification of resources for photonic quantum technologies <i>S. Neves, L. dos Santos Martins, V. Yacoub, P. Lefevbre, I. Šupić, D. Markham and E. Diamanti</i>	27
I.14	Femtosecond laser direct writing of fiber optic microstructure devices <i>X. Shu</i>	28
I.15	Microscopic theory of transport and optics in superlattices and applications to metabolomics and novel device functionalities <i>M.F. Pereira, A. Apostolakis, H. Zafar, V. Vaks and V. Anfertev</i>	29
I.16	Blue and red diode pumped low-cost ultrafast lasers for biomedical applications <i>B. Resan</i>	30

Progress Reports

P.1	Broadband photonic quantum memory in atomic ensembles <i>K. Shinbrough, B.D. Hunt, S. Park, K. Oolman, T. Loveridge, J.G. Eden and V.O. Lorenz</i>	32
P.2	Measuring the dipolar interaction shift of the BEC critical temperature <i>M. Krstajic</i>	33
P.3	Crystal structure, optical properties and photo/electrocatalytic activity of nanostructured $Zn_{1-x}Fe_yO_{(1-x+1.5y)}$ <i>V. Rajic, S. Markovic, M. Popovic, M. Novakovic, Lj. Veselinovic, I. Stojkovic Simatovic, S.D. Skapin, S. Stojadinovic and V. Rac</i>	34
P.4	Synchrotron radiation photoemission spectroscopy study of the valence band electronic structure of Ag-Ag ₂ S Janus nanoparticles for the development of nanomotors propelled by NIR light <i>D. Danilović, D.K. Božanić, J. Pajović, G.A. Garcia, L. Nahon, T. Marić and V. Djoković</i>	35
P.5	Photosensitizer potential of doped and undoped nanostructured TiO ₂ <i>M. Matijević, L. Korićanac, Đ. Nakarada, J. Žakula, M. Stepić, M. Radoičić, M. Mojović, M. Petković and M.D. Nešić</i>	36
P.6	Application of laser-induced breakdown spectroscopy for the determination of trace metals in oils <i>M. Vinić</i>	37

P.7	Influence of thin oxide layer to photoacoustic signal of nano-mechanical structures <i>K.Lj. Đorđević, S.P. Galović, M.A. Dragaš, D.K. Markushev and D.D. Markushev</i>	38
P.8	Modeling microwave ablation for tumor treatment using open-source software components <i>N. Boskovic, M. Radmilovic-Radjenovic and B. Radjenovic</i>	39
Contributed Papers		
1. Quantum optics and ultracold systems		
QO.1	Exploiting the quantumness of coherent states: toward macroscopic quantum light <i>C. Hermann Avigliano</i>	42
QO.2	Anomalous diffusion and mixed dynamics in a classical Bose-Hubbard chain <i>D. Markovic and M. Cubrovic</i>	43
QO.3	Correlated photon pairs by Four Wave Mixing in alkali vapor for imaging application <i>M.M. Ćurčić, D. Arsenović and B. Jelenković</i>	44
QO.4	Transport of cold bosonic atoms in optical lattices <i>I. Vasić and J. Vučićević</i>	45
QO.5	Experimental and theoretical study of the phase response of M_x magnetometer to modulating transversal magnetic field <i>M.M. Ćurčić, A. Milenković, A. Bunjac, T. Scholtes and Z. Grujić</i>	46
QO.6	Spontaneous emission of three-level ladder-type atom coupled to one-dimensional rectangular waveguide <i>Lj. Stevanović and M. Perić</i>	47
QO.7	Quantized vortices in dipolar BECs when crossing the superfluid-supersolid phase transition <i>M. Sindik, A. Recati, S.M. Rocuzzo, L. Santos and S. Stringari</i>	48
2. Nonlinear optics		
NO.1	Absorption coefficients and refractive index changes in a strongly prolate and strongly oblate ellipsoidal quantum dot <i>V. Pavlovic and Lj. Stevanovic</i>	50
NO.2	Impact of nonlinearity on the zero-mode lasing in optical lattices <i>M. Nedić, G. Gligorić, J. Petrovic and A. Maluckov</i>	51
NO.3	The modulation instability triggered band relaxation in photonic Chern insulator <i>A. Mančić, M. Nedić, D. Leykam and A. Maluckov</i>	52
NO.4	Coupled vortex generator in active multi-core fibers <i>P.P. Beliĉev, G. Gligorić and A. Maluckov</i>	53
NO.5	Electric-field induced SHG (EFISHG) in graphene? <i>J. Woeste, N. Stojanovic and M. Gensch</i>	54
NO.6	Rogue wave clusters of the nonlinear Schrödinger equation composed of Akhmediev breathers and Kuznetsov-Ma solitons <i>S.N. Nikolić, S. Alwashahi, N.B. Aleksić and M.R. Beliĉ</i>	55

NO.7	Counterpropagating rogue waves <i>M.S. Petrovic, N.B. Aleksic, A.I. Strinic and M.R. Belic</i>	56
NO.8	Solutions to nematic liquid crystals systems with cubic-quintic and septic nonlinearities using the Jacobi elliptic function expansion method <i>N. Petrović</i>	57
3. Optical materials		
OM.1	Centrosymmetric, non-symmorphic, non-magnetic, spin-orbit coupled layers without Dirac cones: a tight-binding example <i>V. Damljanović</i>	59
OM.2	Helical and square-spiral copper nanostructures: The effect of thickness and deposition conditions on the structural and optical properties <i>J. Potočnik, N. Božinović, M. Popović, M. Nenadović and M. Novaković</i>	60
OM.3	Luminescent lanthanide molecular materials for photonics applications <i>D. Mara</i>	61
OM.4	Interference effect in surface modified ZnS nanoparticles/Poly (methylmethacrylate) nanocomposites <i>N. Romcevic, B. Hadzic, M. Curcic, V. Radojevic, N. Paunovic and M. Romcevic</i>	62
OM.5	Metal ion-implanted TiN thin films: Induced effects on structural and optical properties <i>M. Popović, M. Novaković, D. Pjević, D. Vaña, D. Jugović and P. Noga</i>	63
OM.6	Real-time fabrication of microstructures on the modified chitosan <i>B. Murić, S. Savić-Šević, A. Kovačević, D. Pantelić and B. Jelenković</i>	64
OM.7	Optimization of UV LED design using evolutionary algorithms <i>L. Leguay, H. Mączko, A. Schliwa and S. Birner</i>	65
OM.8	Yellow fluorescent, water soluble N-doped graphene quantum dots: synthesis, photoluminescence and functionalization with L-Phenylalanine <i>Dj. Trpkov, D. Sredojević, D. Tošić, J. Pajović, D.K. Božanić and V. Djoković</i>	66
OM.9	Large thermally irreversible photoinduced shift of selective light reflection in hydrazone-containing cholesteric polymer systems <i>M. Cigl, A. Boychuk, V. Shibaev, V. Hamplová, V. Novotná and A. Bobrovsky</i>	67
OM.10	Strain-induced modulation of electronic and optical properties in hBN/group III monochalcogenide heterostructures <i>A. Solajic and J. Pesic</i>	68
OM.11	Anthocyanin-functionalized biopolymer films as pH-sensitive indicators <i>D. Tosic, R. Dojcilovic, D. Bozanic, Dj. Trpkov and V. Djokovic</i>	69
4. Biophotonics		
B.1	Design of femtosecond microstructured Poly Lactic Acid temporal cellular scaffolds coated with hydroxyapatite by PLD method for bone tissue regeneration <i>L. Angelova, A. Daskalova, R. Mincheva, E. Filipov, A. Dikovska, M.H. Fernandes and I. Buchvarov</i>	71
B.2	Non-linear excitation fluorescence imaging through two-photon laser polymerized microlenses	

	<i>G. Chirico, M. Marini, R. Martínez Vázquez, R. Osellame, A. Nardini, C. Conci, E. Jacchetti,,M.T. Raimondi</i>	72
B.3	SERS-based immunosensor for sensitive detection of cancer protein biomarkers in serum <i>M. Kahraman, A.M. Saridağ and I.D. Karagoz</i>	73
B.4	Fabrication of flexible diatomite-based SERS active platforms <i>A.M. Saridağ and M. Kahraman</i>	74
B.5	Development of two-dimensional superresolution fluorescence microscope with structured illumination <i>A. Denčevski, A.J. Krmpot and M.D. Rabasović</i>	75
B.6	Smart optical assay based on novel bioorthogonal SERS nanoprobe for the β -amyloid peptide quantification <i>C. Dallari, C. Credi and F.S. Pavone</i>	76
B.7	Bioactive compounds of <i>Carlina acanthifolia</i> roots obtained by fractional extraction and their 3D fluorescence spectra <i>N. Petkova, I. Ivanov, E. Saralieva, D. Georgieva, K. Nikolova, T. Eftimov, G. Gentscheva and L. Vladimirova–Mihaleva</i>	77
B.8	Carbon quantum dots/silver based metal organic framework composites in light enhanced wound healing <i>I. Popović, A. Valenta Šobot, J. Filipović Tričković, L. Korićanac, J. Žakula, V. Ralić,,M.D. Nešić</i>	78
B.9	Anti-cancer and imaging potential of fluorescent black carrot Carbon Dot nanoparticles <i>M.D. Nešić, J. Filipović Tričković, A. Valenta Šobot, J. Žakula, L. Korićanac, I. Popović,,M. Petković</i>	79
B.10	In search of conditions for Gd-TiO ₂ activation by light irradiation in photodynamic treatment of pancreatic cancer cells <i>A. Abu el Rub, M.D. Nešić, J. Žakula, V. Ralić, M. Petković, I. Popović, M. Matijević, M. Radoičić and M. Stepić</i>	80
B.11	Quantum sensing and imaging with entangled photons <i>B. Jelenković</i>	81
B.12	Optical skin biopsy through multispectral approach and prototype device <i>Ts. Genova, V. Mircheva, Al. Zhelyazkova, A. Markovski and P. Troyanova</i>	82
B.13	Novel approach for colon cancer detection through fluorescence spectroscopy <i>Ts. Genova, Al. Zhelyazkova, B. Vladimirov and N. Pankov</i>	83
B.14	<i>In vivo</i> multiphoton imaging of a filamentous fungus <i>Phycomyces blakesleanus</i> : the effect of small ambient temperature increase on mitochondrial morphology and lipid droplets density <i>T. Pajic, S. Kozakijevic, A.J. Krmpot, M. Zivic, N.V. Todorovic and M.D. Rabasovic</i>	84
B.15	Synthesis of europium-doped fluorapatite as a promising luminescent biomaterial <i>V. Stanic, M. Omerasevic, D. Mutavdzic, A. Mrakovic, Dj. Veljovic, M. Marinovic Cincovic and D. Jovanovic</i>	85
B.16	FEM analysis of natural photonic structures of insects in the IR band <i>B. Salatic, D. Pavlovic and D. Pantelic</i>	86
B.17	Dynamics of optomechanical array revealed by holography <i>H. Skenderović, A.M. Dezfouli, D. Abramović, M. Rakić, and N. Demoli</i>	87

B.18	Functionalization of biological/bioinspired structures for multispectral surveillance <i>D. Pavlović, B. Salatić, H. Skenderović, M. Rakić and D. Pantelić</i>	88
B.19	A compact, holographic imaging sensor for biophotonic structures <i>D. Pantelic, D. Pavlovic, D. Grujic, B. Salatic, P. Atanasijevic and P. Mihailovic</i>	89
B.20	Cutting edge technique for determination of spatial resolution limits of nonlinear laser scanning microscopy <i>M. Bukumira, J. Jelić, A. Denčevski, M.D. Rabasović, N. Vujičić, A. Senkić, A. Supina and A. Krmpot</i>	90
B.21	Optical fiber curing of a dental composite: a holographic, thermographic, and Raman study <i>E. Novta, T. Lainović, D. Grujić, S. Savić-Šević, E. Toth, Ž. Cvejić, L. Blažić and D. Pantelić</i>	91
B.22	Exploring the nano-scale world using a custom-made Fluorescence Correlation Spectroscopy (FCS) instrument <i>J.Z. Jelić, M.D. Rabasović, S. Nikolić, V. Vukojević and A.J. Krmpot</i>	92
B.23	Calcium imaging of cerebellar granular neurons in culture acutely treated with cerebrospinal fluid of patients with neurodegenerative diseases <i>A. Laudanović, A. Antić, A. Palibrk, P. Andjus, Z. Stević, D. Lutz and M. Milošević</i>	93
B.24	Mid-Infrared quantum scanning microscopy with visible light <i>J.R. León-Torres, J. Fuenzalida, M. Gilaberte, S. Töpfer, V. Gili and M. Gräfe</i>	94
B.25	Fluorescent products upon heme degradation as potential biomarkers: Understanding their formation via Hemoglobin oxidation <i>M.D. Radmilović, I.T. Drvenica, M.D. Rabasović, V.Lj. Ilić and A.J. Krmpot</i>	95
 5. Devices and components		
DC.1	High-power diffraction-limited laser systems with variable output characteristics oscillating in visible spectral range on atomic copper self-terminating transitions for advanced material microprocessing <i>I. Kostadinov, K. Temelkov, S. Slaveeva and G. Yankov</i>	97
DC.2	Interband cascade lasers: advantages of bulk AlGaAsSb claddings <i>B. Petrović, A. Bader, F. Hartmann, R. Weih, F. Jabeen and S. Höfling</i>	98
DC.3	Dependence of transport parameters on interface composition diffusion and doping segregation in longitudinal optical phonon, bound to continuum and hybrid THz quantum cascade laser designs <i>N. Stanojević, A. Demić, N. Vuković, D. Indjin and J. Radovanović</i>	99
DC.4	Investigation of intersubband transitions in wide bandgap oxide quantum well structures for optoelectronic device applications <i>A. Atić, N. Vuković and J. Radovanović</i>	100
DC.5	Multiport splitters based on waveguide arrays <i>K. Bugarski, P. Vildoso, M. Stojanovic, A. Maluckov, G.Z. Mashanovich, R.A. Vicencio and J. Petrovic</i>	101
DC.6	Optical interconnects and filters based on waveguide arrays <i>J. Krsic, M. Stojanovic, K. Bugarski, N. Stojanovic, A. Maluckov, P. Veerman and J. Petrovic</i>	102

DC.7	Photo-electronic security device based on photonics integrated circuits <i>C. Cid-Lara and R.A. Vicencio</i>	103
DC.8	The influence of injection barriers on performance of organic solar cells studied by drift-diffusion model with transport layers <i>T. Pavlicevic, J. Gojanovic and S. Zivanovic</i>	104
DC.9	Characterization and performance evaluation of a dual loop Sagnac interferometer as sensing system for intrusion location detection <i>M. Vasiljević Toskić, J.S. Bajić, L. Manojlović and B. Batinić</i>	105
6. Optical communications		
OC.1	Free-space OAM wave transmission: a short dipole modeling study <i>A.Ž. Ilić, J.Z. Trajković, S.V. Savić and M.M. Ilić</i>	107
OC.2	OAM mode quality comparisons for discrete EM radiating sources <i>J.Z. Trajković, A.Ž. Ilić, S.V. Savić, N. Maletić, E. Grass and M.M. Ilić</i>	108
7. Laser spectroscopy and metrology		
LS.1	An upgrade of the primary length standard of Republic of Serbia <i>Z.D. Grujić, M.G. Nikolić, S. Zelenika and M.D. Rabasović</i>	110
LS.2	Combined spectroscopic approach for the characterization of pigments used in prehistoric pottery from the region of Western Bulgaria <i>V. Tankova, V. Atanassova, V. Mihailov and A. Pirovska</i>	111
LS.3	Fluorescence spectroscopy and sucrose presence in onion genotypes after long-term storage <i>L. Vladimirova-Mihaleva, M. Mihalev, V. Slavova, G. Pevicharova, S. Genova and V. Boteva</i>	112
LS.4	Measurement of the heading error of a free alignment precession magnetometer <i>Z.D. Grujić, M. Ćurčić, A. Milenkovic, J. Hinkel and T. Scholtes</i>	113
8. Ultrafast optical phenomena		
UO.1	Femtosecond laser spectroscopy for exploration of space <i>Y. Ha, O. Gueckstock, G. Kourfakas, J. Petrovic, M. Rabasovic, A. Krmpot, T. Seifert,, M. Gensch</i>	115
9. Laser - material interaction		
LM.1	Preparing the bioactive surface of Ti/Zr/Ti system by femtosecond laser pre-patterning of substrate <i>N. Božinović, V. Rajić, K. Savva, J. Potočnik, E. Stratakis and S. Petrović</i>	117
LM.2	Selective ablation and laser induced periodical surface structures (LIPSS) produced on (Ni/Ti) nano layer thin film with ultrafast laser pulses <i>S. Petrović, B. Gaković, C. Siogka, D. Milovanović and G. Tsibidis</i>	118
LM.3	Experimental demonstration of vectorial spin-orbital Hall effect of light <i>A. Porfirev, S. Khonina, A. Ustinov, N. Ivliev and I. Golub</i>	119
LM.4	Structured laser beams: generation and applications <i>D. Porfirev, A. Porfirev, S. Khonina and S. Karpeev</i>	120
LM.5	Carbon dots nanoparticles as an effective gate for PDT	

	<i>M. Algarra, M.D. Nešić, J. Soto, M. Stepić, A. Urrutia, J.J. Imas, T. Dučić and M. Petković</i>	121
LM.6	All PM, 14 W, 2.8 GHz intra-burst repetition rate Yb-doped fiber laser <i>E. Hasar and P. Elahi</i>	122
LM.7	The analysis of the influence of optical absorbance on photothermally induced surface temperature variations in a thin sample of high optical transparence <i>M. Nesic, M. Popovic, S. Galovic, V. Miletic and Lj. Kostic</i>	123
LM.8	Interaction of ns laser with 316L-NiB stainless steel obtained by powder metallurgy – morphological effects and LIBS analysis <i>J. Stasic, M. Trtica, M. Kuzmanovic, J. Savovic, J. Ruzic, M. Simic, X. Chen and D. Bozic</i>	124
LM.9	ns-Laser – titanium interaction: hydrogen ambience <i>M. Trtica and J. Stasic</i>	125
10. Optical metamaterials and plasmonics		
OMP.1	All-dielectric optical metasurfaces for sensing of substances with identical real parts of refractive index <i>M. Obradov, Z. Jakšić, I. Mladenović, M. Rašljić Rafajilović and D. Vasiljević Radović</i>	127
OMP.2	Electron energy loss spectroscopy of multilayered structures: Theoretical aspects and the role of graphene-insulator distance <i>I. Radović, A. Kalinić, L. Karbunar and Z.L. Mišković</i>	128
OMP.3	Plasmon-phonon hybridization in drift-current biased supported graphene <i>I. Radović, A. Kalinić, L. Karbunar and Z.L. Mišković</i>	129
OMP.4	Terahertz transmission through metal-insulator-metal cavity arrays infiltrated by liquid crystals <i>G. Isić, D.C. Zografopoulos and B. Vasić</i>	130
OMP.5	Ellipsometric Study of Interactions of Erufosine with Solid-supported by Metasurfaces Lipid Films <i>D. Georgieva, M. Tanovska, V. Vassilev, R. Tzoneva, M. Berger, M. Rahmani, D. Neshev and L. Vladimirova-Mihaleva</i>	131
OMP.6	Rosette based metamaterial for circularly polarized terahertz waves manipulation <i>D.B. Stojanovic, U. Ralevic, Y. Demirhan, G. Aygun and L. Ozyuzer</i>	132
11. Machine learning in photonics		
MLP.1	Remote temperature sensing using upconverting phosphor and artificial neural networks <i>M.S. Rabasovic, M.G. Nikolic and D. Sevic</i>	134
MLP.2	Reverse sigmoid-like nonlinearity in Fabry-Perot injection-locked lasers <i>P. Atanasijević, M. Banović, J. Crnjanski, M. Krstić, P. Mihailović, S. Petričević and D. Gvozdić</i>	135
MLP.3	Low-cost raspberry Pi based imaging system for analysis of Fiber Specklegram Sensors <i>L. Brestovacki, M. Golubovic, J. Bajic, A. Joža and V. Rajs</i>	136

12. Other topics in photonics

OP.1	Revealing non-equilibrium dynamics by holography: The case of Briggs-Rauscher reaction <i>M. Pagnacco, M. Simovic Pavlovic, A. Radulovic, B. Bokic, D. Vasiljevic and B. Kolaric</i>	138
OP.2	Using Laser-Induced Fluorescence technique for interdisciplinary natural sciences school experiment <i>L. Zaharieva, M. Stoyanova, V. Dimova, V. Deneva, Ts. Genova, A. Markovski, L. Antonov and C. Andreeva</i>	139
OP.3	One dimensional SP lattices based on photonic molecules <i>D. Román-Cortés, G. Cáceres-Aravena, B. Real and R.A. Vicencio</i>	140
OP.4	Wave-packets induced by the radiation of an atom coupled to the continuum in photonic lattices <i>B. Real, D. Guzmán-Silva and R.A. Vicencio</i>	141
OP.5	Multi-orbital lattices based on photonic molecules <i>R.A. Vicencio</i>	142
OP.6	Pushing the boundaries of metasurface engineering: Hierarchical supercells and experimental validation <i>T. Contino and M. Tamagnone</i>	143
OP.7	Unraveling the phononic mysteries: BIC revealed in hBN resonators through phonon polaritons <i>H. Gupta, J. Edgar, F. De Angelis, A. Toma and M. Tamagnone</i>	144
OP.8	Refractive index change caused by biomolecular adsorption and structural transformations of adsorbed molecules in ultrasensitive plasmonic biosensors <i>I. Jokić, O. Jakšić, M. Frantlović, Z. Jakšić and K. Radulović</i>	145
OP.9	Characterization and testing of fiber optic curvature sensor as an optical mode converter for deformation measurement <i>S. Babić, J.S. Bajić, M. Vasiljević Toskić, A. Joža and V. Rajs</i>	146
OP.10	Application of polymer optical fiber sensor for urine parameter measurements: a preliminary study <i>P. Sokołowski, K. Cierpiak, P. Wityk, A. Drabik-Kruczkowska and M. Szczerska</i>	147
	Index	148

Preparing the bioactive surface of Ti/Zr/Ti system by femtosecond laser pre-patterning of substrate

N. Božinović¹, V. Rajić¹, K. Savva², J. Potočnik¹, E. Stratakis² and S. Petrović¹

¹Vinča Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia

²Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology (FORTH), N. Plastira 100, Vassilika Vouton, 70013 Heraklion, Crete, Greece

e-mail: nevena.bozinovic@vin.bg.ac.rs

The experimental study of the dynamic femtosecond laser substrate pre-patterning of the Ti/Zr/Ti thin film system is reported. The design of surface patterning with the micrometer features in the form of spikes is investigated in order to improve the arrayed surface structures for biomedical applications. Femtosecond laser pulses were used to acquire black silicon surfaces decorated with conical structures (spikes) on crystalline silicon surfaces under 6.5×10^2 mbar of SF₆ environmental atmosphere. After irradiation, the silicon surface exhibits high aspect ratio spikes, which have conical shapes of about 2 μm height, 40° angle opening, 13×10^6 cm⁻² density that remains approximately uniform across the processed area. Results show that the base of the induced conical structures has an elliptical shape with a major (long) and minor (short) axis on the horizontal plane. It is revealed that the orientation of the long axis of the ellipse is polarization-dependent with the long axis oriented always perpendicularly to the electric field of the laser beam. Spike formation has been attributed to a complex mechanism initiated by partial material melting and subsequent capillary wave formation driven by surface tension gradients within the molten region. Ion sputtering was used to create unique composite thin films on pre-patterned Si substrates that consist of two layers of Ti and subsurface layer of Zr on the interface of titanium. The total thickness of the deposited composite in Ti/Zr/Ti form was 300 nm. The composition, surface morphology and wetting properties were analyzed by scanning electron microscopy (SEM-EDS), profilometry and wettability measurements.

The formation of micro-patterns with spikes array of composite Ti/Zr/Ti thin film systems was used to observe the effects of morphology on survival, adhesion and proliferation of the MRC-5 cell culture line. To determine whether Ti/Zr/Ti thin films have a toxic effect on living cells, an MTT assay was performed. The relative cytotoxic effect as a percentage of surviving cells showed that there was no difference in cell number between the Ti/Zr/Ti thin films and the control cells. There was also no difference in the viability of the MRC-5 cells.

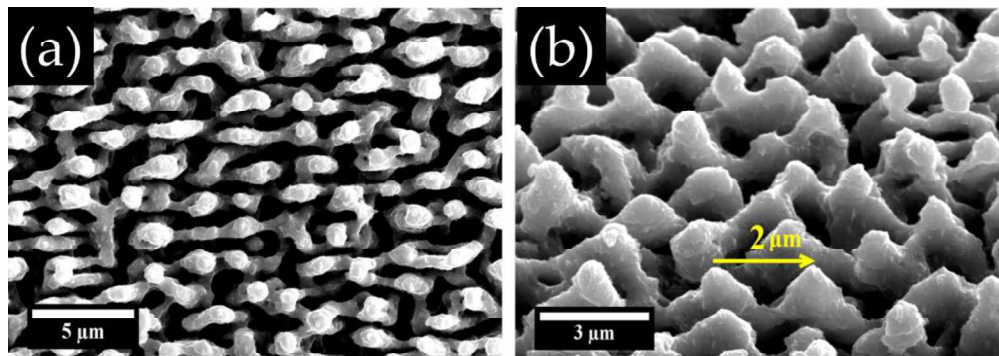


Figure 1. FESEM micrograph of conical spikes produced on Si (100) by femtosecond laser pulses in SF₆ at a pressure of 6.5×10^2 mbar viewed from the normal incident angle (a) and planar view (b). The distance between spikes was noted with a yellow arrow.