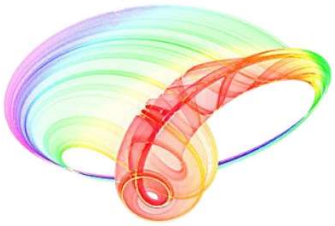
Book of abstracts



IX International School and Conference on Photonics

PHOTONICA2023

with joint events:

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

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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

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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

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Photosensitizer potential of doped and undoped nanostructured TiO_2

M. Matijević[1], L. Korićanac[2], Đ. Nakarada[3], J. Žakula[2], M. Stepić[1], M. Radoičić[2], M. Mojović[3], M. Petković[1] and M.D. Nešić[1]

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Treating cancer remains a major challenge, despite the development of many therapies and advances in general knowledge about the disease. The treatments commonly used are invasive and non-selective, leading to severe side effects and unsatisfactory long-term outcomes. Nevertheless, external stimuli activating therapeutic agents in the affected area can be more beneficial than these aggressive therapies. Photodynamic therapy (PDT) is a minimally invasive, selective treatment that uses photosensitizer (PS) to damage cancer cells. The PS is activated by light, triggering a series of processes that produce reactive oxygen species (ROS), ultimately leading to cancer cell death. Numerous types of nanomaterial possess the capability to act as PS, one of which is TiO_2 [1]. Although nanostructured TiO_2 is biocompatible in the absence of light, its valence band electrons can be stimulated only by ultraviolet (UV) light irradiation. Since the penetration of UV light into tissue is limited, for application in PDT, nanostructured TiO_2 can be doped with heteroatoms like N or C to allow visible light responsiveness [2,3].

This work evaluated the PS properties of unmodified nanostructured TiO_2 (spherical nanoparticles TiO_2 NPs and prolate nanospheroids, TiO_2 PNSs) and doped TiO_2 (N- and C-TiO_2 NPs). After the synthesis, the size of TiO_2 was confirmed to be in the nanoscale range (5-104 nm) by transmission electron microscopy [3,4]. The doped TiO_2 was found to absorb visible light, as demonstrated by UV-Vis spectroscopy and bandgap calculations. Additionally, hydroxyl radicals were detected in water suspensions of TiO_2 PNSs by electron paramagnetic resonance (EPR) spectroscopy, both with and without UV light illumination [4]. However, this radical was observed only with blue light stimulation of the water suspensions of N- and C-TiO_2 NPs [3].

Cell experiments further revealed the internalization process of nanostructured TiO_2 within cells, their cytotoxicity profiles, and the different death modalities triggered by their uptake. After confocal microscopy indicated the successful internalization of the investigated TiO_2, viability tests on different cell lines confirmed their good biocompatibility without light [3,4]. The PDT's efficacy using nanostructured TiO_2 and appropriate light stimuli was evaluated on various cancer cell lines. The most significant viability reduction (60 %) was observed in the HeLa cell line with the combined treatment of C-TiO_2 NPs-blue light. In addition to EPR results, blue light-induced C-TiO_2 NPs-catalyzed generation of ROS was confirmed intracellularly, implying that oxidative stress was the leading cause of HeLa cell death. Fluorescent labeling allowed distinguishing morphological changes inside the cells after the C-TiO_2 NPs, blue light, and the combined C-TiO_2 NPs-blue light treatment. Blue light exposure led to the appearance of large necrotic cells with deformed nuclei, cytoplasm swelling, and membrane blebbing. In contrast, the combined therapy with C-TiO_2 NPs-blue light resulted in controlled cell death, such as autophagy. Since programmed cell death is the desired cancer cell death mechanism, the combined treatment presented here can provide a better outcome of local anticancer therapy.

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