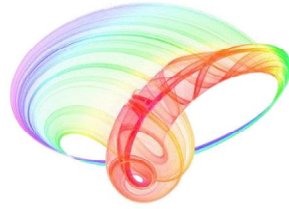


# Book of abstracts



## PHOTONICA2017

The Sixth International School and Conference on Photonics

& COST actions: MP1406 and MP1402



&H2020-MSCA-RISE-2015 CARDIALLY workshop



28 August – 1 September 2017

Belgrade, Serbia

*Editors*

Marina Lekić and Aleksandar Krmpot

Institute of Physics Belgrade, Serbia

Belgrade, 2017

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

of

The Sixth International School and Conference on Photonics  
PHOTONICA2017

28 August – 1 September 2017  
Belgrade Serbia

*Editors*

Marina Lekić and Aleksandar Krmpot

*Technical assistance*

Marko Nikolić and Danica Pavlović

*Publisher*

Institute of Physics Belgrade  
Pregrevica 118  
11080 Belgrade, Serbia

*Printed by*

Serbian Academy of Sciences and Arts

*Number of copies*

300

ISBN 978-86-82441-46-5

PHOTONICA 2017 (The Sixth International School and Conference on Photonica - [www.photonica.ac.rs](http://www.photonica.ac.rs)) is organized by Institute of Physics Belgrade, University of Belgrade ([www.ipb.ac.rs](http://www.ipb.ac.rs)), Serbian Academy of Sciences and Arts ([www.sanu.ac.rs](http://www.sanu.ac.rs)), and Optical Society of Serbia ([www.ods.org.rs](http://www.ods.org.rs)).



Other institution that helped the organization of this event are: Vinča Institute of Nuclear Sciences, University of Belgrade ([www.vinca.rs](http://www.vinca.rs)), Faculty of Electrical Engineering, University of Belgrade ([www.etf.bg.ac.rs](http://www.etf.bg.ac.rs)), Institute of Chemistry, Technology and Metallurgy, University of Belgrade ([www.ihtm.bg.ac.rs](http://www.ihtm.bg.ac.rs)), Faculty of Technical Sciences, University of Novi Sad ([www.ftn.uns.ac.rs](http://www.ftn.uns.ac.rs)), Faculty of Physics, University of Belgrade ([www.ff.bg.ac.rs](http://www.ff.bg.ac.rs)), and Faculty of Biology, University of Belgrade ([www.bio.bg.ac.rs](http://www.bio.bg.ac.rs)).

PHOTONICA 2017 is organized under auspices and with support of the Ministry of Education, Science and Technological Development, Serbia ([www.mpn.gov.rs](http://www.mpn.gov.rs)). PHOTONICA 2017 is supported and recognized by The Integrated Initiative of European Laser Research Infrastructures LaserLab-Europe ([www.laserlab-europe.eu](http://www.laserlab-europe.eu)) and European Physical Society ([www.eps.org](http://www.eps.org)).



The support of the sponsors of PHOTONICA 2017 is gratefully acknowledged:



## Committees

### Scientific Committee

Aleksandar Krmpot, Serbia  
Antun Balaž, Serbia  
Arlene D. Wilson-Gordon, Israel  
Bojan Resan, Switzerland  
Boris Malomed, Israel  
Branislav Jelenković, Serbia  
Dejan Gvozdić, Serbia  
Detlef Kip, Germany  
Dragan Indjin, United Kingdom  
Edik Rafailov, United Kingdom  
Feng Chen, China  
Francesco Cataliotti, Italy  
Giannis Zacharakis, Greece  
Goran Isić, Serbia  
Goran Mašanović, United Kingdom  
Isabelle Philippa Staude, Germany  
Jelena Radovanović, Serbia  
Jerker Widengren, Sweden  
Jovana Petrović, Serbia  
Laurent Sanchez, France  
Ljupčo Hadžievski, Serbia  
Marco Santagiustina, Italy  
Milan Mashanović, United States of America  
Milan Trtica, Serbia  
Miloš Živanov, Serbia  
Milutin Stepić, Serbia  
Milivoj Belić, Qatar  
Nikola Stojanović, Germany  
Pavle Anđus, Serbia  
Peđa Mihailović, Serbia  
Radoš Gajić, Serbia  
Schaaf Peter, Germany  
Sergei Turitsyn, United Kingdom  
Suzana Petrović, Serbia  
Ticijana Ban, Croatia  
Vladana Vukojević, Sweden  
Zoran Jakšić, Serbia  
Željko Šljivančanin, Serbia

## Organizing Committee

Aleksandar Krmpot, (Chair)  
Marina Lekić (Secretary)  
Stanko Nikolić (webmaster)  
Marko Nikolić,  
Vladimir Veljić  
Danica Pavlović

## Technical Organizer



	Subpicosecond Time Scales.....	164
	<i>Veljko Janković and Nenad Vukmirović</i>	
<b>U.O.3</b>	High-harmonic generation in bulk diamond irradiated by intense ultrashort laser pulse.....	165
	<i>Tzveta Apostolova and Boyan Obreshkov</i>	
<b>U.O.4</b>	En route: single-shot THz characterization technique for THz beamline at FLASH1.....	166
	<i>R. Pan, E. Zapolnova, T. Golz, M. Rabasovic, A. Krmpot, A. Vladkovic, J. Petrovic, N. Stojanovic</i>	
<b>U.O.5</b>	Tunable High- field THz source at FLASH: Spectral and spatial characterization.....	167
	<i>E. Zapolnova, T. Golz, R. Pan, A. Vladkovic</i>	
<b>U.O.6</b>	Multiphoton imaging with blue-diode-pumped SESAM-modelocked Ti:Sapphireoscillator.....	168
	<i>B. Resan, A. Rohrbacher, O. E. Olarte, and P. Loza-Alvarez</i>	

## 9. Laser - material interaction

<b>L.M.I.1</b>	One Approach to Laser Scanning Problems for Improving Road Condition Diagnostics.....	169
	<i>N.Slavkovic, D.Mamula Tartalja and M.Bjelica</i>	
<b>L.M.I.2</b>	Photophoresis-based laser trapping with a line optical trap.....	170
	<i>A. Porfirev and S. Fomchenkov</i>	
<b>L.M.I.3</b>	Gold chloride cluster ions generated by vacuum laser ablation.....	171
	<i>Boris Rajčić, Silvana B. Dimitrijević, Marijana Petković, Marija Nišavić, Mario Cindrić, Filip Veljković and Suzana Veličković</i>	
<b>L.M.I.4</b>	Effect of the Corrected Ionization Potential on the High-Harmonic Generation transition rate in a linearly polarized laser field.....	172
	<i>Violeta Petrović, Hristina Delibašić, Kristina Isaković</i>	
<b>L.M.I.5</b>	Laser ablation of nickel/palladium multilayer thin films by nanosecond pulses.....	173
	<i>B. Salatić, S. Petrović, D.Peruško, I. Bogdanović-Radović, M. Čekada, P.Panjan, D.Pantelić and B. Jelenković</i>	
<b>L.M.I.6</b>	Effects of nanosecond laser pulses at 248 nm wavelength on multilayer CrN/(Cr,V)N coatings.....	174
	<i>B. Gaković, Suzana Petrović, P. Panjan, J. Kovač, V. Lazović, C. Ristoscu, I. Negut and I. N. Mihailescu</i>	
<b>L.M.I.7</b>	A Laser-based Fabrication Method of Carbonized Polyimide Surfaces for Flexible Devices.....	175
	<i>Yong-Won Maand Bo Sung Shin</i>	
<b>L.M.I.8</b>	Tungsten modification induced by femtosecond laser with $10^{14}$ W/cm <sup>2</sup> intensity in vacuum.....	176
	<i>M. Trtica, J. Stasic, J. Limpouch, P. Gavrilov</i>	
<b>L.M.I.9</b>	Laser-induced periodic structure on Ti and Ti/Al thin films for photocatalytic application.....	177
	<i>D. Pjević, D. Peruško, E. Skoulas, E. Stratakis, Z. Siketić, I. Bogdanović-Radović, T. Savić, M. Čomor, S. Petrović</i>	
<b>L.M.I.10</b>	Calculation of populations of energy levels of sodium interacting with an intense laser pulse and estimation of the resonant dynamic Stark shift.....	178
	<i>A. Bunjac, D. B. Popović and N. S. Simonović</i>	
<b>L.M.I.11</b>	Inducing periodic structures on multilayers of Ti and Ta by femtosecond laser beam.....	179
	<i>Aleksander G. Kovačević, Suzana M. Petrović, Davor Peruško, Vladimir Lazović, Iva Bogdanović-Radović, Vladimir Pavlović, Dejan Pantelić, Branislav M. Jelenković</i>	
<b>L.M.I.12</b>	Micro-structured biopolymer scaffolds fabricated by femtosecond laser ablation.....	180
	<i>A. Daskalova, I. Bliznakova, P. Loukakos, A. Zhelyazkova, E. Kijeńska and C. Fotakis</i>	
<b>L.M.I.13</b>	Laser parameters optimization for the artifacts silver coated surfaces cleaning.....	181
	<i>B. Radojkovic, S. Ristic, S. Polic, B. Jegdic and M. Janicijevic</i>	

## Laser parameters optimization for the artifacts silver coated surfaces cleaning

B. Radojkovic<sup>1</sup>, S. Ristic<sup>2</sup>, S. Polic<sup>2</sup>, B. Jegdic<sup>3</sup> and M. Janicijevic<sup>4,5</sup>

<sup>1</sup>*Innovation center Faculty of Mechanical Engineering, University of Belgrade, Serbia*

<sup>2</sup>*Central Institute for Conservation in Belgrade, Belgrade, Serbia*

<sup>3</sup>*Institute of Chemistry, Technology and Metallurgy, Belgrade, Serbia*

<sup>4</sup>*Faculty of Electrical Engineering, University of Belgrade, Serbia*

<sup>5</sup>*Metalac A.D. Gornji Milanovac, Serbia*

e-mail:bojana52@yahoo.com

In recent decades, lasers have become the devices that came out of research laboratories and are widely used in industry, engineering, medicine, arts, etc. Among the many applications, lasers have found a place in the conservation of cultural heritage as a source of radiation in the modern diagnostic techniques, cleaning and scanning objects of priceless value [1]. Their importance in cleaning of cultural heritage objects is based on the properties of these techniques, such as high sensitivity, nondestructivity, selectivity, flexibility, on-site applicability and others.

Laser techniques application in metal artifacts cleaning has to be carefully evaluated due to complex phenomena in laser–metal interaction and specificity of every artifact item. There is a large variety of metal materials and their combinations in cultural heritage. Also, the different organic and inorganic encrustations and corrosion products in different progression stage can be found on artifacts surfaces [2,3].

Therefore, the optimization of laser parameters for safe and effective metal artifacts cleaning process is important step in order to avoid unwanted side-effects such as changes in the color or grater surface damages.

A specific field of the metal surface laser cleaning is the cleaning of thin metal foils and coated surfaces. In cultural heritage such examples are metal yarns on the textile embroidery [4, 5]. Often, these yarns are coated with some precious metal as are silver or gold.

This paper presents a study of laser cleaning parameters for safe and effective cleaning of silver coated copper metal yarns. In that purpose the preliminary investigation are performed on silver coated copper plate. That investigation involve numerical modeling of laser– silver coated copper plate interaction and experimental irradiation of real sample surface with pulsed nanosecond Nd:YAG laser by changing laser parameters as are wavelength, laser beam energy and number of pulses. The numerical 3D model of the generated heat on the silver coated copper plate was obtained using the COMSOL Multiphysics software package and was carried out with the aim to define the temperature distribution around the irradiated zone and the maximum temperatures.

Optical microscopy, SEM and EDX analysis are used for the diagnosis of the morphological and chemical effects of laser irradiation on real sample surface. Obtained results are compared with results of laser irradiation analyses on naturally tarnished metal yarns embroidery from museum sample.

This investigation confirms that Nd:YAG lasers can be successfully used for metal yarns cleaning. Application of adequate numerical model can provide an opportunity for a faster and cheaper determination of the cleaning process optimum values range. Some parameters for successfully and safely cleaning of silver coated copper surface were determined.

### REFERENCES

- [1] C. Fotakis, D. Anglos, V. Zafirooulos, S. Georgiou, V. Tornari, CRC Press, 336 pages (2006).
- [2] J. Cronyn, The Elements of Archaeological Conservation, Taylor & Francis e-Library, 326 pages (2004).
- [3] J. Lee, J. Yu, Y. Koh, J Cult Herit, 4, 157s (2003).
- [4] B. Radojkovic, S. Ristic, S. Polic, R. Jancic-Heinemann, D. Radovanovic, J. Cult. Herit. 23, 128 (2017).
- [5] C. Degriigny, E. Tanguy, R. Le Gall, V. Zafirooulos, G. Marakis, J. Cult. Herit. 4, 152s (2003).

## Index

Rabasovic M.D.....		Sazonov S.V.....	73
.81,101,103,104,106,113,116,117,122,157,163,166		Schegoleva K.....	203
Rabasovic M.S.....	101, 122	Schneider F.....	26
Radic S.....	4	Scholtes T.....	154, 156
Radivojevic M.....	148	Seleznev L.V.....	69, 71, 215
Radjenovic B.....	131, 133	Semyachkina-Glushkovskaya O.....	105
Radmilovic-Radjenovic M.....	131, 133	Sendova-Vassileva M.....	213
Radoi V.....	123	Setzpfandt F.....	22
Radoicic M.....	111	Sevostyanov O.G.....	77
Radojicic I. S.....	48, 62, 151	Shi Y.....	156
Radojkovic B.....	181	Shin B.S.....	175
Radonjic M.....	57	Shmavonyan S.....	161
Radotic K.....	218	Shtinkov N.....	209
Radovanovic J. ....	130, 132, 188	Shutov A.V.....	71
Rafailov E.U.....	108	Sibilia C.....	196
Rahi A.....	124	Sierant A.....	205
Rahmani K.....	50	Siketec Z.....	177
Rajcic B.....	171	Simic S.....	152, 162
Rakich P.....	31	Simonovic N.S.....	178
Ralev Y.....	144	Singh A.V.....	189
Ralev Y.....	144	Singh M.B.....	114, 118
Ralevic U.....	185	Sinitsyn.....	215
Ralevic U.....	46, 193	Sinitsyn D.....	69
Ramdane A.....	10	Skarka V.....	67
Ramos R.V.....	145	Skoulas E.....	177
Rašljic M.....	191, 194	Skupin S.....	5
Redjimi A.....	214	Slavchev V.....	68, 72
Resan B.....	168	Slavik R.....	32
Rezai M.....	24	Slavkovic N.....	169
Richardson D.J. ....	32	Sokolovski S.G.....	108
Ristic S.....	181	Spasenovic M.....	80, 94, 128, 138
Ristic-Djurovic J.L.....	86, 120	Spasojevic D.....	218
Ristoscu C.....	174	Sperrhake J.....	186
RizzoPiton M.....	196	Stamenkovic S.....	110
Rohrbacher.....	168	Stancic A.....	104
Romcevic M.....	86, 120	Stanciu G.....	105
Romcevic N.Z.....	67, 86, 120	Stanisavljev D.....	184, 191
Rüegg J.....	123	Stankovic M.....	218
		Stankovic V.....	152
S		Stasic J.....	176
Salakhov M.Kh.....	202	Stavric S.....	211
Salasnich L.....	27	Stef M.....	89
Salatic B.....	173, 182	Stefanov I.....	208
Sancho-Parramon J.....	193, 195	Stein E.....	54
Sanz A.....	220	Steinert M.....	66, 189
Sasanpour P.....	124, 125	Stenishchev I.....	198, 200
Savic T.....	177	Stepic M.....	61, 111
Savic-Ševic S.....	90, 101, 193	Stevanovic K.....	106
Savovic J.....	159	Stevanovic Lj.....	58
		Stoiljkovic M.....	159
		Stojadinovic B.....	102