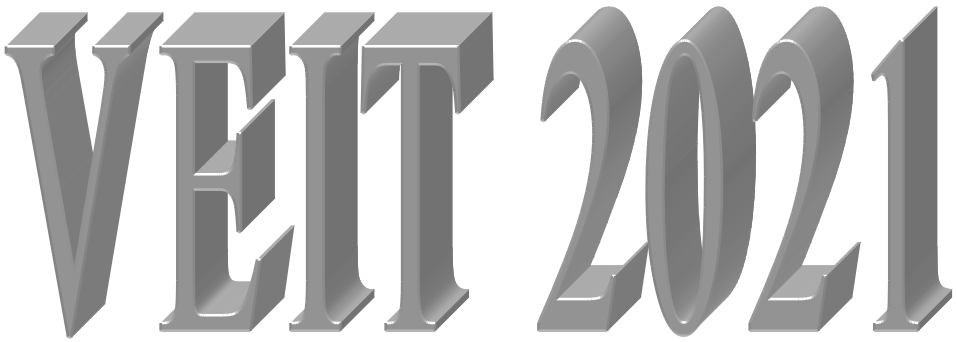
TWENTY-SECOND INTERNATIONAL SUMMER SCHOOL ON VACUUM, ELECTRON AND ION TECHNOLOGIES



20 - 24 September 2021
SOZOPOL, BULGARIA

PROGRAM
ABSTRACTS

Editors: M. Dimitrova, Ch. Ghelev and E. Vasileva

INSTITUTE OF ELECTRONICS
BULGARIAN ACADEMY OF SCIENCES
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The Institute of Electronics carries out research and educational activities in the fields of Physical Electronics, Quantum Electronics and Radiophysics. The research is focused on: studying the processes of generation and control of beams of electrons, ions and photons, and especially on their interaction with matter; development of experimental and industrial equipment for surface modification, thin-film deposition and analysis; welding and melting of metals; low-temperature plasma, and plasma-chemical processes; plasma-assisted formation of thin films and coatings; interaction of laser radiation with matter and thin-film formation; development of laser sources and systems for spectroscopy, metrology, modification and analysis of materials; non-linear optical phenomena in fibers and semiconductors; generation and propagation of electromagnetic waves; non-linear phenomena in a wide MW-frequency range; scattering of electromagnetic waves from homogeneous and inhomogeneous media, signal detection, data acquisition and processing; development of electronic systems for the MW and optical ranges; systems for remote sounding of the atmosphere and sensing of the sea and Earth surface.

DUTCH INSTITUTE FOR FUNDAMENTAL ENERGY RESEARCH
FOM Institute DIFFER, De Zaale 20, 5612 AJ Eindhoven, The Netherlands
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DIFFER was started in 2012 as the focal energy research activity of the Dutch organisation for scientific research NWO and of its physics branch FOM, the foundation for fundamental research on matter. The institute expands the previous FOM Institute for Plasma Physics Rijnhuizen into a multidisciplinary national home for basic energy research. We perform fundamental energy research in the fields of nuclear fusion and solar fuels, actively working together with academic researchers. DIFFER also connects to research and development at enterprises and industries. To accelerate technology innovation, we are building an active national community on energy research.

DIFFER has two fusion research programs, which both address high priority topics in the European Fusion Roadmap. We explore the intense plasma surface interactions expected at the wall of future fusion power plants with our unique high-flux plasma generators Magnum-PSI and Pilot- PSI.

On the shorter timescale, the big challenge in the energy transition is to integrate fluctuating sustainable electricity in an infrastructure which demands predictable power production. This is closely connected to the issue of global energy storage and transport, and at DIFFER we aim to tackle this challenge by converting intermittent sustainable energy into fuels. For instance, DIFFER investigates the splitting of water into hydrogen or the activation of carbon dioxide into carbon monoxide, and the processing of these products into a hydrocarbon fuel. The research involves the synthesis and design of novel materials and processes to obtain scalable, efficient and cost-effective systems.

VEIT '21

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20 – 24 September 2021, Sozopol, Bulgaria

ORGANIZED BY

INSTITUTE OF ELECTRONICS
BULGARIAN ACADEMY OF SCIENCES, SOFIA, BULGARIA

DUTCH INSTITUTE FOR FUNDAMENTAL ENERGY RESEARCH
EINDHOVEN, THE NETHERLANDS

CO-FINANCED by the
MINISTRY OF EDUCATION AND SCIENCE OF REPUBLIC OF BULGARIA,
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M.C.M. van de Sanden,
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MAIN SCIENTIFIC TOPICS:

- **THIN FILMS DEPOSITION**
- **SURFACES AND THIN FILMS PROCESSING AND ANALYSIS**
- **COATINGS FOR ADVANCED APPLICATIONS**
- **NEW MATERIALS**
- **PLASMA-SURFACE INTERACTION AND PLASMA DIAGNOSTICS**
- **GREEN TECHNOLOGIES**
- **MODELING AND COMPUTER SIMULATION**

PLENARY AND POSTER SESSIONS:

A: THIN-FILMS DEPOSITION
COATINGS FOR ADVANCED APPLICATIONS. NEW MATERIALS

B: PLASMA-SURFACE INTERACTION AND PLASMA DIAGNOSTICS. GREEN TECHNOLOGIES. MODELING AND COMPUTER SIMULATION

C: SURFACES AND THIN FILMS PROCESSING AND ANALYSIS

ABBREVIATIONS:

TL – TOPIC LECTURE
PR – PROGRESS REPORT
OP – ORAL PRESENTATION
PA – POSTER SESSION A
PB – POSTER SESSION B
PC – POSTER SESSION C

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PROGRAM

MONDAY, 20 SEPTEMBER

9:50	**OFFICIAL OPENING**	
10:00 – 11:15	**PLENARY SESSION 1** *Chairman: R. van de Sanden*	**TITLE OF THE LECTURE**
10:00	**TL-1 T. Czerwiec**	**Plasma surface engineering of metals to reach sustainable development goals**
10:45	**PR-1 K. Thorwarth**	**Metallization of polymers using HiPIMS**
11:15 – 11:30	**COFFEE BREAK**	
11:30 – 12:50	**PLENARY SESSION 2** *Chairman: T. Trottenberg*	**TITLE OF THE LECTURE**
11:30	**PR-2 N. Nedyalkov**	**Laser technologies for micro- and nano-structures fabrication**
12:00	**PR-3 G. van Rooij**	**Electrification and circularity - a plasma chemistry perspective**
12:30	**OP-1 D. M. Aceti**	**Optimization of titanium and titanium alloy surface properties by ultra-short laser pulse processing for improved antibacterial behavior**
13:00	**LUNCH**	
14:00 – 14:50	**PLENARY SESSION 3** *Chairman: N. Nedyalkov*	**TITLE OF THE LECTURE**
14:00	**PR-4 T. Trottenberg**	**Lab and in-flight diagnostics for electric spacecraft propulsion systems**
14:30	**OP-2 E. Filipov**	**Characterization of laser-processed graphene/chitosan 2D biofilms as potential bactericidal surfaces**
14:50 – 15:00	**COFFEE BREAK**	
15:00 – 16:10	**PLENARY SESSION 4** *Chairman: G. van Rooij*	**TITLE OF THE LECTURE**
15:00	**PR-5 F. Peeters**	**Converting CO_2 using microwave plasma: improvements for application on an industrial scale**
15:30	**OP-3 L. Angelova**	**Ultra-fast laser modification of poly-lactic acid (PLA) – towards enhanced biocompatibility**
15:50	**OP-4 K. Lovchinov**	**Sensitivity study of quartz resonators with electrochemically-deposited ZrO_2 layers**

TUESDAY, 21 SEPTEMBER

10:30 – 11:15	**PLENARY SESSION 5** *Chairman: V. Guerra*	**TITLE OF THE LECTURE**
10:00	**TL-2 H. Kersten**	**History of gas-discharge physics**
10:45	**PR-6 I. Ganachev**	**Non-harmonic multi-species fluid modelling of high-frequency discharges for plasma processing**
11:15 – 11:30	**COFFEE BREAK**	
11:30 – 12:50	**PLENARY SESSION 6** *Chairman: H. Kersten*	**TITLE OF THE LECTURE**
11:30	**PR-7 Z. Petrovic**	**Plasma-activated medium potentiates dendritic cell-mediated anti-tumor response *in vitro***
12:00	**PR-8 N. Puac**	**Plasma treatment as a green technology for modification of plant tissue and synseeds**
12:30	**OP-5 N. Škoro**	**Regeneration of zeolite adsorbent by using non-equilibrium plasma**
13:00	**LUNCH**	
14:00 – 14:50	**PLENARY SESSION 7** *Chairman: N. Puac*	**TITLE OF THE LECTURE**
14:00	**PR-9 V. Schneider**	**Microprobes – small particles for plasma diagnostics**
14:30	**OP-6 V. Ivanov**	**Magnetic-field stabilization of DC arc in cross gas flow**
14:50 – 15:00	**COFFEE BREAK**	
15:00 – 18:00	**POSTER SESSION A**	**Thin-films deposition. Coatings for advanced applications. New materials.**

WEDNESDAY, 22 SEPTEMBER

10:00 – 11:15	**PLENARY SESSION 8** *Chairman: R. Engeln*	**TITLE OF THE LECTURE**
10:00	**TL-3 M. Froehlich**	**On the principles of plasma electrolytic polishing**
10:45	**PR-10 R. Yakimova**	**Challenges of nanostructure growth on dangling bond-free graphene surfaces on SiC**
11:15 – 11:30	**COFFEE BREAK**	
11:30 – 12:50	**PLENARY SESSION 9** *Chairman: R. Yakimova*	**TITLE OF THE LECTURE**

11:30	**PR-11 V. Guerra**	**Monte Carlo simulations of heavy-particle and electron kinetics**
12:00	**PR-12 Tsv. Babeva**	**Nanocomposites from fly ash zeolites: synthesis, characterization and optical sensing applications**
12:30	**OP-7 K. Esmerian**	**Studying the freezing modes of water droplets via soot-coated quartz-crystal microbalances**
13:00	**LUNCH**	
14:00 – 14:50	**PLENARY SESSION 10** *Chairman: Z. Petrovic*	**TITLE OF THE LECTURE**
14:00	**PR-13 S. Radovanov**	**Simulations of ion-beam formation for injectors used in ion implantation beamlines**
14:30	**OP-8 N. Savvin**	**Modification of the CODMATT stand ion optics system**
14:50 – 15:00	**COFFEE BREAK**	
15:00 – 18:00	**POSTER SESSION B**	**Plasma-surface interaction and plasma diagnostics. Green technologies. Modelling and computer simulation**

THURSDAY, 23 SEPTEMBER

10:00 – 11:15	**PLENARY SESSION 11** *Chairman: T. Czerwiec*	**TITLE OF THE LECTURE**
10:00	**TL-4 J. Beckers**	**From dusty plasma to particle contamination control**
10:45	**PR-14 R. van de Sanden**	**Plasma-activated electrocatalysis for nitrogen fixation**
11:15 – 11:30	**COFFEE BREAK**	
11:30 – 12:50	**PLENARY SESSION 12** *Chairman: R. Dejarnac*	**TITLE OF THE LECTURE**
11:30	**PR-15 R. Panek**	**Status of the COMPASS-U project**
12:00	**PR-16 J. Cavalier**	**Recent progress on tomographic inversion of single camera data at the IPP.CR**
12:30	**OP-9 M. Farnik**	**Feasibility of the ECRH system for COMPASS Upgrade**
13:00	**LUNCH**	

14:00 – 14:50	**PLENARY SESSION 13** *Chairman: R. Panek*		**TITLE OF THE LECTURE**
14:00	**PR-17**	**R. Dejarnac**	**Liquid metals as plasma-facing components in tokamak COMPASS divertor**
14:30	**OP-10**	**E. Blagoeva**	**Applying optimum settings of traffic lights in order to reduce harmful emissions**
14:50 – 15:00	**COFFEE BREAK**		
15:00 – 17:00	**POSTER SESSION C**		**Surfaces and thin films processing and analysis**

FRIDAY, 24 SEPTEMBER

10:00 – 11:15	**PLENARY SESSION 14** *Chairman: J. Beckers*		**TITLE OF THE LECTURE**
10:00	**TL-5**	**R. Engeln**	**Vibrational kinetics of CO_2 in non-thermal plasma: a diagnostic study**
10:45	**PR-18**	**N. Tyutyundjiev**	**Atmospheric variations of solar UV irradiation – results of on-ground UV monitoring**
11:15	**CLOSING**		

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ABSTRACTS

TOPIC LECTURES

PROGRESS REPORTS

CONTRIBUTED PAPERS

ORAL PRESENTATIONS

POSTER SESSION A:
THIN FILMS DEPOSITION. COATINGS FOR ADVANCED APPLICATIONS. NEW MATERIALS.

POSTER SESSION B:
PLASMA-SURFACE INTERACTION AND PLASMA DIAGNOSTICS. GREEN TECHNOLOGIES. MODELLING AND COMPUTER SIMULATION

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TL–3

ON THE PRINCIPLES OF PLASMA ELECTROLYTIC POLISHING

M. Fröhlich, S. An

TOPIC LECTURES

OP–5

REGENERATION OF ZEOLITE ADSORBENT BY USING NON-EQUILIBRIUM PLASMA

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Nowadays, all categories of fresh water, surface water, groundwater and atmospheric water, are exposed to various types of pollution. The most troublesome polluting compounds classified as persistent pollutants cannot be completely removed by using conventional water processing methods [1]. Antibiotics fall into this pollutant category due to their very stable molecule structures and a long-life persistence in the environment [2]. One of the effective approaches for treatment of water polluted by antibiotics is adsorption. Zeolite-based adsorbents have recently proved to have excellent performance in antibiotics removal [3]; together with their advantage of having a relatively simple design and cost effectiveness, they appear to be exceptional adsorbents for this purpose. However, the cost of the treatment process, apart from the cost of the adsorbent material, also depends on its recyclability. In case of zeolites, the adsorption of antibiotics was found to be irreversible preventing the reuse of the spent adsorbent material.

In this study, the use of non-equilibrium plasma processing for regeneration of spent natural zeolite-clinoptilolite adsorbent was investigated in order to recover its adsorption properties. The antibiotic ciprofloxacin was used as a model persistent pollutant. Treatments of the spent clinoptilolite were performed in a surface dielectric barrier discharge operating in air. High-voltage sine signal was supplied to the square-shaped segmented upper electrode separated by 2 mm from the lower electrode, which served as a sample holder. The simple geometry of the plasma source design allowed scaling up the device in order to study the effect of the electrode surface in the zeolite treatment. Recovery of the adsorption potential of up to 70% was achieved after 20 minutes of treatment in the first regeneration cycle. High recovery rates were also obtained in subsequent cycles showing that non-equilibrium plasma is a prospective method for recycling used adsorbent material.

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References:

[1] M. Magureanu, N. B. Mandache, and V. I. Parvulescu, Water Res. **81**, 124 (2015).
[2] Verlicchi, P., Al Aukidy, M., Zambello, E. Sci. Total Environ. 2012, 429, 123–155.
[3] Ngeno, E.C., Shikuku, V.O., Orata, F., Baraza, L.D., Kimosop, S.J. S. Afr. J. Chem. 2019, 72, 139–142.