XVI МЕЂУНАРОДНИ НАУЧНИ СКУП

САВРЕМЕНИ МАТЕРИЈАЛИ 2023

ПРОГРАМ РАДА И
КЊИГА АПСТРАКАТА

XVI INTERNATIONAL SCIENTIFIC CONFERENCE

CONTEMPORARY MATERIALS 2023

PROGRAMME AND
THE BOOK OF ABSTRACTS

Бања Лука, 7 – 8. септембар 2023. године
Banja Luka, September 7th to 8th, 2023

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ОРГАНИЗАТОР НАУЧНОГ СКУПА

Академија наука и умјетности Републике Српске

СУОРГАНИЗАТОРИ

Alma Mater Europaea
Технички универзитет Габрово

ПОКРОВИТЕЉ НАУЧНОГ СКУПА

Министарство за научнотехнолошки развој, високо образовање и информационо друштво

ОДРЖАВАЊЕ СКУПА СУ ПОМОГЛИ

Универзитетски Клинички центар Републике Српске
Комора доктора медицине РС

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Academy of Sciences and Arts of the Republic of Srpska

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UNDER THE PATRONAGE OF

Ministry for Scientific and Technological Development, Higher Education and Information Society

THE SCIENTIFIC CONFERENCE HAS BEEN SUPPORTED BY

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ЧЕТВРТАК, 7. СЕПТЕМБАР 2023. ГОДИНЕ

- Долазак и смјештај пленарних предавача у хотелу „Босна" у Бањој Луци
- Долазак и смјештај учесника научног скупа који живе изван Бање Луке у хотелима по избору

ПЕТАК, 8. СЕПТЕМБАР 2023. ГОДИНЕ

08.30 Регистрација учесника научног скупа (АНУРС)
09.00 Отварање конференције
09.20 Пленарна предавања
12.30 Постер презентације
13.30 Дискусија
Затварање конференције

THURSDAY, SEPTEMBER 7, 2023.

- Arrival of the plenary speakers and accommodation in the hotel „Bosna" in Banja Luka
- Arrival of the participants and accommodation in the hotels optionally

FRIDAY, SEPTEMBER 8, 2023.

08.30 Registration of the participants in the ASARS
09.00 Opening of the Conference
09.20 Plenary session
12.30 Poster presentations
13.30 Discussion
Closing ceremony

ПЕТАК, 8. СЕПТЕМБАР 2023. ГОДИНЕ

FRIDAY, SEPTEMBER 8, 2023

СВЕЧАНО ОТВАРАЊЕ СКУПА
OPENING CEREMONY
(09.00 – 09.20)

- Скуп ће отворити и учеснике поздравити академик Рајко Кузмановић, председник АНУРС-а

  Academician Rajko Kuzmanović, president of ASARS will give an opening speech

- Поздравни говор министра за научнотехнолошки развој, високо образовање и информационо друштво доц. др Жељка Будимира

  Welcome speechs – Minister of Scientific and Technological Development, Higher Education and Information Society, Željko Budimir, Ph.D.

- Поздравно обраћање гостију

  Welcome speeches of the guests

РАДНИ ДИО СКУПА
WORKING SESSION
(09.20 – 14.00)

ПЛЕНАРНА ПРЕДАВАЊА
PLENARY SESSION
(09.20 – 12.00)

9.20 – 9.40 Zoran Lj. Petrović
Applications of Non-Equilibrium Plasma in Nano-Electronica, Materials for Modern Technologies and Biological Materials Through the Control of Kinetic Phenomena

9.40 – 10.00 Nenad Filipović
Digital Twin Technology for Bioengineering

10.00 – 10.20 Plamen Tsankov
Measurement and Analysis of the Spectral Emission of Different Types of Domestic Lamps in the Blue Light Hazard Wavelength Range

10.20 – 10.40 Ljubomir Majdandžić
Energy Crisis and Climate Change

10.40 – 11.00 Coffee Break

11.00 – 11.20 Duško Dudić
Contact-to-Mechanical Energy Conversion

11.20 – 11.40 Stevan Armaković
The Role of Molecular Modeling in the Pharmaceutical Industry: From Stability and Reactivity to Drug Delivery

11.40 – 12.00 Ivana Radonjić Mitić
PV Modules Performances During Heating Season in Urban Areas

ПОСТЕР ПРЕЗЕНТАЦИЈЕ

POSTER SESSION

1. Snježana Dupljanin, Olivera Šašić, Zoran Lj Petrović
   Transport Characteristics of Electrons in Nitrous Oxide (N_2O) Under the Influence of Orthogonal DC Electric and Magnetic Fields

2. Momir Đurović
   New Materials Mean New World

3. Suzana Apostolov, Dragana Mekić, Aleksandra Bogdanović, Slobodan Petrović, Borko Matijević, Gorana Mrđan, Đenđi Vaštag
   Chromatographic Approach in the Assessment of Lipophility of Chloroacetamide Derivatives

4. Đenđi Vaštag, Suzana Apostolov, Špiro Ivošević
   Monitoring of Corrosion Degradation of Shape Memory Alloys in Real Conditions

5. Gorana Mrđan, Đenđi Vaštag, Suzana Apostolov, Isidora Nikolić, Petar Knežević, Borko Matijević
   Investigation of Antimicrobial Activity of Selected Monothiocarbohydrazone Derivatives

6. Slavica Maletić, Dragana Cerović, Mirjana Milić, Nataša Jović Orsini
   Effects of Surfactant Treatment on Dielectric Properties of Epoxy/Graphite Composites

7. Branka Ružičić, Dragana Grujić, Blanka Škipina, Ljiljana Topalić-Trivunović, Aleksandar Savić, Teodora Bojović, Mitja Kolar
   Colorimetric Characteristics of Ultrasound Dyed Textiles with Extracts of Reynoutria Japonica and Copper-Based Mordants

8. Darja Pečar, Vladan Mićić, Andreja Goršek
   The Influence of the Catalyst on the Rate Constant of the Chemical Reaction of Esterification of Oleic Acid with Methanol

9. Dragana Kostić, Marija Mitrović, Milorad Tomić, Duško Kostić
Influence of Current Density on Morphology and Roughness of Sonoelectrodeposited Zn-Co-Al_2O_3 Nanocomposite Coatings

10. Ljiljana Tankosić, Svjetlana Sredić
Application of the Method of Focculation and Selective Flocculation Methods in the Treatment of Industrial Sludge from the Iron Ore Concentration Process

11. Milena Rašljić-Rafajilović, Teodora Vićentić, Marko Spasenović, Danica Bajuk-Bogdanović, Igor Pašti, Katarina Radulović, Marija Pergal
Optimal Laser Parameters for Laser Induction of Graphene on Poly(dimethylsiloxane)-based Materials

12. Nebojša Vasiljević, Marija Mitrović, Snježana Vučićević, Danijel Milošević, Milorad Tomić, Stana Stanišić
Optimization of Technological Parameters for Obtaining Hard Chrome Coatings Using Minitab 21 Software

13. Jovan Šetrajčić, Siniša Vučenović, Ana Šetrajčić-Tomić
Quantum-Size Effect and IR Absorption in Crystalline Molecular Ultrathin Films

14. Jovan Šetrajčić, Siniša Vučenović
Energy Spectra and States of Phonons and Charge Carriers in a Model of Superconducting CuO Ceramics

15. Jelena Lamovec, Stevo Jaćimovski, Vojkan Zorić, Jovan Šetrajčić
Analytical Model of Air Pollutants Dispersion from Stationary Point Sources of Pollution

16. Predrag Dašić
The Role of Modern Software Systems Based on Artificial Intelligence (AI) in the New Education of Engineers

17. Daniela Korolija Crkvenjakov, Maja Gajić Kvaščev, Velibor Andrić, Vladimir Pavlović, Olivera Klisurić
Scientific Investigation of the Materials in the Zographic-Styled Icon

18. Danijela Petrović, Zoran Govedar, Vojislav Dukić, Srđan Bilić
Dynamic Bending Strength of Pančić Spruce Wood from Natural and Artificially Raised Stands

19. Nebojša Vasiljević, Vladan Mićić, Ljubica Vasiljević, Duško Kostić, Jelena Perić, Mirko Radić
Extraction of (Poly)Phenolic Compound from Hawthorn (Crataegus Monogyna Jack.)

20. Dejana Savić, Sanja Pržulj, Vesna Antić, Mališa Antić, Milica Balaban
Examination of the Potential of Using By-Products of Beer Production in the Food and Pharmaceutical Industry

21. Bogdan Milićević, Miloš Ivanović, Boban Stojanović, Nenad Filipović
Overview of Physics-informed Neural Networks Applications

22. Darko Divnić, Dragoljub Mirjanić, Esad Jakupović, Zoran Ž. Avramović, Tomislav Pavlović, Ivana Mitic Radonjić
Analysis of Spectral Response of Led Based Solar Simulator

23. Stefan Djorđević, Lana Pantić, Marko Krstić, Ivana Radonjić, Tomislav M. Pavlović, Dragoljub Mirjanić, Anđelina Marić Stanković
Evaporative Cooling of Photovoltaic Modules

24. Maria Savanović, Andrijana Bilić, Stevan Armaković, Milinko Perić, Svetlana Pelemiš, Sanja Armaković
Photocatalytic Degradation of Metoprolol Commercial Formulation: Validation of the RP-HPLC Method

25. Milesa Srećković, Nadežda Talijan, Aco Janicijević, Uroš Stamenković, Aleksandar Bugarinović, Milovan Janićijević, Zoran Karastojković, Slobodan Bojanić
Interaction of Coherent Beams with Material of Interest for Specific Applications

26. Mladen Tomić, Predrag Živković, Jovan Škundrić, Indir Mujanić, Danilo Đurica, Miroslav Kljajić
Enhancing Emission Reduction and Efficiency in Biomass Steam Boilers Through FGR: Examining Nox Production and Operational Dynamics

27. Dušan Ješić, Borislav Savković, Pavel Kovač, Branko Štrbac, Ildiko Mankova, Dražen Sarjanović
Contribution to the Modern Selection of Materials in Machine Production

28. Zoran Petrović, Ana Đokić, Pero Dugić, Tatjana Botić, Dragana Kešelj, Nebojša Vasiljević, Marija Jevtić
The Influence of the Conditions of Chemical Activation of Natural Bentonite on Its Adsorption Capacity in the Process of Rapeseed Oil Processing

29. Nada Čitaković, Marin Tadić, Lazar Kopanja
Influence of Nanoparticles Magnetic Properties and Morphology on Its Applications

30. Pavel Kovač, Branislav Dudić, Borislav Savković, Dušan Ješić
Recycling of Electronic Waste

31. Dušanka Marčetić, Biljana Pećanin
The Connectivity Constant of Neighbor-Avoiding Walks on a Fractal Lattice

32. Neđo Đurić, Ivan Stević, Dijana Đurić
The Importance of Knowledge of the Geological Environment when Designing Spatial - Planning Documents

33. Borislav N. Malinović, Maja Preradović, Draženko Bjelić, Tijana Đuričić
Treatment of Wastewater from Cyanide-Free Zinc Plating

34. Dragana Malivuk Gak, Zoran Rajilić
Newton's Second Law in the Service of Climate Change – Temperature Trend Analysis

35. Predrag Dašić, Radovan Nikolić, Violeta Đorđević, Jelena Medić
Classification and Application of Composite Materials

36. Nikola Cekić
Polycarbonate Panels on Modern Facades of Buildings

37. Marina Karić, Jelena Erić Obućina
Biomass As a Potential Source of Different Forms of Energy

38. Milena Radenković, Sanja Stojanović, Stevo Najman
Analysis of Tissue Response to Collagen Membrane with and without Addition of Blood in a Mouse Subcutaneous Implantation Model

39. Svetlana Stević, Dijana Đurić
Water Reservoirs as Green Accumulators and Large Dams as Multi-Purpose Facilities of Complex Systems

40. Ivan Stević, Dijana Đurić
Small Watercourses and Strategic Management of Their Use Through Environmental and Social Impacts

41. Tijana Geroski, Ognjen Pavić, Lazar Dašić, Marina Petrović, Dragan Milovanović, Nenad Filipović
Machine Learning in Medical Image Processing – From Medical Images to Automated Diagnosis

42. Igor Hut, Katarina Čolić
Integrating AI in Biomaterials Design and Development

43. Zdenka Stojanovska, Jana Djounova, Ilia Tasev, Kremena Ivanova
Radon Seasonal Variation in Bulgarian Schools and Kindergartens

44. Saša Nježić, Slobodan Savić, Živana Jovanović Pešić, Strahinja Milenković, Nikola Palić, Nenad Grujović, Fatima Živić
Modeling Friction Phenomena in Gelatin-Based Systems for Bioprinting and Material Interactions

45. Nikola Palić, Strahinja Milenković, Živana Jovanović Pešić, Vukašin Slavković, Saša Nježić, Nenad Grujović, Fatima Živić
Comparative Study of Different 3D Printed Pla Joining Techniques

46. Zoran Ćurguz, Dragoljub Mirjanić, Srđan Vuković
The Influence of Building Construction Methods on Internal Radon Concentrations in Public Buildings

47. Andrijana Bilić, Maria Savanović, Stevan Armaković, Svetlana Pelemiš, Sanja Armaković
Advancing Environmental Sustainability: Enhanced Photocatalytic Degradation of Cefoperazone Using ZnO and H_2O_2 Under Different Radiation Sources

48. Aleksandar Vuković, Srđan Vuković, Danijela Rajić, Svetlana Pelemiš
Contemporary Methods for Measuring Radon 222Rn in Water

49. Milica Jovanović, Anđela Milojević Šamanović, Dejan Zdravković, Dea Krstičević, Nedeljka Ivković, Marko Milosavljević
Application of High Performance Polymers in Prosthetic Restoration on Implants

50. Vladan Mirjanić, Milesa Srećković, Aleksandar Bugarinović, Đorđe Mirjanić, Svetlana Pelemiš, Mirko Družijanić, Dragan Družijanić
Interaction of Laser Beams with Materials as Seen From the Side of Modern Applications of Quantum Generators in Medicine with an Emphasis on Dentistry

51. Svetlana Pelemiš, Srđan Vuković
Nanomaterials in Cosmetics

52. Darija Knežević Ratković, Irena Kasagić-Vujanović
Retention Mechanisms of Amitriptyline and Its Impurities in Hydrophilic Interaction Liquid Chromatography

53. Ognjenka Janković, Radmila Arbutina, Tijana Adamović, Sanja Gnjato, Renata Josipović, Igor Đukić, Vladan Mirjanić
Genotoxic Effect of Newly Synthesized Nanomaterials for Potential Dental Application

54. Ognjenka Janković, Smiljana Paraš, Radmila Arbutina, Tijana Adamović, Vladan Mirjanić, Jovana Lovrić, Karolina Vukoje
Subcutaneous Connective Tissue Reaction to Nanomaterial Based on Calcium Aluminate and Diaroot Bioaggregate

55. Anđela Bojanić, Relja Suručić, Mirjana Đermanović
Integration of Nanotechnology and Herbal Medicine: Improvement of Therapeutic Potential in Health Care

56. Zorana Stamenković, Nenad Nedeljković, Vladan Mirjanić, Vanja Stojić, Nemanja Marinković, Ivan Arsić
Treatment of Severe Crowding Using Self-Ligating Fixed Appliances – Case Report

57. Zorana Stamenković, Nenad Nedeljković, Vladan Mirjanić, Vanja Stojić, Jovan Marković, Nemanja Marinković
Combined Orthodontic and Surgical Treatmen in Patient with Mandibular Prognathism– Case Report

58. Jelena Marković, Ivan Stevović
Environmental Status in Correlation with Water Quality Parameters of the South Morava River

59. Goran Kolarević, Tatjana Ignjić, Dejan Ignjatić, Dragoljub Mirjanić
Dose Measurement of Megavoltage Pretreatment Verification in Radiotherapy

60. Dražan Jaros, Petar Janjić, Tatjana Ignjić, Goran Kolarević
Comparison of Dose Distribution of Hybrid (IMRT+VMAT), IMRT and 3D Conformal Treatment Planning

61. Josipa Karij, Vladan Mirjanić
Influence of Hereditary Factors on Congenital Anomalies

62. Zorana Golubović, Božica Bojović, Ljubiša Petrov
Biomedical Engineering and Additive Manufacturing

63. Jelena Erić Obućina, Marina Karić
Application of Quality Materials in Order to Improve the Service Life of Hydraulic Pumps

64. Dajana Đuka, Nebojša Knežević, Igor Milunović
Analysis of the State and Impact of Waste Water During the Exploitation of the Highway Banja Luka - Gradiška

65. Predrag Dašić, Mitar Lutovac, Violeta Đorđević, Zvonko Petrović
Structure and Application of Modern Materials Database

66. Stevo Jaćimovski, Jelena Lamovec, Siniša Vučenović, Jovan Šetrajčić
Energy Spectra and Thermodynamics of Charge Carriers in Mono and Bi-Layer Graphene

67. Bojan Pavičar
Absorption Characteristics of Monochromatic Light Through Various Oil Types

68. Josipa Karij, Vladan Mirjanić
Temporomandibular Disorders (TMD)

69. Radmila Lišanin, Čedo Lalović
Comparative Methods of Analysis of Commercial "Voda Voda" to Assess Its Biological Value

70. Valentina Veselinović, Nataša Trtić, Tijana Adamović, Olivera Dolić, Radmila Arbutina, Aleksandra Đeri, Saša Marin, Nataša Knežević
Influence of Different Concentracions of Gold Nanoparticles on Surface Properties and Antimicrobial Potential of Denture Base Acrlyic Resin Materials

A B S T R A C T S

PLENARY PRESENTATIONS

APPLICATIONS OF NON-EQUILIBRIUM PLASMA IN NANO-ELECTRONICA, MATERIALS FOR MODERN TECHNOLOGIES AND BIOLOGICAL MATERIALS THROUGH THE CONTROL OF KINETIC PHENOMENA

Zoran Lj. Petrović

Serbian Academy of Sciences and Arts, Belgrade, Serbia
Ulster University, Jordanstown, North Ireland, United Kingdom

Abstract: In this lecture we shall present numerous kinetic phenomena whose explanation requires application of Boltzmann equation or Monte Carlo (MC) simulations. These phenomena are usually manifested in counter-intuitive behaviour of transport and rate coefficients of electron and ion swarms that cannot be predicted simply from the energy dependence of the relevant cross sections. There are several classes of the observed/predicted kinetic phenomena:

1. In equilibrium with the external electric field: Negative Differential Conductivity, Anisotropic Diffusion, Saturated conductivity due to inelastic collisions;

2. In temporal relaxation: transient negative mobility, diffusion heating or cooling or attachment induced heating or cooling of electron or positron swarms due to non-conservative nature of the collisional processes;

3. Relaxation in crossed time varying electric and magnetic fields; negative transient diffusion, anomalous diffusion;

4. Kinetic phenomena in the vicinity of conductive or dielectric surfaces: selective acceleration of ions and neutrals towards the surfaces due to double layers or electrode sheaths;

5. Kinetic phenomena on surfaces: selective charging and removal of charges from the surfaces and structures: …

In addition to the explanation of the physics of these phenomena we shall describe how to control them having in mind potential applications in nanoelectronics and technologies for the treatment of modern materials and biological samples.

Keywords: electron swarms, transport coefficients, relaxation, kinetic phenomena, control of swarms for applications in treatment of materials.

DIGITAL TWIN TECHNOLOGY FOR BIOENGINEERING

Nenad Filipović

Faculty of Engineering, University of Kragujevac, Kragujevac, Serbia
BIOIRC Research and Development Center for Bioengineering, Kragujevac, Serbia

Abstract: Today digital twin technology become a new concept in many areas of science, starting from basic computer science, material science, engineering, finance, medicine, food development etc. In silico clinical trials are a new paradigm for development of a new drug and medical device. SILICOFCM project is multiscale modeling of familial cardiomyopathy which considers a comprehensive list of patient specific features as genetic, biological, pharmacologic, clinical, imaging and cellular aspects.

The ventricle wall model is simulated by the muscle material model. Muscle fiber orientation is defined by direction vector in 3D prescribed through input data. The outlet blood pressure is used as the boundary condition. At the same time, the wall muscle fibers are activated according to the activation function taken from specific patient measurements.

Computational Platform for Multiscale Modelling in biomedical engineering is results of SGABU project that is served as an educational tool for students and researchers. The platform integrates already developed solutions and various datasets related to cancer, cardiovascular, bone disorders and tissue engineering into one multiscale platform. This will enable further validation and parameterization of models, creation of environment for future trends, e.g. in silico clinical trials, virtual surgery, development of prediction models.

Digital twin technology connects basic experimental research with clinical study and bioinformatics, data mining and image processing tools using very advanced computer models for drug, medical device, new design materials and patient database in order to reduce animal and clinical studies.

Keywords: digital twin, material science, bioinformatics, insilico clinical trials, machine learning, cardiovascular disease.

MEASUREMENT AND ANALYSIS OF THE SPECTRAL EMISSION OF DIFFERENT TYPES OF DOMESTIC LAMPS IN THE BLUE LIGHT HAZARD WAVELENGTH RANGE

Plamen Tsankov

Technical University of Gabrovo, Gabrovo, Bulgaria

Abstract: In recent years, research on the photobiological impact of light on humans has been expanding and deepening. A significant part of this research is aimed at harmful effects such as the blue light hazard (BLH) on the retina of the human eye, for which there are standardized indicators in international normative documents. The current research presents laboratory measurements and results for the spectral emission in blue light hazard wavelength range for several domestic lamps: conventional tungsten filament lamps, halogen and metal halide lamps, compact fluorescent lamps, and state-of-the-art LED lamps. The measurements are conducted in a specialised laboratory in the Technological Park of the Technical University - Gabrovo using a photometer with a spectroradiometer in an integrating sphere and are processed with specialised software. Graphical comparisons of the spectral distributions of lamps in the visible part of the electromagnetic spectrum with the dangerous blue light wavelength range are shown. Data on the main photometric and colour characteristics - luminous flux, light efficacy, chromaticity coordinates, colour temperature, colour rendering index, and indicators for assessing the presence of dangerous blue light - Blue light (weighted power) and Blue light hazard factor (weighted power/ lux), for the different types of lamps, are shown in tables. Conclusions and recommendations regarding the choice of the type of domestic lamp and its colour characteristics to limit the level of dangerous blue light are made.

Keywords: blue light hazard, domestic lamp, light-emitting diode, spectral distribution of lamp, spectroradiometer measurement.

ENERGY CRISIS AND CLIMATE CHANGE

Ljubomir Majdandžić

Faculty of Electrical Engineering, Computer Science and Information Technology Osijek, Josip Juraj Strossmayer University of Osijek, Croatia
Croatian Professional Association for Solar Energy

Abstract: This Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action sets out the necessary legislative foundation for reliable, inclusive, cost-efficient, transparent and predictable governance of the Energy Union and Climate Action (governance mechanism), which ensures the achievement of the 2030 and long-term objectives and targets of the Energy Union in line with the 2015 Paris Agreement on climate change following the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (the 'Paris Agreement'), through complementary, coherent and ambitious efforts by the Union and its Member States, while limiting administrative complexity. The Energy Union should cover five dimensions: energy security, the internal energy market, energy efficiency, decarbonisation, and research, innovation and competitiveness.

Keywords: European Parliament and of the Council, energy crisis, climate change, United Nations Framework Convention, energy security, the internal energy market, energy efficiency, decarbonisation, research, innovation and competitiveness.

CONTACT-TO-MECHANICAL ENERGY CONVERSION

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Abstract: The production of green energy today represents an imperative that determines the future of our planet. We are witnessing the development of a large number of methods that produce or convert energy in an environmentally friendly way. The phenomenon of contact electrification of materials has found application in the production of electricity on a small scale using tribological generators. Such sources of electricity are primarily used for sensor applications and have not found wider application in industry. The aim of this presentation is to provide a broader insight into the phenomenon of contact electrification and to present a new idea that allows mechanical energy to be obtained in the process of changing contact energy.

Keywords: contact phenomena, contact energy, mechanical energy.

THE ROLE OF MOLECULAR MODELING IN THE PHARMACEUTICAL INDUSTRY: FROM STABILITY AND REACTIVITY TO DRUG DELIVERY

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Abstract: In contemporary pharmaceutical innovations, the utilization of molecular modeling takes a pivotal role. Nowadays, the initial stride towards creating novel pharmaceutical products involves employing diverse computational methods, including first-principles calculations (such as density functional theory calculations or modern wavefunction-based methods), molecular dynamics simulations, semiempirical methods and molecular docking. These methodologies unravel the intricate reactive properties of active drug compounds and provide insight into the interactions between these compounds and drug delivery agents. The application of molecular modeling significantly streamlines experimental optimization, reducing the time required for novel product development. This lecture will demonstrate how different types of atomistic calculations can be used to address different aspects of the development of pharmaceutical products. A particular focus will be directed toward investigating interactions between drug carriers and drugs, showing how drug carriers with finely-tuned properties can be developed. Online molecular modeling platform freely available at https://atomistica.online will also be presented.

Keywords: molecular modeling, calculations, simulations, drug delivery, molecular modeling, calculations, simulations, drug delivery.

PV MODULES PERFORMANCES DURING HEATING SEASON IN URBAN AREAS

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Abstract: Production of safe, reliable, affordable, available, and clean energy is the main goal in the energy sector worldwide.

Air pollution in Eastern Europe and Balkan countries is typically higher compared to Western Europe, mainly because of wide use of fossil fuels power plants, solid fuel heating and cooking, and fewer air pollution reduction policies. Also, fuel crisis and electricity prices rise have additionally highlighted renewable energy sources utilization. Among them, photovoltaic (PV) technologies represent a good solution not only due to production of clean energy, but also due to providing self-production and self-consumption, and lower dependence on the electrical grid.

Factors that can cause unfavorable effects on the PV modules' performances, like soiling, are being increasingly examined. PV modules soiling represents the degree of modules surface dirtiness, i.e., the accumulation of contaminants (particles) either from mineral or organic origin on PV modules surfaces. Soiling reduces solar radiation intensity reaching solar cells and decreases solar radiation transmittance through the PV modules front cover, causing a reduction of the PV modules output.

PV modules soiling is geographical and time-dependent. Adjacent locations can have various PV modules soiling because specific places have particular anthropogenic particle sources (factories, fossil fuels power plants, heating plants, roads, airports, etc). Local soiling accumulation may show seasonal variances, mainly due to precipitation differences. Some locations in the world have consistent soiling throughout the year, but some of them have seasonal differences in PV modules soiling.

Rooftop and building integrated PV systems in urban areas are affected by soiling mostly initiated by the vicinity of streets with frequent traffic, factories, fossil fuels power plants, etc, and during heating season additionally by the utilization of heating plants, boiler rooms and individual residential heating systems usually using fossil fuels.

PV modules in Serbia are mainly cleaned by precipitation and wind, but sometimes they are not enough to reach PV modules efficiency specified by manufacturers, especially in the cases of vicinity of anthropogenic particle emission sources (e.g., close to the chimneys). PV modules soiling research was conducted

at the Faculty of Sciences and Mathematics in Niš. Throughout the three heating seasons in Niš, PV modules power decrease for horizontally installed module was in the interval 7.2-87.2%, and for optimally inclined module in the interval 7.2-30.6%, thus it was concluded that PV modules soiling cannot be neglected.

In order to achieve as low as possible PV modules soiling and to avoid cleaning, it is important to consider PV modules positioning before their installation, and to encourage further design and production innovations of PV integrated systems and PV modules.

Keywords: PV module, soiling, PV modules performances, heating season, urban areas.

POSTER PRESENTATIONS

TRANSPORT CHARACTERISTICS OF ELECTRONS IN NITROUS OXIDE (N_2O) UNDER THE INFLUENCE OF ORTHOGONAL DC ELECTRIC AND MAGNETIC FIELDS

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Abstract: Monte Carlo (MC) calculations of transport and rate coefficients of an electron swarm moving in nitrous oxide (N_2O) under the influence of DC crossed electric and magnetic orthogonal configuration fields are presented. The set of cross sections for e^-/N_2O interaction obtained in our previous investigations was used as the initial parameter. Calculations of mean energy, drift velocity, diffusion coefficients and rate coefficients for elastic and individual inelastic processes were performed for five different values of reduced magnetic field (B/N = 100 Hx, 200 Hx, 500 Hx, 1000 Hx and 2000 Hx, (1Hx = 10^{-27} Tm^3), where for each of these values, the value of the reduced electric field (E/N) varied in the range from 50 Td to 2000 Td (1Td = $10^{-21}Vm^2$). The ratio of the cyclotron to total collision frequency in these cases is less than one for all values of B/N (except for the highest one when it is slightly greater than one), so we may suggest that electrons are in a collision-dominated mode. The cooling effect of the swarm is visible, i.e. there is a decrease in its mean energy as the magnetic field increases, as well as a decrease in the drift velocity component in the electric field direction. Electron diffusion is slightly anisotropic for the higher values of B/N.

Keywords: electron swarm, rate coefficients, nitrous oxide.

NEW MATERIALS MEAN NEW WORLD

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Abstract: Everything is made up of one or more materials. Different materials have different properties resulting in many kinds of objects. Many new materials can revolutionize our life, transforming our habits, too. Such, industrial breakthroughs usually go with new development of materials. Advancements in materials science, while accelerating research and experimentation, effect material's sustainability, light weighting, nanomolecular, and programmable qualities. Such, material's trends in aerospace, automotive, manufacturing, energy, and packaging, show the benefits of emerging innovations. It should be of great benefit to identify material's innovations by considering the wide-range of their applications in industrial, commercial, and household products. Advanced materials have superior properties and performances, such as strength, durability, conductivity, biocompatibility, etc. compared, to existing once.

Scientists invent new materials by intention to solve many problems therefore creating new possibilities in different fields of science, engineering, and technology. Today, we tend to invent, rather than discover, new materials. The material trends range from solutions for sustainability, light weighting, 3D printing, and surface engineering. Furthermore, the development of intelligent materials, nano-formulations, and advanced composites with enhanced characteristics is practice, too. Some examples of advanced materials are: Composite metal foams, Self-healing gel, Lithium-ion batteries and similar. Those advanced materials were invented by using various methods and tools, such as: Materials Genome Initiative: and Atomic-scale fabrication.

Scientists continue to make better materials by making them stronger, lighter, and more functional than conventional ones. Using advances in nanotechnology new materials and material combinations seem endless. Furthermore, new material technology is integrated with biotechnology, and information technology, too.

Very important current R&D is related to investigation of rare earth elements having unique properties. Such, for example, neodymium magnets can store impressive amounts of energy. Further, the cerium, another rare earth element in combination with aluminum improves high-temperature performances, having better corrosion properties when compared to most aluminum alloys, too. Precision engineering on microscopic scales enables us to make metamaterials that behave in ways that "nature can't be matched".

The application of artificial intelligence, machine learning, and data management enables scientists to explore and develop new materials much faster. This shorten the time for developing new material to just a few years.

Today we are in the middle of a materials revolution. The Internet of Things, the Industry 4.0, and nanotechnology play center role. Engineers, scientists, and other researchers are changing the limits and nature of material science. The material advances are going to improve many types of products we can manufacture. They will, also, give us chances to create a healthier and more sustainable world. In those processes there will be used powerful simulation techniques, as well as sophisticated machine learning algorithms,. That will result in innovation forward at astonishing speed. Certainly, we will, in these processes use and even generate possibilities which had been never considered. No dough, the next decade will result in the rapid advancement in materials what will have, non easy predictable, impact on our life...

Keywords: new materials, industrial breakthroughs, rare earth elements, artificial intelligence

CHROMATOGRAPHIC APPROACH IN THE ASSESSMENT OF LIPOPHILITY OF CHLOROACETAMIDE DERIVATIVES

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Abstract: Chloroacetamides are widely used and highly effective herbicides. However, in addition to the positive aspects of application, their residues and metabolites remain in water and soil for a long time, which is why they represent a threat to the ecosystem. Lipophilicity, as the most important physico-chemical parameter closely related to bioavailability or potential biological activity of compounds for the newly synthesized chloroacetamide derivatives was determined computationally by using appropriate software packages, as well as experimentally, by using thin-layer chromatography on reversed phases, RPTLC C18/UV254s in a mixture of water and four organic modifier, separately. It was found that the chromatographic behavior of the studied derivatives of chloroacetamide is affected to a small extent by the applied organic modifier, and to a greater extent by the total number of carbon atoms in the structure of their molecules, as well as by the type of hydrocarbon substituents. Dependence between the chromatographic parameters and the software-derived values of the partition coefficient as a standard measure of lipophilicity, as well as the relevant parameters of acute ecotoxicity, was examined by using the linear regression analysis.The reliable application of chromatographic parameters in the assessment of lipophilicity and ecotoxicity of the tested chloroacetamide derivatives was confirmed by the obtained mathematical models.

Keywords: herbicides, chloroacetamides, chromatography, lipophilicity, acute ecotoxicity.

MONITORING OF CORROSION DEGRADATION OF SHAPE MEMORY ALLOYS IN REAL CONDITIONS

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Abstract: Shape memory alloys belong to contemporary materials that occupy an increasingly important place in various areas of modern society, which opens a new question – what is their corrosion behavior in real conditions? Corrosion degradation of metals and especially alloys in real conditions is a complex phenomenon, which results in a complex structure. The analysis of these structures gives voluminous data that are most often connected by complex interdependence with the large degree of mutual deviation. Therefore, understanding and identifying the most important corrosion factors as well as the degree of their influence on alloy degradation in real conditions is extremely difficult. In the processing of this type of data, multivariate analysis, especially the Principal component analysis (PCA), become increasingly popular due to its ability to recognize and eliminate redundant data, thus achieving a significant reduction in the number of analyzed data with minimal loss of essential information.

In this paper, the results of the corrosion test of the shape memory alloy in real conditions were processed by using PCA. The obtained distribution of the analyzed parameters indicates that multivariate methods can be successfully apply to monitoring the corrosion behavior of shape memory alloy in real conditions.

Keywords: corrosion, multivariate analysis, shape memory alloys.

INVESTIGATION OF ANTIMICROBIAL ACTIVITY OF SELECTED MONOTHIOCARBOHYDRAZONE DERIVATIVES

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Abstract: The resistance of microorganisms to antimicrobial agents known so far represents a global clinical and therapeutic problem. The loss of the drug's ability to kill bacteria or inhibit its reproduction forces scientists to find a new target of the drug's action or to synthesize new compounds to which microorganisms have not yet developed resistance. Many thiocarbohydrazone derivatives have been shown as good antimicrobial agents. Most of the tested thiocarbohydrazones so far belong to bisubstituted compounds, while monothiocarbohydrazones have been studied less, despite the fact that due to the free amino group, they can have greater biological activity than their bisubstituted analogs. In this work, the antimicrobial activity of eighteen previously synthesized and characterized monothiocarbohydrazone derivatives was tested using a modified microdilution method. The obtained results show that the studied derivatives act to a greater or lesser extent on Gram-positive bacteria, as well as that their activity depends on the type and position of the substituent present on the benzene ring.

Keywords: antimicrobial agents, biological activity, Gram-positive bacteria, microdilution method, monothiocarbohydrazones.

EFFECTS OF SURFACTANT TREATMENT ON DIELECTRIC PROPERTIES OF EPOXY/GRAPHITE COMPOSITES

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Abstract: In this work, dielectric properties of composites based on bisphenol-A-epoxy resin loaded with 5 wt.% of graphite flakes or exfoliated expanded graphite have been studied. The frequency and temperature dependence of the dielectric permittivity (ε_r) and dielectric loss (tanδ) have been examined in temperature (170 – 370 K) and frequency (20 Hz – 8MHz) range. Influence of the filler surface chemistry and geometry have been studied for composites loaded with 5 wt.% graphite flakes obtained: (*i*) under wet milling, without or with adding Triton-100x as a surfactant, or (*ii*) under dry milling in the presence of KOH. The surface treatment with KOH notable increased dielectric constant of the epoxy/GF-KOH composite. The surface treatment with Triton-100x significantly increased dielectric loss of the composite in a way that became comparable to the dielectric losses of the one loaded with exfoliated expanded graphite.

Keywords: dielectric properties, composites, graphite nanosheets. functionalized surfaces.

COLORIMETRIC CHARACTERISTICS OF ULTRASOUND DYED TEXTILES WITH EXTRACTS OF REYNOUTRIA JAPONICA AND COPPER-BASED MORDANTS

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Abstract: In this study, the influence of the type of extract (leaf and rhizome of *R. japonica*) and the type of copper-based mordant (copper (I) oxide - Cu_2O and copper (II) sulfate - $CuSO_4$) on the spectroscopic and antimicrobial properties of dyed wool knitwear was investigated. The antimicrobial activity of all samples was tested against the bacteria *Staphylococcus aureus* and *Escherichia coli* and the yeast *Candida albicans*. It was observed that knitted fabrics dyed with *R. Japonica* leaf extract and Cu_2O show a better antimicrobial effect on *S. aureus* bacteria compared to knitted fabrics dyed with the addition of $CuSO_4$. However, in the case of knitwear dyed with *R. Japonica* rhizome extract, we have the opposite case; $CuSO_4$ proved to be better as a mordant. Conductance was measured using the dielectric spectroscopy method in the frequency range from 20 Hz to 100 kHz. The highest increase in conductivity was observed in the sample dyed with the rhizome extract of *R. Japonica* and Cu_2O, where the increase at the frequency of 24 kHz was 20 times higher compared to the initial sample. The obtained results of the coloration spectrophotometric analysis of the samples show that the highest color strength (K/S) was achieved with the sample dyed with *R. Japonica* leaf extract and $CuSO_4$. The obtained results indicate the possibility of using the tested knitwear for antimicrobial as well as electromagnetic protection.

Keywords: colorimetric characteristics, antibacterial properties, dielectric properties, wool knitwear, Reynoutria japonica, Copper (I) oxide, Copper (II) sulfate.

THE INFLUENCE OF THE CATALYST ON THE RATE CONSTANT OF THE CHEMICAL REACTION OF ESTERIFICATION OF OLEIC ACID WITH METHANOL

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Abstract: Catalysis and catalysts play an important role in modern technology. Catalysis means a change in the rate of a chemical reaction under the influence of a substance that does not change chemically as a result of the reaction. This substance is called a catalyst. The catalyzed reaction proceeds on a different reaction path than the uncatalyzed reaction, thanks to the participation of the catalyst. The reactants are absorbed on the surface of the catalyst, and then a mutual reaction of the adsorbed species occurs. The reaction produces a product that is desorbed from the surface, while the catalyst remains unchanged and ready for a new reaction cycle.

An important piece of information for evaluating the quality of a catalyst is the rate of the reaction in which it participates. The subject of kinetic research is the study of the influence of process parameters on the reaction rate. It is safe to say that the study of reaction kinetics is a central part of chemical reaction engineering. Therefore, the study of the kinetics of real heterogeneous catalysts is of particular importance, both for the improvement of existing catalysts and for the development of new ones. These tests involve determining the influence of process parameters such as the type of catalyst present, temperature, pressure, and concentration of reactants and products on the reaction rate.

In this work, the influence of the mass of the catalyst at a certain temperature on the rate constant of the chemical reaction of esterification of oleic acid with methanol was studied. The catalyst used was mesoporous silica, an amorphous solid that can be obtained by drying hydrogels. It was found that as the mass of the catalyst increases, the rate of the chemical reaction constant also increases, i.e. the rate of the esterification reaction increases.

Keywords: catalyst, reaction rate constant, kinetic model, temperature.

INFLUENCE OF CURRENT DENSITY ON MORPHOLOGY AND ROUGHNESS OF SONOELECTRODEPOSITED ZN-CO-AL_2O_3 NANOCOMPOSITE COATINGS

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Abstract: Nanocomposite Zn-Co-Al_2O_3 coatings were electrodeposited from three different solutions, at 1, 2, 4 and 6A/dm^2 current densities. Electrodeposition time was same for all samples, 15 minutes. Steel plates were used as cathodes while the anode was made of 99.99% pure zinc. All samples were mechanically and chemically prepared before electrochemical deposition of the Zn-Co-Al_2O_3 nanocomposite coating. Electroplating solutions were prepared from the chemicals of p.a. purity and aluminium oxide nanoparticles. All solutions possesed the same chemical composition, they differed only in the concentration of Al_2O_3. Solution R_1 was without Al_2O_3, while solutions R_2 and R_3 containedz 2g/dm^3 and 5g/dm^3 Al_2O_3, respectively. All experiments were performed in an electrochemical cell, with a volume of 100cm^3 at room temperature and atmospheric pressure. The surface of the obtained coatings was examined by Leica EZ4 HD optical microscope at a 100x magnification, while the roughness was measured by TR 200 device. Based on the obtained results, it can be concluded that the thickness of the obtained Zn-Co-Al_2O_3 coatings depends on the current density, but also on the composition of the solution. With increasing current density, the thickness of the coating increases, as well as the roughness of the deposited coatings, while the current utilization decreases with increasing current density, no matter of plating solution composition. The morphology of the coatings was generally uniform and compact with good adhesion.

Keywords: nanocomposite coatings, electrochemical deposition, roughness, ultrasonic agitation

APPLICATION OF THE METHOD OF FOCCULATION AND SELECTIVE FLOCCULATION METHODS IN THE TREATMENT OF INDUSTRIAL SLUDGE FROM THE IRON ORE CONCENTRATION PROCESS

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Abstract: The paper presents research on the use of flocculation and selective flocculation methods in the treatment of industrial sludge, generated in the processing of iron ore minerals. The large quantity of fine sized sludge disposed as final waste still contains a relatively high concentration of iron minerals, as well as quartz and clay minerals, as tailings. It is both an environmental and an economic problem. In both cases it is useful to use flocculants to accelerate settling of fine particles. The action of flocculants, which accelerate settling, can be selective or non-selective. The research was aimed at determining the conditions under which selectivity can be achieved when using some commercial flocculants.

Key words: sludge, iron ore processing, flocculation, selective flocculation,environment

OPTIMAL LASER PARAMETERS FOR LASER INDUCTION OF GRAPHENE ON POLY(DIMETHYLSILOXANE)-BASED MATERIALS

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Abstract: The objective of this study was to develop optimal laser parameters (resolution, power, and velocity) for the formation of graphene on poly(dimethylsiloxane) (PDMS)-based materials using laser-induced graphene (LIG). A series of novel PDMS/poly(ethylene glycol) (PEG) materials with varying concentrations of PEG (30, 40, and 50 wt.%) was prepared through a blending approach. For comparison, pure PDMS was prepared using a casting method. To the best of our knowledge, the synthesis of PDMS/PEG materials and the direct laser graphenization (LIG) of PDMS/PEG materials have not been reported in the literature. Once the optimal laser parameters were established, the prepared PDMS/PEG/graphene composites were characterized using Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, and scanning electron microscopy (SEM). The results demonstrated that the addition of PEG led to an enhanced degree of graphenization compared to the pure PDMS sample, which did not induce graphene formation. Among the materials tested, the PDMS/PEG/graphene composite with 30 wt.% PEG in the PDMS matrix exhibited the optimal degree of graphenization. SEM analysis of the LIG on PDMS/PEG material revealed a porous network structure. With their improved properties, the developed PDMS/PEG/graphene composites hold promise as materials suitable for the production of flexible electronic devices.

Key words: laser induced graphene, poly(dimethylsiloxane), poly(ethylene glycol)

OPTIMIZATION OF TECHNOLOGICAL PARAMETERS FOR OBTAINING HARD CHROME COATINGS USING MINITAB 21 SOFTWARE

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Abstract: In this paper, the influence of temperature, current density, as well as the concentration of CrO_3 and H_2SO_4 on the cathodic current utilization, thickness and roughness of electrochemical chromium coatings in industrial and laboratory conditions was investigated. The influence of current density was examined at a constant bath temperature of 60°C for 30 minutes at current densities of 35, 40, 45, 50 and 55 A/dm^2. To determine the influence of temperature, a constant current density of 50A/dm^2 was used at bath temperatures of 45, 50, 55 and 60°C. The optimization of the experimentally obtained results was done using the MINITAB 21 software. It was found that the optimal parameters for the electrochemical deposition of hard chromium coatings are: temperature: 50.45-50.98°C, current density 38.17-40.66A/dm^2 and electrolyte concentration 500g/dm^3 CrO_3 and 5g/dm^3 H_2SO_4.

Keywords: chromium coatings, electrochemical deposition, current density, roughness, utilization of current, coating thickness.

QUANTUM-SIZE EFFECT AND IR ABSORPTION IN CRYSTALLINE MOLECULAR ULTRATHIN FILMS

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Abstract: In this paper, we presented a microscopic theory of the optical properties of nanoscopic thin crystalline molecular structures bounded by two surfaces. Exposure of such nanofilm to external electromagnetic fields results in the creation of excitons - but with different properties than those in the corresponding dimensionally unlimited (bulk) structure. Exciton states and energy spectra were calculated using the method of two-time and temperature-dependent Green's functions, and it was shown that two types of optical excitations could occur in films: bulk and surface exciton states. The exciton energy dispersion law shows a discrete behavior with non-zero values. Analysis of the dielectric properties of these crystalline nanosystems shows that the permittivity strongly depends on the thickness of the film, due to the quantum-size effect. In addition, the permittivity shows a very narrow and discrete dependence on the frequency of the external electromagnetic field, as a consequence of resonance effects. The influences of the boundary conditions on the absorption characteristics of these nanostructures were investigated in detail. Analyzes have shown that the broad absorption zone in the near-IR region of bulk crystals is reduced to only a few discrete absorption peaks in ultrathin films of the same crystallographic composition.

Keywords: ultrathin film, frenkel´s excitons, green´s functions, permitivity; absorption index

ENERGY SPECTRA AND STATES OF PHONONS AND CHARGE CARRIERS IN A MODEL OF SUPERCONDUCTING CUO CERAMICS

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Abstract: The translational symmetry of the distribution of atoms (ions) of the charge carriers (electrons or holes) system is broken by sputtering (doping) and due to the existence of two boundary surfaces. This is a model of high-temperature superconductors in which the observed symmetry breaking orthogonal to the CuO plane is treated as a perturbation. Single-particle fermion wave functions and possible charge carrier energies were determined. The competing existence of superconducting and normal regions in such a sample is shown in agreement with experimental data. The conditions for the formation of superconducting states and the limits of the current density values in the planes parallel to the boundary surfaces (in the CuO planes) were obtained and discussed.

Keywords: High Tc superconductivity, Copper-oxide ceramics, phonons, charge carriers, dispersion law, energy states.

ANALYTICAL MODEL OF AIR POLLUTANTS DISPERSION FROM STATIONARY POINT SOURCES OF POLLUTION

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Abstract: By air pollution we usually mean the presence of a certain concentration of gaseous and particulate pollutants in the atmosphere. A stationary or point source of air pollution is a non-moving source of pollutant emissions, such as an industrial plant. The speed of spreading pollution from a point source is a decisive parameter when we talk about the impact of pollution on natural resources or built objects, but the most important is its impact on human health. Modeling the process of air pollutant dispersion is an important engineering tool in researching the impact of pollution on the natural environment. The analytical solution of the transport two-dimensional gradient equation of advective-turbulent diffusion in the stationary state is presented. The derived equations represent the dependence of diffusion coefficients and wind speed as a complex function of the distance from the ground surface. This model is suitable for accurately predicting the level of concentration of emitted pollutants near the source as well as further downwind, under neutral or stable atmospheric conditions. The parameters necessary for specific calculations are adopted from literature data. The results obtained in this way were compared with the results obtained using the Gaussian dispersion model.

Keywords: analytical model, dispersion of pollutants, turbulent diffusion, state of the atmosphere, point source of pollution.

THE ROLE OF MODERN SOFTWARE SYSTEMS BASED ON ARTIFICIAL INTELLIGENCE (AI) IN THE NEW EDUCATION OF ENGINEERS

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Abstract: In the new real world, everything is becoming digital and smart with a large admixture of different artificial intelligence (AI) technologies. In part of the educational process, students have already widely started to use modern software systems based on artificial intelligence (AI) for writing seminar, diploma and master theses (a large group of software systems called LLM), for making presentations (such as BeautifulAI), etc. In contrast, the teaching staff uses and will increasingly use software systems for detecting plagiarism (software for plagiarism) in the mentioned works of students. Currently, the big problem for both is how to properly use unfamiliar software systems. Large Language Models (LLM) are language models that can recognize, summarize, translate, predict and generate content using very large data sets. They consist of neural networks with many parameters (typically billions of weights or more), trained on large amounts of unlabeled text using self-supervised learning or semi-supervised learning. LLMs are more recent, and the first of this group of software BERT and GPT-1 appeared in 2018. Examples of LLM are: BERT, GPT (GPT-1, GPT-2, GPT-3 and GPT-4), LaMDA, BLOOM, ChatGPT, LLaMA etc. All of the above examples of developed LLM systems are widely used in education in the field of engineering sciences.

Keywords: education, software, artificial intelligence (AI), large language models (LLM).

SCIENTIFIC INVESTIGATION OF THE MATERIALS IN THE ZOGRAPHIC-STYLED ICON

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Abstract: Although icons were considered religious art, rigidly stereotyped by the heavy hand of church and tradition with the usage of typical medieval materials (wooden supports, chalk and gypsum for the preparation layer, egg tempera paint, and gold and silver leaves), various historical and territorial influences made the icon often chosen as the means of launching new painting materials. This fact triggered the current scientific investigation of the materials of the Zographic-styled icon, St. Theodor Tiron and St. George (inv. no. GMS/U 6334; 95 x 65.5 x 2.5 cm) by an anonymous painter, dated 1700, from the collection of the Gallery of Matica srpska from Novi Sad (Serbia), the museum that holds one of the richest collections of Serbian 18th-century religious art.

The icon was found in the Serbian church of St. Theodore Tyron in Irig in Srem where it was a part of a throne. Painted in the spirit of late-Byzantine painting, just after the last Great Migration of Serbs, icon shows a golden background, the hilly ground which is lit in the distance, and the figures of the two holy warriors: Saint George, the greatest protector of soldiers, and the great martyr Saint Theodore Tyron the protector of recruits, of those who go off to war for the first time [1].

The wooden support of the icon consists of three boards, glued together. The canvas has been glued on the board, and then covered by a gesso preparation. The preparatory drawing is visible as incised lines, defining the main contours of composition. The gold was applied in leaves, on the orange bole layer and burnished. The silver leaf is applied on the sword and on the figures of saints, giving idea of armor on chests and legs. The paint layer is thick and compact. The palette is simple, including base colours: blue, green, red, brown, black and white.

The present study puts focus on blue pigments, a good indicator of the painter's choices of materials according to price and availability. The aim of this study was to use non-destructive analytical techniques (UVR-ultraviolet reflected photography, UVL-ultraviolet luminescence photography, EDXRF-energy dispersive X-ray fluorescence) to characterize the materials used on the blue parts of the icons. On the other hand, there were a few cross-sections of samples of blue pigments available as additional information about the stratigraphy of the layers, for a final discussion about the painting technique. The SEM-EDX offered detailed analysis through paint layers, enabling more reliable identification of the used materials.

Both EDXRF and SEM-EDX analytical techniques confirmed the presence of the azurite pigment ($Cu_3(CO_3)2(OH)_2$). In the EDXRF spectra the azurite was identified by the presence of characteristic peak of copper [2]. This was confirmed by EDX spectra, containing the copper peak, as well as, an intense peak of carbon and oxygen. EDXRF and EDX spectra displayed the peaks of lead and calcium, indicating the presence of lead white pigments and usage of calcium carbonate-based materials.

Keywords: blue pigment, XRF, SEM-EDX, icon.

DYNAMIC BENDING STRENGTH OF PANČIĆ SPRUCE WOOD FROM NATURAL AND ARTIFICIALLY RAISED STANDS

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Abstract: Dynamic bending strength is an important indicator of wood quality, because a large number of wood products crack under the influence of dynamic and not under the influence of static load. Among other things, the origin of the stand has a great influence on the quality of wood as a material. The aim of this work is to show the values of the dynamic bending strength, i.e. the impact strength of spruce wood originating from natural stands and wood originating from artificially raised stands, i.e. cultures. For this purpose, the material of nine trees from three localities from natural stands and six trees from two spruce cultures in Republika Srpska was used. The average value of dynamic bending strength for trees from natural stands is 5.14 J/cm^2, and for trees from artificially raised stands 3.14 J/cm^2. Regression analysis revealed that there is a very strong negative correlation between dynamic bending strength and the width of growth rings, while there is a positive correlation between dynamic bending strength and the proportion of late wood and wood density.

Key words: impact strength, Pančić spruce, natural stands, cultures.

EXTRACTION OF (POLY)PHENOLIC COMPOUND FROM HAWTHORN (*CRATAEGUS MONOGYNA* JACK.)

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Abstract: Given that many synthetic medications can induce a variety of negative reactions in patients, a search for natural substances with minimal side effects in patients has been conducted. Nowadays, researchers are focusing on plant medicines, which have been used to heal illnesses since ancient times. The plant *Crataegus monogyna* Jack. (hawthorn) is the most abuntant plant in the Rosaceae family that is also used in traditional medicine. *C. monogyna'*s pharmaceutical, phytochemical, functional, and therapeutic qualities are based on a wide range of useful secondary metabolites, which include phenolic compound (flavonoids, anthocyanins, tannins), vitamin C and antioxidants.

Total (poly)phenols, flavonoids and anthocyanins contents in *C. monogyna* Jacq. extracts were measured using the Folin-Ciocalteu reagent, aluminium chloride and pH differential methods, respectively. The extraction lasted 15 to 120 min, with a solid-to-solvent ratio of 1:15 w/v and 1:30 w/v by using solvent of 30% ethanol.

According to the results, the extraction process has the highest velocity within the first 15 min, when the majority of (poly)phenols and flavonoids are extracted, but it becomes slower as time passes. Higher yields are obtained by utilizing a solid-to-solvent ratio of 1:30 w/v rather than a solid-to-solvent ratio of 1:15 w/v, which indicates that when the amount of drug increases over a certain optimal value, the resistance to mass transfer from a solid material to liquid increases.

Keywords: anthocyanins, extraction, flavonoids, (poly)phenols.

EXAMINATION OF THE POTENTIAL OF USING BY-PRODUCTS OF BEER PRODUCTION IN THE FOOD AND PHARMACEUTICAL INDUSTRY

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Abstract: The brewing industry is a large producer of waste, which includes brewer's spent grain, brewer's spent yeast, and various auxiliary and packaging materials. Brewer's spent grain and brewer's spent yeast as organic industrial waste, represent materials rich in complex carbohydrates. In this paper, the potential of brewer's spent yeast and brewer's spent grain for the isolation of mannan-type polysaccharides and their hydrolysis to D-mannose, which finds application in the pharmaceutical industry, as well as the possibility of using these by-products in the food industry, was examined. Analysis of samples of brewer's spent grain and brewer's spent yeast determined their chemical composition. After that, the yeast cell wall was isolated from a sample of brewer's spent yeast from which mannans were extracted. After mannan extraction, proteins were removed and acid hydrolysis was performed. The resulting purified precipitate was analyzed by thin-layer chromatography (TLC).

Keywords: brewing industry, waste, brewer's spent grain, brewer's spent yeast, D-mannose.

OVERVIEW OF PHYSICS-INFORMED NEURAL NETWORKS APPLICATIONS

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Abstract: When simulating various physical phenomena, the law of the phenomenon is often known in advance, in the form of a partial differential equation, that needs to be solved. Numerical methods, such as the finite element method, have been developed over decades, and these methods approximate the solution to the partial differential equation. However, these methods can be computationally demanding. On the other hand, neural networks, can provide predictions that approximate the given partial differential equation. Neural networks are computationally more efficient than numerical methods, but they often face issues of generalization and consequently problems with solution accuracy. Insufficient generalization, among other things, can result from data collected from numerical simulations. In the last few years, physics-informed neural networks are being developed, for which it's not necessary to gather data from simulations. These networks use automatic differentiation and during training, they minimize the residuals of the partial differential equation, its initial, and boundary conditions. After training, these neural networks can be used as a replacement for traditional numerical solvers.

Keywords: physics-informed neural networks, numerical analysis, machine learning.

ANALYSIS OF SPECTRAL RESPONSE OF LED BASED SOLAR SIMULATOR

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Abstract: Solar energy becomes one of the most promising renewable energy sources available in the modern age. Due to the enormous expansion of the production of solar cells and solar radiation conversion modules, it is very important to provide an appropriate environment (equipment and software) for testing their efficiency under standard conditions. The solar simulator provides a controlled closed facility for testing solar cells and photovoltaic modules under laboratory conditions, emitting radiation that approximates natural sunlight. Light sources represent the most important component of solar simulators used in the research of photovoltaic devices. Today, LEDs have become popular as a solar simulator lighting source due to their advantages (compactness, low energy consumption, low cost, long lifetime, etc.) over conventional light sources. This work focuses on measuring, analyzing and matching the output spectrum response of the LED solar simulator with the reference spectral distribution of sunlight in the visible spectral range at AM1.5 with the help of a spectrometer, according to official world standards. Experimental measurements were performed in the Solar Energy Laboratory of the Academy of Sciences and Arts of the Republic of Srpska in Banja Luka.

Keywords: solar energy, solar simulator, light-emitting diodes, photovoltaic effect, simulation, spectrometer.

EVAPORATIVE COOLING OF PHOTOVOLTAIC MODULES

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Abstract: The total solar energy that falls on the photovoltaic (PV) module is partly converted into electricity, while a greater part is spent on temperature increase of the PV module. PV module efficiency drops with the rise in temperature, with a magnitude of approximately 0.5 %/°C. The aim of this paper is to experimentally determine the PV module output power changes during the cooling process with alcohol. In the experiment, PV modules were positioned one beside the other, and the front surface of the module was cooled with 96% ethyl alcohol. Alcohol was chosen for its innate aptitude in the process of evaporation. Presented measurement data are for the period between 10:45 and 11:05, which corresponds to solar noon and the time of maximum solar irradiation intensity. After all cycles of active cooling, the temperature of the back side of the cooled PV module was 36.8 °C, while the temperature of the uncooled module was 59.4 °C. The biggest difference in power between the cooled and uncooled module was 4.9%. On average, the efficiency of the PV module increased by 3.2%.

Keywords: PV module; active cooling; 96% ethyl alcohol.

PHOTOCATALYTIC DEGRADATION OF METOPROLOL COMMERCIAL FORMULATION: VALIDATION OF THE RP-HPLC METHOD

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Abstract: The goal of validation is to provide an optimized method that provides reliable and accurate results. Optimization and validation of the Reversed-Phase High-Performance Liquid Chromatography (RP-HPLC) method are highly significant to pharmacy, agriculture, biomedicine, etc. This method is used for qualitative and quantitative analysis and quality control. The main objective of this study was to optimize and validate a simple and rapid analytical method for isolating the active component metoprolol tartrate from commercial tablets. Parameters such as specificity/selectivity, sensitivity, linearity, dynamic range, detection limit, quantification limit, accuracy, precision, and robustness were determined. The practical application of the validated method was observed in the photodegradation study of metoprolol in the presence/absence of TiO_2 Hombikat using simulated solar and UV irradiation.

Keywords: Method validation, TiO_2, β-blocker.

INTERACTION OF COHERENT BEAMS WITH MATERIAL OF INTEREST FOR SPECIFIC APPLICATIONS

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Abstract: One specific area of application, in relation to materials of interest for electrical contacts, contain materials with a rich history and technological operations, related to them. In the theoretical approach, they are positioned near by electrical or thermal *schemesbut on many wayscould be seen at the* science of materials. In this paper, the selected materials with their previously, theoretical and laboratory results further are exposed to the new experimental treating by pulse laser beams. After thar, the interactions are modelled and monitored through parallels inside existing combinations of the same materials and with other types of lasers, also some paralels will be established against to another cases. The *remake* to the older and later modified relations between electrical and thermal conductivity is based on the accomplishing and fullfilling formalisms taken from classical and more general approximations and also on new registered, experimental results or theoretica predictions, commonly faced with sophisticated dependences.

Keywords: materials, interactions, pulsed laser, modeling, comparison, formalisms.

ENHANCING EMISSION REDUCTION AND EFFICIENCY IN BIOMASS STEAM BOILERS THROUGH FGR: EXAMINING NOX PRODUCTION AND OPERATIONAL DYNAMICS

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Abstract: As a result of efforts to follow sustainable development trends in thermal energy, the increasing utilization of biomass-fired boilers is notable as an environmentally acceptable alternative to conventional fossil fuel-based designs. However, while more ecologically viable, biomass boilers still emit specific pollutants, with particulate matter (PM), sulfur dioxide (SO_2), nitrogen oxides (NOx), and carbon monoxide (CO) being the major concerns. To mitigate these emissions, modern biomass-fired boilers often incorporate Flue Gas Recirculation (FGR). This study examines a 14 MW biomass-fired boiler with a 20% FGR rate. Analysis encompasses three scenarios: two FGR levels and operation without FGR. The research reveals a complex interdependence between emissions reduction through FGR and boiler efficiency. Moreover, findings suggest justified reduction in FGR levels to enhance boiler efficiency. The study presents a comprehensive plan for efficient FGR implementation in biomass-fired boilers while maintaining acceptable efficiency levels. For NOx emissions analysis, combustion simulation software and the Zeldovich method were employed to estimate thermal NOx production.

Keywords: biomass, efficiency, FGR, NOx, steam boiler.

CONTRIBUTION TO THE MODERN SELECTION OF MATERIALS IN MACHINE PRODUCTION

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Abstract: The state of the material to the current state in our machine production was recorded and discussed. The frequency of certain material selection criteria was quantified. The recorded situation showed that there is a lack of systematicity in the selection process, and that the criteria for the selection of materials are mostly of a qualitative, i.e. subjective, nature. In order to improve the material selection process, it is necessary to increase the share of qualitative criteria, the frequency of which is now less than 12%.

Key words: analysis of criteria, selection of materials, materials.

THE INFLUENCE OF THE CONDITIONS OF CHEMICAL ACTIVATION OF NATURAL BENTONITE ON ITS ADSORPTION CAPACITY IN THE PROCESS OF RAPESEED OIL PROCESSING

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Abstract: Natural bentonites are widely used in various adsorption processes due to their structural and chemical composition, as well as the possibility of modification by various procedures, among which chemical modification procedures are most often used. The effects of chemical activation of bentonite depend on the activation conditions, such as: type of acid or alkali, mass concentration of the activation agent, ratio of the activation agent and bentonite, activation temperature and contact time. Various modern test methods are used to determine the effects of activation, some of which are: XRD, FTIR, BET, SEM/EDS, laser method. In the process of refining rapeseed oil, the bleaching method is carried out using commercial bleaching earths or active clays.

In this paper, the chemical activation of pre-calcined bentonite was performed using 8% m/m solutions of hydrochloric acid (HCl) and sulfuric acid (H_2SO_4) at the following parameters: temperature 95°C, contact time 180 minutes, ratio of bentonite and acid solution 1:5. The analysis of the results of testing samples of activated bentonite showed that the effects of activation on the specific surface are significantly better when using HCl solution (316.28 m^2/g) compared to H_2SO_4 solution (193.04 m^2/g). In the continuation of the research, the effects of 8% HCl activated bentonite in the rapeseed oil bleaching process were examined, compared to commercial bleaching earth. The bleaching parameters were: temperature 95°C, time 30 minutes, doses of bleaching agent: 0.2, 1, 2 and 3 % w/w. To determine the effects of bleaching, the methods of testing rapeseed oil samples before and after bleaching, prescribed by the relevant national regulations, were carried out. The obtained results showed that the bleaching effects of rapeseed oil with HCl activated bentonite are similar to or better than the effects of commercial bleaching earth: there are no residual soaps in oil samples after bleaching, the peroxide number is lower, by application of a higher dose of activated bentonite the color change is more significant, and the GC method determined that there was a slight change in the fatty acid composition.

Keywords: bentonite, acid activation, bleaching, rapeseed oil, bleaching earth

INFLUENCE OF NANOPARTICLES MAGNETIC PROPERTIES AND MORPHOLOGY ON ITS APPLICATIONS

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Abstract: Magnetic nanoparticles are using to make magnetic mediums for data record and storage. For optimal magnetic mediums properties, nanoparticles must have high intensity of coercitive field and remanent magnetization and to be single domain and corrosion and friction resistant. In this investigation, nanoparticle sample of hematite (α-Fe_2O_3) was obtained by hydrothermal synthesis. Morphology and size of nanoparticles are determined using high resolution electron transmission microscope (HRTEM), where can be seen that the sample consist of plate nanoparticles with ~ 500 nm width and ~ 100 nm thickness. The coercitive field intensity for this sample on room temperature is 1140 Oe, and it is higher than with other hematite nanosystems on room temperature. Plates morphology can improve magnetic properties of nanomaterials.

Keywords: magnetic nanoparticles, magnetic memories, single domain particles, iron oxides, hematite.

RECYCLING OF ELECTRONIC WASTE

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Abstract: From the point of view of preserving the environment and ecology, one of the global world problems is electrical and electronic waste, its complexity and the speed with which this waste becomes obsolete and contains dangerous substances that are in short supply in the world, this waste most often becomes part of municipal waste and records the fastest growth in Europe, America and Asia. Electronic waste is growing three times faster than municipal waste. According to the data, a large amount of used and new electrical and electronic devices was imported into the Republic of Serbia in one period of the previous 20 years. This waste is classified as hazardous waste, and is a source of secondary scarce raw materials that can be reused. This creates new jobs and ensures the conditions for the creation of a healthy living space. Electrical and electronic waste must be collected in an organized manner. Then it is sorted and transported. A rough estimate is that in e-s 10% of correct parts, 5% can be restored and reused, and the other 85% must be dismantled, sorted and used. Recyclability of metal materials is good. Today, iron, copper, aluminum, zinc, and brass are successfully recycled. precious metals chrome. cobalt, selenium gallium germanium, silicon and many others. Recycling of plastics requires separation by type. here arises the problem of sorting the identification of types of plastic. In the case of small electrical devices, the parts are not separated individually, but crushed and shredded. An important task of waste disposal is the separation of hazardous materials and their disposal in the prescribed manner. Waste processing requires a large number of different technologies due to the wide variety of products. The content of individual components of computers and telecommunication devices such as motherboards, printed circuit boards, processors and integrated circuits, connection panels, secondary memory units, power supply devices, electric motor cables, coolers and fans will be described here.

Keywords:ecology, electronic, electrical waste, recycling.

THE CONNECTIVITY CONSTANT OF NEIGHBOR-AVOIDING WALKS ON A FRACTAL LATTICE

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Abstract: We consider Neighbor-avoiding walks (NAWs) on the fractal, 3-simplex lattice. NAWs are self-avoiding random walks that never visit any site of the lattice that is a nearest neighbor of the previously visited site (contact). They are simple models of polymer conformations in an extraordinary good solvent (usually referred to as super-perfect solvent). A closed form expression for the connectivity constant of NAWs on the 3-simplex lattice, which determines the entropy of a polymer in the thermodynamic limit, is obtained and confirmed numerically. The exclusion of the nearest neighbors has led to a reduced value of the connectivity constant and thus the entropy, in comparison with ordinary self-avoiding walks, as expected.

Keywords: neighbor-avoiding walks, polymer conformations, connectivity constant.

THE IMPORTANCE OF KNOWLEDGE OF THE GEOLOGICAL ENVIRONMENT WHEN DESIGNING SPATIAL – PLANNING DOCUMENTS

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Abstract: Terrain as a geological environment is an important factor in the creation of spatial planning documentation. It is observed on the surface of the terrain from the aspect of geomorphological formation as well as directly below the surface of the terrain from the aspect of its geological structure.

All plans, which can be strategic or executive documents, of a higher or lower order, are based on the natural environment. The geological environment, as a working and living environment and as a medium of geological resources, represents one of the basic criteria for quality use, that is, planning and reserving space for the realization of the contents outlined in the plan.

Deficiencies related to the geological environment that arise during the development or realization of the plan leave permanent or temporary devastation of the environment, and often also the endangerment of buildings either as a result of geological or modern engineering geological processes.

Keywords: geological environment, geological resources, engineering geological and hydrogeological characteristics, spatial planning documents, land use, working environment, living environment.

TREATMENT OF WASTEWATER FROM CYANIDE-FREE ZINC PLATING

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Abstract:Wastewater from the electroplating process often contains high concentrations of heavy metals, and must be treated before being discharged into public sewage systems or natural recipients. In this research, rinsing wastewater after acid and alkaline zinc electroplating process was treated by the electrocoagulation process. The experiments were performed in a batch electrochemical reactor made of polypropylene with a volume of 250 cm^3. During all treatments constant mixing was performed at a speed of 200 rpm. Different electrode pairs (anode-cathode) were used: Fe-Fe, Al-Al, Fe-stainless steel (SS), Fe-Cu, Al-SS, Al-Cu. The success of the electrocoagulation process, in terms of zinc removal from cyanide-free electroplating rinsing wastewater, achieved with electrode pairs was: Fe-NČ > Fe-Cu > Fe-Fe, respectively. The initial concentration of zinc in the wastewater was 173.5 mg/L, and after 60 minutes of treatment with the Fe-SS electrode pair it was achieved removal efficiency of 99.8%, while the specific energy consumption was 6.10 kWh per m^3 of treated wastewater, or 8.74 kWh per kg of removed zinc.

Keywords: electroplating, rinsing wastewater, electrocoagulation.

NEWTON'S SECOND LAW IN THE SERVICE OF CLIMATE CHANGE – TEMPERATURE TREND ANALYSIS

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Abstract: New approach of using Newton's Second Low in the analysis of a non-mechanical system is presented. A force that satisfies Newton's second law is introduced, where real time series of average monthly temperatures are transformed into time-dependent force parameters. The force acts on a point in data space. This method of data analysis can be considered as a type of information filtering. Extreme values of certain force parameters were analyzed as potential predictors of temperature trend emergence. Specific force parameters were calculated based on the average monthly temperatures values for several cities in Bosnia and Herzegovina. A review and discussion of possible changes in average monthly temperatures in the future are provided, based on the values of the obtained force parameters.

Keywords: Newton's second low, climate changes, temperature.

CLASSIFICATION AND APPLICATION OF COMPOSITE MATERIALS

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Abstract: A composite material is a material that is made by combining two or more materials with different physical and chemical properties. By combining them, they create a material that has better physical, chemical and mechanical properties than both basic materials from which it is made, e.g.: it is many times lighter, has greater strength, is resistant to electricity, has improved strength, hardness, stiffness, etc. The reason for their production and use over traditional materials is that they improve the properties of their base materials and are applicable in many areas. They can be divided into several basic (main) groups: NC (Nano-Composites), MMC (Metal Matrix Composites), CMC (Ceramic Matrix Composites), PMC (Polymer Matrix Composites), NFC (Natural Fiber Composites), FGC (Functionally Graded Composites), HC (Hybrid Composites) and other ACM (Advanced Composite Materials) and their subgroups. Some examples of the application of composite materials are: auto industry, electrical equipment, aviation structures, infrastructure, pipes and tanks, construction, etc.

Keywords: material, composite material (CM), nano-material (NM), hybrid material (HM), advanced materials (AM):

POLYCARBONATE PANELS ON MODERN FACADES OF BUILDINGS

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Abstract: There is a great interest in the wide application of polycarbonate panels in the creative design of facade planes of urbrchitectural physical structures, especially among architects, planners and designers. In addition to a long lifespan, the advantage of the crystal clear thermoplastic polycarbonate material is its temperature resistance from -40°C to +115°C, exceptionally up to +130°C, then resistance to physical and mechanical impacts, light transmission with superior thermal insulation, as well as the realization of very attractive aesthetic and artistic effects on facades. In this work, the author's attention is focused on the design and execution of sophisticated façade appearances made of polycarbonate materials for outdoor use, most often for numerous administrative-business, commercial and other buildings. Examples of the application of polycarbonate products in eco-urban architectural physical structures, from different climates, were considered, which illustrate the importance of influencing the function and ecological-synthetic design of the building cladding, including visual-spatial requirements, cultural-historical-citybuilding performance and other criteria. The displayed buildings are of different sizes, functions, colors and shapes. They contain the successful application of designed compositions with clad exterior facade surfaces, using the polycarbonate modular panels that brought significant innovative-conceptual and artifact-inspiring urban change in the microambient space. Keywords: polycarbonate panels, module, thermoplastic material, facade design, microambient space

Keywords: polycarbonate panels, module, thermoplastic material, facade design, microambient space.

BIOMASS AS A POTENTIAL SOURCE OF DIFFERENT FORMS OF ENERGY

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Abstract: The demand for all forms of energy is growing rapidly, which is influenced by global economic growth and population growth. The use of fossil fuels, whose reserves are otherwise limited, leads to environmental pollution and climate change. The solution to the problem is achieved by increasing energy efficiency and using renewable energy sources. Biomass, as a renewable source of energy, means matter made of plant mass in the form of products, by-products, waste or residues of that plant mass in agriculture, forestry and associated industry, as well as the biodegradable part of industrial and municipal waste. Biomass is a clean fuel, without harmful and dangerous substances in it and is carbon neutral (it is part of a closed carbon cycle). Carbon from the atmosphere accumulates in newly grown plants, during the burning of biomass, carbon is released into the atmosphere again as carbon dioxide. While respecting the principle of renewable development (plant as many trees as are cut down), this energy source has no significant impact on the environment. By processing biomass, we can obtain different types of biofuels that represent an ecological alternative to the still dominant fossil fuels. With the combined production of heat and electricity in cogeneration plants, the utilization rate of biomass increases drastically - it reaches more than 85%. Biomass can be called a sustainable source of energy because its supplies are quickly renewed, its use is harmless to the environment with reduced emissions of gases with the greenhouse effect.

Keywords: Biomass, renewable energy sources, biofuels, thermal energy.

ANALYSIS OF TISSUE RESPONSE TO COLLAGEN MEMBRANE WITH AND WITHOUT ADDITION OF BLOOD IN A MOUSE SUBCUTANEOUS IMPLANTATION MODEL

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Abstract: Collagen membranes are widely used in the regeneration of soft and bone tissue when they can be applied alone, enriched with cells and certain physiological factors, or in combination with bone substitutes. As a natural polymer, collagen is a biocompatible material. Collagen can be isolated from various tissue compartments of different organisms, using different production procedures, which causes differences in the physico-chemical characteristics of collagen materials, but also tissue response after implantation. In addition, when placing biomaterials at the site of tissue injury, biomaterials come into contact with blood, which is another factor that can affect the dynamics of the interaction of tissues and implanted biomaterials. The aim of this study was to perform a comparative analysis of the tissue response to the collagen membrane with and without the addition of blood as a physiological factor, in order to predict the tissue response in realistic physiological conditions. The tissues response of to the collagen membrane of porcine origin with and without the addition of blood, as well as the changes in the membranes, were investigated in the mouse subcutaneous implantation model 3, 10 and 30 days after implantation. The explanted membranes and their interaction with the surrounding tissue were analyzed by histological method as well as the application of scanning electron microscopy. A difference was observed in the reaction of the surrounding tissue, which is reflected in the different number of cells and the presence of different cell populations, as well as the pattern of cellular infiltration, at all observed time points The obtained results indicate that the tissue response and the behavior of the implanted collagen membrane differ depending on whether blood is added to the membrane or not, which may have a great practical significance in the clinical application of collagen membranes.

Keywords: collagen membranes, implantation, tissue response, blood.

WATER RESERVOIRS AS GREEN ACCUMULATORS AND LARGE DAMS AS MULTI-PURPOSE FACILITIES OF COMPLEX SYSTEMS

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Abstract: Although the water reservoirs become a green accumulators of the modern era, their construction is still the subject of conflicting interests and discussions. The main goal of this research is to analyse all the purposes, advantages and disadvantages of big water reservoirs, as well as to check pros and cons of building large dams. The philosophy of sustainability and mater of environmental protection is more critical analysed. One meter cube of water can be used for increasing a head and for energy production, flooding agriculture land or it can be used for irrigation and food production. One meter cube of the space behind the dam can be used for flood control, or for water supply, or for energy production. Different optimization models and its suitability for conflicting purposes of water accumulations will be presented. The subject of the strategy for renewable hydro projects adoption and decision making process will be discussed.

Keywords: water reservoirs, large dams, optimization models, multi-purpose facilities, renewable hydro projects.

SMALL WATERCOURSES AND STRATEGIC MANAGEMENT OF THEIR USE THROUGH ENVIRONMENTAL AND SOCIAL IMPACTS

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Abstract: Mountain areas are usually rich in watercourses, which are a significant resource of every country. They are typically torrential in their most upstream part and can cause extensive damage to downstream landscapes. Proper strategic management of all resources is the basis of the development of any society. The water is an esencial material for the life, environment and economy. That is why the main subject of this research is small watercourses and modalities of their strategic management, with a special attention to environmental and social impacts. This manuscript cover the review of the hydro potential of small courses in different countries, as well as the level of their usage and experiences. Main positive and negative environmental and social impacts are explained. The multicriteria methodology is offered as a support for decission makers, with the goal to reach the optimal holistic solution for optimal watercourses exploitation.

Keywords: watercourses, small hydro power plants, environmental and social impacts, EU, strategic management.

MACHINE LEARNING IN MEDICAL IMAGE PROCESSING – FROM MEDICAL IMAGES TO AUTOMATED DIAGNOSIS

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Abstract: Machine learning has the ability to discover significant and hidden relationships in a data set and finds great application in clinical diagnosis, treatment and prediction of disease development. Medical images from magnetic resonance imaging (MRI), computed tomography (CT) or X-ray are most often used as input data. The standard medical procedure, which uses manual annotation by an expert doctor, showed high variability and poor reproducibility. This paper shows several examples of the application of deep learning, as a subfield of machine learning, in automating the process of analyzing medical images, shortening the time for diagnosis, as well as ensuring high accuracy and reproducibility of results. In the field of cardiovascular diseases, as part of the SILICOFCM project (https://silicofcm.eu/), extraction of characteristic geometric parameters of the heart was performed in ultrasound images for the purposes of early detection of cardiomyopathy. In the field of neurosurgery, an example of the application of deep learning is the segmentation and classification of the level and side of disc herniation based on MRI images, using convolutional neural networks U-net, AlexNet, ResNet5, VGG16 etc. In the field of pulmonology, deep learning is used for the needs of detection of lung diseases on X-ray images, which is realized within the SoftLungX project (http://softlungx.bioirc.ac.rs/).

Keywords: deep learning, medical images, convolutional neural networks

INTEGRATING AI IN BIOMATERIALS DESIGN AND DEVELOPMENT

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Abstract: The integration of artificial intelligence (AI) and machine learning has sparked a transformative shift in the realm of biomaterials research. With the pressing need for sustainable solutions, AI's potential in guiding material design and innovation has gained significant attention. This paper explores the pivotal role of AI in generating new, eco-friendly, and economically viable biomaterials.

Numerous applications demand materials with precise physical properties, prompting researchers to harness AI's predictive capabilities to identify promising molecular configurations. The marriage of AI and sustainable design is exemplified by the evolution of compounds, such as environmentally friendly 'Photoacid generators' (PAGs) in microchip manufacturing. AI-guided molecular design and optimization present a promising route to greener alternatives.

The convergence of AI and synthetic biology opens avenues to predict the properties of novel molecules, revolutionizing high-value chemical production through microbes.

Collaborations between industry and academia are fostering the refinement of AI software and expanding material databases for training purposes. This paper delves into these collaborative efforts, showcasing their pivotal role in accelerating AI-driven material innovation.

AI's integration into biomaterials research is propelling the field toward sustainable, innovative, and efficient material design. This paper provides an in-depth exploration of AI's applications, impact, and potential challenges in advancing biomaterials science.

Keywords: artificial intelligence (AI), machine learning, material design, biomaterials.

RADON SEASONAL VARIATION IN BULGARIAN SCHOOLS AND KINDERGARTENS

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Abstract: Radon is noble gas from the uranium-radium radioactive family, can leave its place of origin and enter the atmosphere. In the atmosphere, radon dynamic is affected by meteorological conditions. In order to study seasonal variations, a radon survey was conducted on 90 premises of buildings with public access (schools and kindergartens) in different regions of Bulgaria. For the purposes of the study, in each position two RADOSYS track detectors were exposed in two periods, the firs only in winter season and second for whole year. The annual radon concentration (CRn(y)) in 77 out of 90 premises is below 300 Bq/m^3 (radon reference level in Bulgaria). While the seasonal values CRn(s) are lower than 300 Bq/m^3 in 75 rooms. The average value of the seasonal variation coefficient CRn(y)/CRn(s) is 0.92. Seasonal radon concentrations were expected to be higher than annual, but this expectation was not confirmed for all sites, so the coefficients ranged from 0.36 to 2.19. Correlation between CRn(y) and CRn(s) was investigated, and it was significant at a 95% confidence level with probability $p<0.0001$ with the obtained coefficient of determination R^2=83%. This indicates that using the liner model annual radon value could be determined due to seasonal measurements with 83% accuracy. The obtained results can optimize the protocols for carrying out the measurements in buildings with public access and will contribute to the more accurate assessment of children's exposure.

Keywords: radon, seasonal variation, track detectors, schools, kindergartens.

MODELING FRICTION PHENOMENA IN GELATIN-BASED SYSTEMS FOR BIOPRINTING AND MATERIAL INTERACTIONS

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Abstract: This study investigates friction phenomena in bioprinting and material interactions, focusing on gelatin-based systems. A novel analytical and numerical model is presented, investigating the relationships between sliding velocity, relaxation time, and tangential stress. The model's application to gelatin highlights its two-component structure and its significance in tribology. Computational outcomes are validated against Baumberg, Caroli, and Ronsin's experimental data, showcasing consistency. This research enhances comprehension of friction mechanisms in bioprinting and material science, offering insights into intricate physical and chemical interactions. The study underscores the utility of advanced modeling in deciphering complex tribological processes and their broader applications.

Keywords: bioprinting, gelatin, analytical model, numerical model.

COMPARATIVE STUDY OF DIFFERENT 3D PRINTED PLA JOINING TECHNIQUES

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Abstract: This study investigates various joining techniques for 3D-printed Polylactic Acid (PLA) specimens in comparison with fully printed specimens. Fused Deposition Modeling (FDM) is employed as the primary 3D printing method due to its cost-effectiveness and PLA's biocompatibility. Three distinct joining methods: welding, super glue, and hot glue are examined for their impact on the mechanical properties of PLA. Experimental part of study included two different ASTM D638 Type V dog bone tensile testing specimen preparation approach. One approach was 3D printing complete dog bone specimen, and the second one was two-halves fabrication of above mentioned specimens. These halves are subsequently joined using the selected techniques. The samples were tested for tension, in this way it was shown which of the joining techniques shows the results that are closest to the results of completely printed samples. The best characteristics from aspect of load bearing, both in sustained elongation (2.63 mm) and maximum load (396 N) was demonstrated by fully printed specimen. Among three joined specimens, the best characteristics were demonstrated by welded specimen (elongation at break = 1.72 mm; maximum load = 306 N), followed by superglued (elongation at break = 1.69 mm; maximum load = 125 N) and hot glued (elongation at break = 2.11 mm; maximum load = 31 N).

Keywords: 3D printing, PLA, joining materials, tensile testing.

THE INFLUENCE OF BUILDING CONSTRUCTION METHODS ON INTERNAL RADON CONCENTRATIONS IN PUBLIC BUILDINGS

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Abstract: This paper will discuss measured radon concentrations in public institutions, schools and hospitals in three cities: Banja Luka. Prijedor and Trebinje. The reason why these three cities were chosen is the geogenic potential, which is very heterogeneously expressed in these three environments. The area of the city of Banja Luka showed a pronounced radon potential in certain locations, Trebinje in almost all measured areas and the area of the city of Prijedor in all measured locations showed a low level of radon potential. The measurement was made with Gamma 2 detectors with an exposure time of 3 months in the winter-spring period, when the highest concentrations of radon in closed spaces were expected. After exposure, the detectors were read in accredited laboratories in Norway. The results showed that there are differences in the obtained results, i.e. that radon concentrations are higher in schools compared to hospitals in all three cities. The locations of the institutions where the measurements were made are located on land with a similar composition for each city. The results of this work will confirm that one of the reasons for the difference in radon concentration may be the way the buildings were built.

Keywords: indoor radon, radon concentration, Cr-39 detectors, hospitals, schools.

ADVANCING ENVIRONMENTAL SUSTAINABILITY: ENHANCED PHOTOCATALYTIC DEGRADATION OF CEFOPERAZONE USING ZNO AND H_2O_2 UNDER DIFFERENT RADIATION SOURCES

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Abstract: Cefoperazone is a widely utilized antibiotic from the cephalosporins group to treat bacterial infections. Nevertheless, due to its extensive use as a β-lactam antibiotic, it has been found to accumulate in aquatic environments, leading to notable adverse effects on flora and fauna. Consequently, there arises a necessity for its removal from the environment. The aim of this work was to investigate the efficiency of photocatalytic degradation of cefoperazone by ZnO and H_2O_2 using different types of radiation (simulated solar (SS), UV-LED, and UV). The applied nanomaterial in the presence of H_2O_2 showed significant efficiency in removing cefoperazone compared to direct photolysis. In the first 20 min of irradiation, 49.0% and 59.4% of cefoperazone were degraded when SS and UV-LED were used, respectively, while cefoperazone was completely degraded under UV irradiation. The reaction rate constant indicates that the degradation of cefoperazone is pseudo-first order.

Keywords: antibiotics, photocatalysis, environmental protection.

CONTEMPORARY METHODS FOR MEASURING RADON 222Rn IN WATER

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Abstract: Radon (222Rn) is an odorless and invisible radioactive gas. It is produced by the radioactive decay of 226Ra and is soluble in water. The presence of radon on Earth is large and it is found in all places where radium can be found. The dominant sources of radon are rocks, soil and water. Radon is the largest source of natural radiation and is recognized as one of the most significant risk factors for lung cancer. Water monitoring has a key role in assessing radiological safety, water quality and identifying sources of contamination. Contemporary techniques for determining radon in water play a key role in providing quality monitoring. This paper provides an overview of the different methods of measuring radon in water, emphasizing the advantages and limitations of each technique. Further development and application of these methods can significantly contribute to ensuring water quality and protecting human health from potential dangers caused by radon in water.

Keywords: natural radionuclides, radon, monitoring, experimental methods.

APPLICATION OF HIGH PERFORMANCE POLYMERS IN PROSTHETIC RESTORATION ON IMPLANTS

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Abstract: For prosthetic hybrid restorations on implants, different combinations of materials are used, from metal alloys, titanium, ceramics, polymers or composites. The aim of this paper is to summarize the characteristics and advantages of certain polymers in the production of hybrid restorations, as well as to present the protocol for treating patients with this type of restoration. Polymers based on poly-ether-ether-ketone have gained great popularity and success in the field of implant-prosthetic therapy. Among them, the most famous high-performance polymers developed by Bredent (Bredent group, Senden Germany) are BioHPP (containing 20% ceramic fillers) and breCAM.HIPC (highly cross-linked polymer composite material). Both polymers are machinable and are used to make temporary and permanent resaturations in prosthetics. They are biocompatible and non-allergenic, do not contain metal, oxide and monomer components, and also do not discolor the gingiva. They are characterized by excellent workability and elasticity, which is greater than zirconium ceramics and metal alloys, different shades of color is characteristics for breCAM.HIPC, unlike BioHPP, which is monolithic and monochromatic. Due to their characteristics, these high-performance polymers can be exceptional "allies" for the restorations on implants.

Keywords: polymers, implants, BioHPP, breCAM.HIPC.

INTERACTION OF LASER BEAMS WITH MATERIALS AS SEEN FROM THE SIDE OF MODERN APPLICATIONS OF QUANTUM GENERATORS IN MEDICINE WITH AN EMPHASIS ON DENTISTRY

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Abstract: With a history of several decades, depending on the country in which they are in use, with rich experience in experimental clinical treatments, it is no longer operated so much with phrases "of potential interest", but with concrete quantitative descriptions of the results of laser-type interaction in modern confirmed practice. Although there are established mean values for modeling in relation to dental tissues and materials for the formation of fillings, bridges, models for prosthetic purposes, computer programs should be equipped with the formation of a rich database for preliminary evaluation (if possible) of precise input data, starting from coefficients of reflection, absorption, i.e. optical and thermodynamic quantities. (This refers to study studies of liquid or solid materials or beams for possible cooling, formation of thin films, etc.). In the paper, for the selected set of materials, in addition to exposure to the selected type of laser, microstructure, before and after interaction and quantitative indicators are analyzed, for the purposes of modification, ejection (removal) or deep penetration of beams, with and without catastrophic conditions.

Keywords: interactions, dentistry, tissues, prosthetics, computer support.

NANOMATERIALS IN COSMETICS

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Abstract: There are a large number of cosmetic products made based on Nano-Technology. These products contain nanomaterials because they have many advantages, of which are some of which are the delivery of active ingredients, stability, increased efficiency and skin tolerance for different UV filters. Although they offer many benefits, their use requires caution. It is necessary to take care of volumes leading to their reactivity and changes in the bio-logical activity compared to the parents materials applicable. The shape and size of the particles are the cause of the appearance of toxic effects, not their chemical properties. In this paper, we will review those materials that find applications in personal care products such as: Liposomes, Niosomes, Transfers, Nanoemulsions, solid lipid nanoparticles, polymeric systems, nanocriteria, Fullerene and finally metal oxide nanoparticles.

Keywords: nano-technologies, nano- particles, cosmetics, toxicity.

RETENTION MECHANISMS OF AMITRIPTYLINE AND ITS IMPURITIES IN HYDROPHILIC INTERACTION LIQUID CHROMATOGRAPHY

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Abstract: Hydrophilic interaction liquid chromatography (HILIC) become method of choice in the analysis of small polar compounds latelly. Retention mechanism in HILIC system involves the distribution of the analyte between the mobile phase and a partially immobilized water layer on the surface of the stationary phase. Apart from partitioning, surface adsorption and ion–exchange are included in the retention mechanism as well. In addition, hydrophobic interactions can affect tested substances separation process. Retention mechanisms in HILIC are very complex. Interactions between mobile and stationary phase depend on multiple factors: analyte properties, type of the stationary phase, and mobile phase composition. Thus, the separation mechanism differs for each pair of mobile and stationary phase. The aim of this paper was to investigate retention mechanisms of amitriptyline and its impurities A, B, C, D, F and G on 4 different HILIC stationary phases: silica, amide, diol and amino. In HILIC region, partitioning was dominant only on amino stationary phase, while on all the other stationary phases adsorption model fitted data better. The explanation for this phenomenon lies in fact that adsorption and/or partition occurs only in case of stationary phases that does not have conspicuous surface charge. Otherwise, ionic interactions are very dominant.

Keywords: retention mechanisms, hydrophilic interaction liquid chromatography, adsorption, partition, amitriptyline.

GENOTOXIC EFFECT OF NEWLY SYNTHESIZED NANOMATERIALS FOR POTENTIAL DENTAL APPLICATION

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Abstract: Introduction: Biocompatibility is the property of a material to fulfill its function in the body without causing harmful side effects. To confirm biocompatibility, all newly synthesized materials must undergo numerous in vitro and clinical tests. The starting point is cytotoxicity and genotoxicity tests. This study aimed to determine the genotoxicity of newly synthesized nanomaterials based on calcium aluminates and calcium silicates with additional hydroxyapatite.

Material and methods: The research was conducted at the Institute of Oncology in Belgrade. An alkaline version of the Comet test was used, following the recommendation of the international standard ISO / DIS 10993-3, and MRC-5 (normal human lung fibroblasts) was used as a cell line. Cells were grown in monolayer culture, in a complete nutrient medium, at a temperature of 37 °C in air enriched with 5% CO_2 and saturated water vapor. The genotoxicity of calcium aluminate and mixtures of hydroxyapatite and calcium silicate was investigated. and untreated cells were used as controls. A 40x lens on a fluorescence microscope was used to visualize the DNA damage. Comet Assay IV (Perceptive Instruments) was used to statistically process the results.

Results: ALBO-CA extract did not show a genotoxic effect, that is, the percentage of DNA damage at the highest applied concentration of cement of 100 mg / mL, was 9.6%. ALBO-CS-HA extract showed genotoxic potential at concentrations ≥ of 25 mg / mL

Conclusion: Nanostructured calcium aluminate did not show genotoxic potential on human lung fibroblasts, unlike ALBO-CSHA, with recommendations for further studies.

Keywords: genotoxicity, nanomaterials, calcium aluminates, calcium silicates.

SUBCUTANEOUS CONNECTIVE TISSUE REACTION TO NANOMATERIAL BASED ON CALCIUM ALUMINATE AND DIAROOT BIOAGGREGATE

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Abstract: Introduction: This study aimed o evaluate connective tissue reaction to experimental nanomaterial based on calcium aluminate (*ALBO-CA*) and commercial nanostructured tricalcium silicate DiaRoot Bioaggregate (DiaDent Group International, Burnaby, BC, Canada) in Wistar rats.

Material and methods: The study included 36 rats aged from 10 to 11 weeks. In all animals, an incision took place on the back and two pockets of 15 mm in depth were made, in which sterile polyethylene tubes with test materials (*ALBO-CA -Group F*, Diaroot Bioaggregat-Group C) were implemented. The empty half of the tubes represented a negative control. After 7, 15, and 30 days (n = 12), the animals were euthanized, and the tissues were processed for histological evaluation using hematoxylin-eosin (H&E) staining. Patohystological analysis included: inflammation, bleeding, fibrous capsule, and tissue integrity around the implanted material. Data were analyzed by the Mann -Whitney U test.

Results: ALBO-CA induced a statically significantly less inflammatory response after 15 (U=42.000, Z=-2,460, p=0,014) and after 30 days (U=42,000, Z=-2,198 p=0,028,). At the end observation period significantly less vascular congestion (U=42.000, Z=-2,460, p=0,014) and significantly greater preservation of connective tissue integrity was noted (U =36,000, Z=-2,769, p=0,006) after ALBO-CA implantation compared to Diaroot Bioaggregate. The Man-Whitney U test did not show a statistically significant difference in the fibrous capsule between tested materials at any of the control times.

Conclusion: The tested materials proved to be biologically acceptable, with the experimental nanostructured ALBO-CA showing a slightly better tissue response after subcutaneous implantation in rats.

Keywords: biocompatibility, nanostructured calcium aluminates, Diaroot Bioagregate, subcutaneous connective tissue.

INTEGRATION OF NANOTECHNOLOGY AND HERBAL MEDICINE: IMPROVEMENT OF THERAPEUTIC POTENTIAL IN HEALTH CARE

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Abstract: Herbal medicine represents one of the oldest forms of medical practice since ancient times, which is still used around the world and includes the use of herbal medicines for preventive or therapeutic purposes. On the other hand, nanomedicine represents a new scientific field that uses nanotechnology, the manipulation of materials on the nanoscale (1 - 100 nm), for the diagnosis, treatment and prevention of diseases at the molecular level. Although these two disciplines are very different at first glance, their integration could unlock the full therapeutic potential of phytotherapy by enabling innovative approaches to improve the bioavailability and efficacy of herbal medicines through targeted and controlled delivery, allowing to overcome its current limitations and reduce side effects. This paper explores the importance of implementing nanotechnology in herbal medicine, emphasizing its potential impact on health care. Also, the techniques of encapsulating herbal medicines into nanomedicines, various herbal nanoformulations and application and modes of action, are presented. In conclusion, continued research in this area is considered as a key to unlocking the full potential of nanomedicine application in herbal medicine. Such research drives innovation, as well as personalized approaches to therapy and advances healthcare, which could pave the way for a healthier and more sustainable future.

Keywords: herbal medicine, nanomedicine, nanoformulations, bioavailability

TREATMENT OF SEVERE CROWDING USING SELF-LIGATING FIXED APPLIANCES – CASE REPORT

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Abstract: This case report presents the treatment of a 12-year-old boy with a complete permanent dentition using self-ligating fixed appliances. The analysis of study models revealed an 8mm space deficiency in the upper and 9mm in the lower dental arch, with a skeletal and dental Class I occlusion. The initial lateral cephalogram showed maxillary normognathism (SNA 82°), mandibular retrognathism (78°), and ANB angle of 4°. There were no vertical skeletal deviations, the SpP/MP angle was 20°. The total Bjork's polygon angle was 389°, the Jarabak's method was 67.7%, the inclination of upper incisors I/SpP was 78°, the inclination of lower incisors i/MP was 95°, with no deviations in the length of the maxilla, mandible and mandibular ramus. Therapy with self-ligating upper and lower fixed appliances was applied, considering the oral inclination of upper and lower incisors, horizontal facial growth pattern and harmonious profile appearance. The fixed appliance therapy lasted for 26 months, with interproximal reduction in the upper and lower anterior teeth region. During the treatment, the dental arches were expanded and adequate space was provided for the proper alignment of all teeth. The retention phase was ensured using retainers worn every night. The therapeutic result was stable, without signs of relapse, with a Class I occlusion on both sides, 2mm overjet and 3mm overbite.

Keywords: severe crowding, self-ligating fixed appliance, interproximal reduction.

COMBINED ORTHODONTIC AND SURGICAL TREATMEN IN PATIENT WITH MANDIBULAR PROGNATHISM– CASE REPORT

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Abstract: The aim of this case was to present a combined orthodontic-surgical treatment for a 30-year-old patient. The initial clinical examination revealed a Class III malocclusion, concave profile, 4.5mm overjet, and 2mm overbite. The treatment plan included orthodontic preparation with fixed appliances, surgical correction of skeletal discrepancies, and post-surgical orthodontic treatment. Lateral cephalograms were taken before the orthodontic therapy, just before the surgical intervention, and after the treatment, following the removal of fixed appliances. On the initial lateral cephalogram SNB angle was 88°, ANB -5°, SpP/MP 28°, total Bjork's polygon angle 405°, I/SpP 71°, i/MP 111° and mandibular corpus length was increased by +11mm. On the final post-surgical lateral cephalogram, after the intervention and appliance removal the SNB angle was 81°, ANB 3°, SpP/MP 25°, total Bjork's polygon angle 398°, I/SpP 64°, i/MP 96° and mandibular corpus length was increased by +3mm. The pre-surgical orthodontic treatment lasted 12 months, followed by bimaxillary surgery. The post-surgical orthodontic treatment lasted 12 months. After appliance removal, a retentive phase with night-time wear of retainers was implemented. The result was stable Class I occlusion, satisfactory profile appearance, 2.5mm overbite, and 2mm overjet.

Keywords: skeletal class III, mandibular prognathism, presurgical orthodontic treatment, bimaxillary surgery.

ENVIRONMENTAL STATUS IN CORRELATION WITH WATER QUALITY PARAMETERS OF THE SOUTH MORAVA RIVER

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Abstract: The South Morava River is very important for the City of Vranje. It water serves for irrigation of agricultural land and for drinking, so the water quality and its environmental status is of great importance. Water quality control in the South Morava is done on a monthly basis by chemical and physical methods. Controlling is done at two measuring points from which the samples are taken, namely the village of Mezgraje, near the Railway Bridge, and the site of Mramora Novo Selo. Tests of water samples from the South Morava River included determination of: general parameters, nutrients, salinity, organic substances and microbiological parameters. Measured values of the investigated physicochemical parameters at the sampling location at Mezgraja village level, with the Railway Bridge, dominantly correspond to class I, except for BOD5 corresponding to class V, HPC corresponding to class IV, TOC, phenolic compounds and total nitrogen corresponding to class II, nitrites, orthophosphates, ammonium ion, copper and iron content corresponding to Class III,. At the same location, the measured values of microbiological parameters correspond to Class IV. The water of South Morava River, from the physico-chemical aspect, has a mixed excellent to poor environmental status, while from a microbiological point of view it has a moderate environmental status at Mramor (Novo Selo) or poor ecological status at the level of the village of Mezgraja, at the Railway Bridge. The results of the water quality control tests show that the water is nutrient-poor and has microbiological parameters present in MPN/100 ml.

Keywords: water quality control, environmental status, South Morava River, testing, chemical methods, physical methods.

DOSE MEASUREMENT OF MEGAVOLTAGE PRETREATMENT VERIFICATION IN RADIOTHERAPY

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Abstract: **Background/Aim.** Accurate pre-treatment image verification of patient positioning in radiotherapy (RT), known as Image-guided radiotherapy (IGRT), has consistently remained crucial for ensuring the precise administration of RT treatment to the patient. Electronic Portal Imaging Devices (EPID) have largely taken over the role of film-based verification, resulting in enhanced image quality and improved depiction of critical information regarding the tumor volume's position. The imaging dose delivered to the patient can vary based on the chosen verification method (such as two orthogonal mega-voltage scans, two orthogonal kilo-voltage scans, or Cone beam CT) and the energy level of the radiation photons being used. This study aimed to measure the pre-treatment verification doses administered to patients using MV photon radiation.

Methods. In our RT center, we use the medical linear accelerator True Beam (Varian Medical Systems, Palo Alto CA, USA), which has a-Si 1200 EPID. All measurements were conducted using the lowest photon energies available, specifically 2.5 MV flattening filter free (FFF) and 6 MV with a flattening filter (FF). For the purposes of the study, a heterogeneous phantom CIRS Thorax 002LFC (Computerized Imaging Reference Systems Inc, Norfolk VA, USA) was used. This phantom is designed to anatomically and dimensionally simulate an average human thorax, measuring 30 cm in length, 30 cm in width, and 20 cm in height. It is made of plastic water, lungs and bone. Within the phantom, there are 10 cylindrical inserts designed to accommodate ionization chambers for the precise measurement of absolute dose. To ascertain the absolute dose at ten specified measurement locations within the Thorax 002LFC phantom, an Exradin A-19 farmer-type ionization chamber (0.62 cm^3 in volume) paired with a SuperMax electrometer (Standard Imaging Inc, Middleton WI, USA), was used. All dose measurements were carried out utilizing the isocentric technique for every measurement point. This involved acquiring measurements from two projections: Anterior-Posterior (AP) and Lateral (LAT)-with a single monitoring unit (MU) for each projection. The field dimensions were set at 16x16 cm^2. Absolute doses were computed following the guidelines outlined in Technical Reports Series No. 398, which provides the protocol for absorbed dose determination in external beam radiotherapy.

Results. The depth dose percentages at 10 cm and 20 cm (10x10 cm^2, SSD 100 cm), for photon beams 2.5 MV FF and 6 MV FF are: 52.7 % and 22.7 % vs 66.3 % and 38.1 %. Quality index (D_{20}/D_{10}) was 0.485 vs 0.669 (2.5 MV FFF vs 6 MV FF). The measured absorbed doses (2.5 MV FFF) in the soft tissue, for two orthogonal projections (1 MU each), were 14.1-16.7 mGy. Using identical measurement conditions in the lungs, absorbed doses ranging from 16.8 to 18 mGy were measured. In the bone region, 11.4 mGy was measured. For 6 MV FF, under the same conditions, all measured doses were found to be higher by 29 % in comparison to the doses measured for 2.5 MV FFF. For an average number of about 20 RT treatments (fractions), the patient receives an additional imaging dose of 300 mGy (2.5 MV), i.e. about 400 mGy (6 MV).

Conclusion. In the field of external photon beams radiotherapy (RT), Image-guided radiotherapy (IGRT) stands as the recognized gold standard. Delivering treatment without image verification is deemed unacceptable due to the crucial role it plays in ensuring the precise administration of the dose to the tumor volume. If using MV photon beams for pre-treatment image , it is advisable to opt for lower MV energy whenever feasible. Imaging modalities based on kV photon beams (kV-kV and kV CBCT), This approach facilitates a concurrent reduction in the margin between the clinical target volume (CTV) and the planning target volume (PTV), aligning with the ALARA principle (As Low As Reasonably Achievable) for minimizing radiation exposure. In clinical practice, the majority of radiotherapy (RT) centers commonly rely exclusively on kV imaging, except when dealing with treatment fields.

Keywords: radiotherapy, MV imaging, dose, MV photon beam.

COMPARISON OF DOSE DISTRIBUTION OF HYBRID (IMRT+VMAT), IMRT AND 3D CONFORMAL TREATMENT PLANNING

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Abstract: Background/Aim: For women with left sided breast cancer, a major concern is the dose of radiation delivered to the heart. In order to reduce the dose to the heart during tangential breast irradiation, in our institution we implemented a deep inspiration breath hold (DIBH) technique. Aim of this retrospective study was to compare dosimetric effects of the DIBH on the heart, left anterior descending artery (LAD) and ipsilateral lung (IL) planned with hybrid plan (IMRT+VMAT), IMRT and conformal-forward IMRT plans.

Methods: Twenty patients who underwent RT with DIBH at our institution were retrospectively analysed. Conformal plans consisted of two opposed tangential segmented 6MV beams and one direct beam with small dose contribution. Hybrid plan consisted of two tangential IMRT 6MV beams with 90% of the dose contribution and two 180° arcs (6MV) with 10% of the dose contribution. IMRT plan consisted of two opposed tangential beams. Doses to the planning target volume (PTV), clinical target volume (CTV), heart, LAD, IL and contralateral breast were assessed.

Results: Dosimetric comparison between hybrid, IMRT and conformal DIBH radiotherapy for mean dose to the heart was 2.42Gy vs. 1.64Gy (p=0.03) vs. 2.88Gy (p=0.137), and the mean percentage of the volume receiving 25Gy was 0.54% vs. 0.77% (p=0.832) vs. 0.85% (p=0.04), respectively. radiotherapy Mean PTV coverage was 98.98% vs. 96.38% (p<0.001) vs. 96.33% (p<0.001), mean CTV coverage was 99.49% vs 98.79% (p<0.001) vs. 97.85% (p<0.001) for hybrid, IMRT and conformal treatment plans, respectively. Mean dose for LAD was 7.73Gy vs. 7.33Gy (p<0.001) vs. 11.88Gy (p<0.001). Mean percentage of the volume receiving 20Gy for the IL was 12.06% vs. 12.09% (p<0.001) vs. 13.26% (p<0.001) for hybrid, IMRT and conformal plans, respectively. Mean percentage of the volume receiving 5Gy for the contralateral breast was 1.71% vs. 1.52% (p<0.001) vs. 0.81% (p=0.002) for hybrid, IMRT and conformal treatment planning, respectively. Mean percentage of the volume receiving 10Gy for the contralateral breast was 0.40% vs. 0.69% (p=0.363) vs. 0.49% (p=0.414) for hybrid, IMRT and conformal techniques, respectively.

Conclusion: Comparison of three planning techniques showed better target coverage for hybrid radiotherapy plans. Hybrid and IMRT planning and delivery reduces the dose delivered to the heart, LAD and ipsilateral lung. IMRT Conformal planning technique showed better results for contralateral breast.

Keywords: breast cancer radiotherapy, deep inspiration breath hold, hybrid planning

INFLUENCE OF HEREDITARY FACTORS ON CONGENITAL ANOMALIES

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Abstract: A congenital anomaly is a medical (dental) term referring to an irregular development of teeth, oral cavity, jaws, or other structures of the oral region that occur during the embryonic development of a fetus. These anomalies are present at birth and can result from genetic factors, inheritance, or other influences during prenatal development. They affect the appearance, function, and health of the oral cavity, teeth, jaws, or soft tissues. Cleft lip and cleft palate, also known as orofacial cleft, are a group of conditions that involve a separation in the lip, palate, or both. Cleft lip includes an opening in the upper lip that can extend to the nose. The opening can be on one side, on both sides, or in the middle. Cleft palate occurs when the roof of the mouth has an opening into the nasal cavity. These anomalies are polygenically and/or environmentally controlled. The treatment of cleft lip and palate depends on the severity of the malformation. For most children, during their development, they are cared for by craniofacial surgery teams, and the treatment can last a lifetime. Surgical techniques depend on the surgical team. The primary method of detecting congenital anomalies in dentistry is through a clinical examination by a dentist. Dentists examine the oral cavity, teeth, jaws, and soft tissues to identify any abnormalities or irregularities. This clinical assessment can reveal many congenital anomalies in dentistry, such as cleft palate and lip, irregular tooth development, or jaw irregularities. Each therapy is individual and is based on the evaluation of the specific dental congenital anomaly and the patient's needs. The dentist will conduct a detailed diagnosis and assessment to determine the most appropriate therapy for each patient. The treatment of certain dental congenital anomalies may take place over an extended period of time, and sometimes collaboration with other specialists will be necessary to achieve the best possible outcome for the patient.

Keywords: congenital anomalies, cleft lip and palate, diagnosis, therapy.

BIOMEDICAL ENGINEERING AND ADDITIVE MANUFACTURING

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Abstract: Additive manufacturing (AM) technologies have evolved significantly in recent decades, bringing new trends to production processes. The advantages compared to conventional technologies are numerous: production is simpler and faster, geometry can be adjusted more easily, the quality of finished parts is better, less material is wasted, and costs are lower. Because of the wide range of possibilities, the different AM processes and the materials that can be used, these technologies have found their place in many industries, with significant application in biomedical field. Flexibility in geometric freedom, in particular, is important for the fabrication of biomedical devices. AM technologies proved that diagnostics is facilitated and improved through the fabrication of customized and in-demand parts, consultation between physicians and patients are supported, and thus the opportunity to develop individualized, patient-specific medicine is provided. This review briefly outlines current applications and AM processes in the biomedical field.

Keywords: additive manufacturing, biomedical engineering, applications, areas.

APPLICATION OF QUALITY MATERIALS IN ORDER TO IMPROVE THE SERVICE LIFE OF HYDRAULIC PUMPS

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Abstract: This paper analyzes the application of high-tech ceramics in hydraulic axial-piston pumps with variable working volume. These pumps have their own developed modern solutions that provide them with modern management and the ability to adapt to the conditions prevailing in the hydraulic system. That management and response to certain conditions in the hydraulic system is carried out so that energy losses are minimal, and the application of modern materials ensures that the working life is improved in places with heavy loads. The paper will analyze the application of such materials along with the characteristics of the pump that are provided and that improve mechanical properties and performance. Modern pump solutions are primarily reflected in economical operation with satisfactory performance characteristics. This characteristic mainly depends on the basic solutions of the pump, but also on the materials that make up that hydraulic component. In connection with this, a high-quality hydraulic pump must have a long working life in exploitation while achieving high reliability. The combination of a good constructive solution in the implementation of the application of quality materials results in a high-quality hydraulic pump.

Keywords: high-tech ceramics, graphite parts, hydraulic servo pump.

IMPACT OF WASTE WATER DURING THE EXPLOITATION OF THE HIGHWAY BANJA LUKA - GRADIŠKA

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Abstract: The occurrence of wastewater is recognized as a problem that appears in the preservation of the environment. Given that the highway Banja Luka - Gradiška represents the busiest section in the Republic of Srpska, in the subject research, water samples from 40 separators that represent regular monitoring of waste water during the operation of the highway Gradiška - Banja Luka, prescribed by the environmental permit, will be analyzed. The classification of surface waters is based on two groups of criteria: general, which define the ecological status of water, and criteria for specific hazardous and toxic substances that reach the aquatic environment as a result of various industrial and other anthropogenic activities. The examination covered the basic groups of physico-chemical parameters of the water sample, in this case the obtained measurement results were compared with the limit values defined by the Rulebook on conditions for discharge of waste water into surface waters. Based on the analysis of the quality of the effluent, the goal is to determine whether they meet the conditions, given that the problem of wastewater pollution is one of the most important parameters defining the relationship between the highway and the environment.

Keywords: wastewater, highway, impacts, separators, monitoring.

STRUCTURE AND APPLICATION OF MODERN MATERIALS DATABASE

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Abstract: A database (DB) is an organized set of related data from a specific field, which can be collected and processed. The data in the database are somehow logically connected, and can represent data from all areas of human activity and all aspects of the real world. Entering or adding, updating (editing, changing and deleting), organizing, accessing, searching, sorting and displaying data, as well as sharing it with others via reports, e-mails or the Internet, is made possible by database management systems (DBMS). Dozens of material databases (MDB) have been developed for the field of materials in the world. They allow storing, accessing, searching, sorting and displaying data about materials according to their type, physical characteristics, mechanical properties and standard classifications. This makes material databases (MDB) an excellent and powerful software tool for any engineer which, with the development of the Internet, has become easily accessible to both engineers and anyone else interested in the production and application of various types of materials. Some examples of material databases (MDB) are: a large number of online material databases developed by ASM (American Society for Metals International), such as: ACDB™ (Alloy Center Database), MMDB™ (Medical Materials Database), MPDS (Materials Platform for Data Science), MakeItFrom, MAPTIS (Materials and Processes Technical Information System), Materials Project, MatDat (Materials Database), MatNavi developed by NIMS (National Institute for Materials Science), MatWeb (Materials Information on Web), MC (Material Connexion), MWeb (Materials Web), OMDB (Open Materials Database), Total Materia, UL Prospector etc. Each of the listed Material Databases (MDBs) contains more than 150,000 data on different materials.

Keywords: Material, database (DB), database management system (DBMS), materials database (MDB).

ENERGY SPECTRA AND THERMODYNAMICS OF CHARGE CARRIERS IN MONO AND BI-LAYER GRAPHENE

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Abstract: Using quantum Green's functions, expressions for the energy spectra of charge carriers of monolayer and bilayer graphene were found. Expressions for the density of states of charge carriers of the observed systems were found based on the spectra. Also, the paper considers the share of charge carriers in the thermodynamic characteristics (specific heat) of monolayer and bilayer graphene and makes a comparison with available experimental data..

Keywords: quantum Green's functions, graphene, charge carriers, energy spectra, specific heat.

ABSORPTION CHARACTERISTICS OF MONOCHROMATIC LIGHT THROUGH VARIOUS OIL TYPES

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Abstract: Light absorption serves as a potent investigative tool for examining light's properties and the mediums through which it travels. Our study encompassed measuring light absorption across a spectrum of wavelengths, passing through diverse mediums including water and various oils. Utilizing monochromatic sources—violet (405nm), green (532nm), and red (650nm) lasers—we observed light transmission, capturing the optical signal and converting it into electronic data. Demonstrating the Lambert-Beer law, we identified diminishing light intensity relative to the absorbing medium's thickness. This technique proves invaluable for gauging oil layer depth in mixed water-oil mediums, such as during water contamination incidents, facilitating pollution quantification and guiding responsive measures. Beyond absorption, the presence of oil in water was vividly evidenced by intense luminescence phenomena.

Keywords: absorption, monochromatic light, oil, luminescence.

TEMPOROMANDIBULAR DISORDERS (TMD)

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Abstract: The temporomandibular joint is the connection between the jaw and the skull, enabling chewing and speaking. TMJ disorder is a condition that can cause pain, discomfort, and limited movement in this joint. Symptoms include jaw pain, headaches, difficulty opening the mouth, and chewing. The disorder can be caused by various factors such as stress, poor chewing habits, injuries, or genetic predisposition. Diagnosis involves a physical examination, X-rays, and MRI scans. Treatment is tailored to the symptoms and may include changes in habits, medication therapy, physical therapy, and the use of splints. Managing stress and maintaining a healthy lifestyle can also help. TMJ disorder can significantly impact daily life, but with proper treatment, most people improve symptoms and joint functionality.

Keysword: temporomandibular joint, TMJ disorder, pain, headaches, difficulty opening mouth, genetic predisposition, diagnosis, medication therapy, physical therapy.

INFLUENCE OF DIFFERENT CONCENTRACIONS OF GOLD NANOPARTICLES ON SURFACE PROPERTIES AND ANTIMICROBIAL POTENTIAL OF DENTURE BASE ACRLYIC RESIN MATERIALS

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Abstract: The gingivally supported denture base, made of conventional polymethyl methacrylate (PMMA), is susceptible to biofilm formation and the development of denture stomatitis. The purpose of this work is the production of PMMA enriched with gold nanoparticles (AuNPs) with improved antimicrobial properties.

Material and methods. AuNPs were added to denture base PMMA in concentration of 0,5% and 1%. Heat-polymerized acrylic resin specimens of pure PMMA and nanomodified PMMA (PMMA/AuNPs) were prepared according to each test specification. Surface roughness and surface free energy were measuremed by Profilomethar, and hydrofobicity and contact angle were measured by Tensiometar. Antimicrobial activity of newly formed PMMA/AuNPs were evaluated for two different microbial streins (Candidae albicans and Staphylococcus aureus) in monomicrobial biofilm form. Colony forming units (CFUs), cell metabolic activity (MTT) and disc diffusion test for each tested strain were performed.

Results: The surface roughness, surface free energy increase in PMMA/AuNPs samples. There is no statisticaly differences between tested groups. Hidrofobicity and contact angle measurement shows differences compare to unmodified PMMA. PMMA/AuNPs showed a significant reduction in the monomicrobial biofilms of all tested species compare to control group and it is in direct coleration with percentage of added AuNPs. The CFUs test of AuNPs modified PMMA samples did not show change compare to pure PMMA. Released AuNPs did not recorded around the PMMA/AuNPs samples.

Conclusion: Incorporation of AuNPs into heat-polymerised denture base PMMA led to surface properties change. Antimicrobial activity of PMMA/AuNPs increase in corelation with percentage of AuNPs and it is significantly expressed even in a very small concentration of gold nanoparticles.

Keyword: gold nanoparticles, denture base, acrylic resin, denture stomatitis.

NOTES