



8th International Workshop on Surface Engineering & 4nd International Workshop on Applied and Sustainable Engineering

Collection of workshop proceedings in varied subject categories

Abstracts



International Workshop, 02–08 June 2019, Koszalin University of Technology, Poland



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PROGRESS OF PESTICIDE RESIDUE DEGRADATION IN FOOD

4th International Workshop on Applied and Sustainable Engineering

Marta Stachnik

Department of Food Industry Processes and Facilities, Faculty of Mechanical Engineering,
Koszalin University of Technology, Poland

e-mail: marta.stachnik@tu.koszalin.pl

Type: POSTER

Abstract: Concerns about chemicals and pesticides in food plants have increased dramatically during the last decade. Following stricter legislation and studies about toxicity and human health risks, new ways of reducing toxic residues are urgently required.

Key Words: pesticides, pesticide removal, food safety

PESTICIDE RESIDUE – A PRESSING ISSEU

4th International Workshop on Applied and Sustainable Engineering

Marta Stachnik, Monika Sterczyńska

Department of Food Industry Processes and Facilities, Faculty of Mechanical Engineering,
Koszalin University of Technology, Poland

e-mail: marta.stachnik@tu.koszalin.pl

Type: POSTER

Abstract: Pesticides fight crop pests and reduce competition from weeds, thus improving yields and protecting the availability, quality, reliability and price of produce. At the European Union level the principle aim is to ensure that pesticides are used correctly to minimize health or environmental risks. Still, pesticides residue can be found in many item both raw and processed.

Key Words: food contamination, pesticides, analytical methods

RHEOLOGICAL PROPERTIES OF CONGRESS HOT TRUB

4th International Workshop on Applied and Sustainable Engineering

Marta Stachnik, Monika Sterczyńska, Karolina Żmuda-Trzebiatowska

Department of Food Industry Processes and Facilities, Faculty of Mechanical Engineering,
Koszalin University of Technology, Poland

e-mail: marta.stachnik@tu.koszalin.pl

Type: PRESENTATION

Abstract: Hot trub is a side product of beer making. It is usually thrown away, but it's high BOD necessitates need for recycling. If hot trub is recycled it is added to the spent grains and fed to animals. Little is known about hot trub properties. Rheological properties were measured for a congress hot trub made from different raw material composition. It was noted that hot trub shows thixotropic and shear thinning properties. Viscosity change can be approximated with Hershey-Bulky model and values depended on the raw material composition.

Key Words: rheology, hot trub, non-newtonian fluid

THE SCREW-DISC EXTRUDER IN WPC (WOOD-POLYMER COMPOSITES) PROCESSING

Wróblewska-Krepsztul J., Rydzkowski T.

Department of Processes and Equipment of the Food Industry, Faculty of Mechanical Engineering,
Koszalin University of Technology

e-mail: tomasz.rydzkowski@tu.koszalin.pl, jolanta.wroblewska-krepsztul@s.tu.koszalin.pl

Type: POSTER

Abstract: Literature from recent years indicates the growing interest of research centers and industry in the composites of polymer materials with wood fillers. Wood - polymer composites arouse interest for several reasons. Crude oil and gas deposits are exhaustible, which affects their price and the price of polymers. Partial replacement of polymers with wood that is cheaper, renewable is reasonable for economic and ecological reasons. The combination of wood and polymer material is characterized by good properties of the obtained products [1]. Wood - polymer composites can be obtained by extrusion of mixtures in a screw-disk extruder. In the screw-disk system, it is possible to extrude WPC mixtures containing more than 30% by weight of the wood fraction. Screw-disk extruder in addition to the rotational speed of the screw has the ability to set an additional process parameter - the width of the gap of the disk zone, which is original and in other designs does not occur. During the screw-disk extrusion of WPC composites, the wood phase may be crushed in the disk zone of the extruder, the resulting fineness being dependent on the width of the slit and the rotational speed of the screw. The filler material, depending on the shape, will be subject to crushing, grinding, exfoliation, breaking. The dimensions of filler particles, especially reinforcing particles, affect the properties of the composites obtained [2]. It is possible to control and thus design the properties of the composite obtained by specific extrusion parameters in the plasticizing system of the screw-disk extruder, i.e. gap width and rotational speed, depending on the amount and type (shape, particle size, origin) of the filler used [3].

Literature:

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- [3] Michalska-Požoga I., Rydzkowski T., The effect of extrusion conditions for a screw disk plasticizing system on the mechanical properties of wood-polymer composites (WPC)., Polimery 2016, 61, nr 3.

Key Words: screw-disk extruder, polymer composites, WPC composites

BIONIC INSPIRATIONS IN SURFACE LAYER PROPERTIES CREATION

8th International Workshop on Surface Engineering

Adam Ruszaj^{1,2}, Mariusz Cygnar¹

1 State University of Applied Sciences in Nowy Sącz, Technology Institute, Poland

2 Cracow University of Technology, Kraków, Faculty of Mechanical Engineering, Poland

e-mail: ruszaj@mech.pk.edu.pl

Type: PRESENTATION

Abstract: The Bionic (from Greece words "bios – life" and "mimesis – to mimic"); is an interdisciplinary science, which investigates alive organisms (plants and animals), materials and processes occurring in the natural surroundings in order to apply results in technical solutions. The "Bionic" achievements have been applied in many branches of industry [1, 2, 3, 4, 5]. Nowadays the intensive research are carried out also on biological inspirations in the area of surface layer properties creation. "Bionics structures" on details working surfaces can improve its quality or make it possible to adopt for special working conditions. For example skin structure of butterfly wings gives high lifting force, high speed, good control and low loudness of the flight. This sophisticated butterfly wings surface layer structure was an inspiration for bionic wind turbine blades surface layer design [2, 3]. Experimental research proved that "bionic turbine" has ~15% higher efficiency in energy production in comparison with turbine with smooth blades. It means that bionic blade take of 15% more energy from the wind in comparison smooth turbine blade. There are many animals which skin has a special geometrical structure with very low coefficient of friction. For example: sharks, snakes or dung beetle [4, 5]. These structures were the inspirations for design surface layer structure for cooperated parts. Parts made of grey cast iron – GCI with bionic surface layer structure have significantly higher (of ~20 to 53%) fatigue wear resistance in comparison to samples with conventional smooth surface structure. Similar conclusion results from experiments carried out for samples made of steel. From above presented examples results that "bionic" builds a bridge between "world of plants, animals and processes" developed by the Nature in evolution process and technical solutions and applications. Using "bionic" solutions it is possible to solve satisfactory technical problems occurred in area of production engineering.

Literature:

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- [4] Chen Z., Lu S., Song X., Zhang H., Yang W., Zhou H., Effects of bionic units on the fatigue wear of gray iron surface with different shapes and distributions, *Optics & Laser Technology* 66 (2015), pp. 166-174.
- [5] Lu J., Yang CH., Zhang L., Feng A., Jang Y., Mechanical Properties and Microstructure of Bionic Non-Smooth Stainless Steel Surface by Laser Multiple Processing, *Journal of Bionic Engineering* 6 (2009), pp. 180–185.

Key Words: bionic, bio-inspirations, lightweight design, optimal shape, optimal surface structure, fatigue wear, clean energy

ESTIMATION OF LIQUID DEPOSITION ON PLANTS SPRAYED FROM A DRONE

4th International Workshop on Applied and Sustainable Engineering

Bogusława Berner

Faculty of Mechanical Engineering, Koszalin University of Technology, Poland

e-mail: boguslawa.berner@tu.koszalin.pl

Type: POSTER

Abstract: In this paper were presented results of research into the impact of rotors rotary speed of moving drone on the spray deposition on plant surfaces. Modern management in sustainable agriculture requires the fast information about condition of cultivated plants and the quick response to undesirable phenomena such as appearance of pests. The use of drones for spraying plants will allow for rapid application of plant protection agents on the growing areas.

Key Words: UAV, spraying plants, liquid deposition, drone, multi-rotor

Acknowledgment: The research was financially supported by the statutory resources of the Mechanical Faculty of the Koszalin University of Technology.

LiDAR SENSORS BASED ON UAVs FOR PRECISION AGRICULTURE

8th International Workshop on Surface Engineering

Bogusława Berner

Faculty of Mechanical Engineering, Koszalin University of Technology, Poland

e-mail: boguslawa.berner@tu.koszalin.pl

Type: POSTER

Abstract: In this paper present how work a Light Detection and Ranging (LiDAR) sensor mounted on an Unmanned Aerial Vehicle (UAV) can map the overflowed environment in point clouds. Mapped canopy heights allow for the estimation of crop biomass in agriculture. The work presented in this paper contributes to sensory UAV setup design for mapping and textual analysis of agricultural fields. LiDAR data are combined with data from Global Navigation Satellite System (GNSS) and Inertial Measurement Unit (IMU) sensors to conduct environment mapping for point clouds.

Key Words: UAVs, remote sensing, lidar; streams, point cloud, vegetation, crop breeding

Acknowledgment: The research was financially supported by the statutory resources of the Mechanical Faculty of the Koszalin University of Technology.

pH-SELECTIVE POTENTIOMETRIC SENSOR BASED ON CERAMIC NANOPARTICLES

Nikola Lenar, Robert Piech, Beata Paczosa-Bator

AGH University of Science and Technology, Faculty of Materials Science and Ceramics,
al. Mickiewicza 30, PL-30059 Krakow, Poland

e-mail: nlenar@agh.edu.pl

Type: PRESENTATION

Abstract: PH level, which is indirectly connected to the quantity of hydrogen ions is the critical parameter determining the environmental status and the quality of water or aqueous solution both in natural environment and industrial processes. The pH range is also decisive parameter in human body as an indicator of the acid-base balance. According to IUPAC the only accurate method of pH measurement is the potentiometry method with the use of ion-selective electrodes (ISEs). Measurements of pH are routinely performed using the glass electrode due to its high selectivity and wide pH measurement range. However, as a result from the presence of internal solution glass electrodes are characterized by the fragility, large size and the need for vertical position. This work presents the new pH sensor developed with the use of ceramic nanoparticles instead of internal aqueous filling. Implementing the ceramic nano-sized material into ion-selective electrode's construction enabled to achieve fast and stable potentiometric response in the wide pH range from 2 to 12. Designed electrodes exhibit analytical properties nearly as excellent as glass electrode. Moreover, in comparison with the glass electrode they are less fragile, smaller and easier to use. Developed sensor enabled to overcome the drawbacks resulting from glass electrode's construction while exhibiting great analytical properties thus may be considered as a replacement for glass electrode.

Key Words: pH sensor, ion-selective electrode, glass electrode, ceramic nanoparticles

CeO₂ - CONTACTED ION-SELECTIVE ELECTRODES AS ELECTROCHEMICAL SENSORS FOR NITRATE IONS DETERMINATION IN LEAFY VEGETABLES

Agata Wieczorek, Nikola Lenar, Robert Piech, Beata Paczosa-Bator

AGH University of Science and Technology, Faculty of Materials Science and Ceramics,
al. Mickiewicza 30, PL-30059 Krakow, Poland

e-mail: nlenar@agh.edu.pl

Type: POSTER

Abstract: The new chapter in potentiometry method's history begun with developing the first all-solid-state ion-selective electrode. The first all-solid-state electrode called the coated-disc electrode was developed by casting the disc electrode's surface with ion-selective membrane. This solution enabled to improve the performance parameters yet the analytical properties were not sufficiently good to obtain reliable potentiometric sensor. There was a clear need for a material to be placed between electrode material and the membrane. This led to developing the so called solid-contact electrodes with the solid material used instead internal solution. This work presents the 2 – contacted electrodes and their analytical parameters compared with the ones obtained for coated-disc electrodes. Developed sensors were used for nitrate ions determination in leafy vegetables enabling to obtain the fast potential response revealing the nitrate ions concentration. Nitrate ions are described to have both harmful and beneficial effects on human health therefore their concentration in our diet should be balanced. Different content of nitrate ions in vegetables was observed depending on their variety, source and storage conditions.

Key Words: nitrate ions, cerium dioxide, all-solid-state electrodes

HERITAGE RECORDING AND 3D MODELING WITH 3D SCANNING AND PHOTOGRAMMETRY

4th International Workshop on Applied and Sustainable Engineering

Štefan Gubo, Ondrej Takáč, András Molnár

J. Selye University, Bratislavská cesta 3322, 945 01, Komárno, Slovakia

e-mail: gubos@ujs.sk, takaco@ujs.sk

Type: PRESENTATION

Abstract: The importance of cultural heritage recording and documentation is well recognized at international level and capturing historic structures, archaeological sites and landscapes their current state have become nowadays a common practice. However, the creation of such 3D models requires a powerful methodology able to capture and digitally model the fine geometric and appearance details. This presentation mainly focuses on the methodology used to document selected Romanesque round churches in Slovakia and Hungary using various state of the art techniques, such as LiDAR and UAV. Furthermore, it also reports an application of 3D model generation of ancient tombstones and reliefs by using photogrammetric techniques.

Key Words: cultural heritage, digital recording, 3D reconstruction, UAV, LiDAR

COMPARISON OF HCR GEARS COATED BY PVD COATING AlCrN WITH NON-COATED HCR GEARS LUBRICATED BY BIO-FRIENDLY LUBRICANT

8th International Workshop on Surface Engineering

Adam Fürstenzeller¹, František Tóth¹, Milan Kadnár¹, Juraj Rusnák¹,
Miroslav Bošanský², Marian Kučera¹

¹ Faculty of Engineering, Department of Machine Design, Slovak University of Agriculture in Nitra, Tr.
A. Hlinku 2, 949 76, Nitra, Slovakia

² Institute of Transport Technology and Designing, Faculty of Mechanical Engineering, Slovak
University of Technology in Bratislava, Námetie Slobody 17, 812 31, Bratislava 1, Slovakia

e-mail: adam.furstenzeller@gmail.com

Type: POSTER

Abstract: The submitted scientific poster deals with application PVD coating AlCrN on HCR gears in conditions lubricated by eco-friendly lubricant and with the comparison of coated and non-coated HCR gears. HCR gears were made from material 16MnCr5. As lubrication environment was chosen eco-friendly lubricant OMV Biogear S150. Experimental tests were performed on the Niemann M01 FZG testing rig. In the experiment, we followed standard STN 65 6280. After each load level were measured values of the maximum height of the assessed profile Rz for tip and reference diameters. Results of experimental tests were statistically processed and on a basis on them were established relations between the maximum height of the assessed profile Rz and load level.

Key Words: biological oil, HCR gears, PVD coating AlCrN, FZG test

Acknowledgment: Contribution has been prepared within the solving of scientific grant project VEGA 1/0227/15 "Study of tribological characteristics of the new high hard coatings on materials suitable for gearings."

NANOCOMPOSITE COATINGS TECHNOLOGY

Jan Novotný

J.E Purkyně University in Ústí nad Labem, Faculty of Mechanical Engineering, Ústí nad Labem, CR

e-mail: jan.novotny@ujep.cz

Type: POSTER

Abstract: The aim of the research is to inform about the formation of nanocomposite coatings. These coatings can be of wide use. His particular research has been carried out to extend the durability of the molds used to vulcanize rubber materials in the automotive industry. A base material in this case is an aluminum alloy, specifically Al-Si. This alloy is coated with a nanocomposite coating. In this case the PTFE coating, which can be used on its own, is enriched with nanoparticles based on titanium dioxide, tungsten carbide and aluminum oxide.

Key Words: nanoparticles, coatings, electron microscopy

POSSIBILITIES OF USING PCM MATERIALS IN AGRICULTURE

4th International Workshop on Applied and Sustainable Engineering

Juraj Maga

Slovak University of Agriculture in Nitra, Faculty of Engineering,
Tr. A. Hlinku 2, 949 76 Nitra, Slovak Republic

e-mail: juraj.maga@uniag.sk

Type: POSTER

Abstract: Currently, energy storage is a very important part of heating systems. Energy storage allows the storage of thermal gains of the environment in the period when they are available and their recovery in times of lack of heat. For example, phase change materials (PCMs) that allow not only storage of sensible but also latent thermal energy can be a solution to the problem of energy storage. The use of these materials leads to reduced energy consumption and increased thermal comfort. These aspects cause temperature fluctuations to stabilize during the day and at the same time reduce or shift the peak load. The aim of this work was to analyze the existing PCM materials on the market and their possible application in agricultural production. The work suggests the use of PCM materials for the selected farm to accumulate solar radiation from autumn to spring. The application concerned a company that deals with vegetable production, where it was necessary to reduce the night temperature fluctuations. In this work, emphasis was placed on the technical development of a new system that meets the required economic and technical requirements.

Key Words: phase change material, PCM, heat accumulation

POSSIBILITIES OF GENERATING PRECESIONAL GEARS BY CNC MILLING MANUFACTURING METHODS

S. Scaticailov

Technical University of Moldova, Department of Manufacturing Engineering, Republic of Moldova

e-mail: serghei.scaticailov@utm.tcm.md

Type: POSTER

Abstract: Processing precesional gears requires advanced machining technologies. In the paper are presented new methods of processing these gears using CNC technologies. Five-axis machine -tools require skills in CAM programming, with the benefits they give and that are recommended.

Key Words: milling, precession transmission, gear, CNC technologies

I-MACHINING ADVANTAGES AND OPPORTUNITIES

S. Scaticailov¹, A. But²

¹ Technical University of Moldova, Department of Manufacturing Engineering, Republic of Moldova

² Polytechnic University of Timisoara, Department of Materials and Manufacturing Engineering,
Romania

e-mail: serghei.scaticailov@utm.tcm.md, adrian.but@gmail.com

Type: POSTER

Abstract: Modern technologies give to the CAM engineers more opportunities and benefits. The paper present the real results obtain using the i-machining strategies from SOLID CAM software. Was underline the modality how was implement and the time comparision between the classical CAM milling strategies versus the i-machining strategies adapt on real part.

Key Words: CAM milling, CNC technologies, CAD software, i-machining

THE USE OF BISMUTH ELECTRODES FOR THE DETERMINATION OF SELECTED CYTOSTATIC DRUGS

Justyna Lipińska, Bogusław Baś

AGH University of Science and Technology, Faculty of Materials Science and Ceramics,
al. Mickiewicza 30, PL-30059 Krakow, Poland

e-mail: justyna.lipinska@agh.edu.pl

Type: POSTER

Abstract: Cytostatic drugs are the most common form of chemotherapy. The group of cytostatics includes both natural and synthetic drugs. The most widely used classification of anticancer drugs based on their origin and their chemical structure and mechanism of action. This division distinguishes: cytostatic antibiotics, antimetabolites, alkylating drugs and others. This paper focus on different constructions of bismuth electrodes, which can be applied in the voltammetric determination of cytostatic drugs. Attention is given to drugs from the group of antimetabolites and the group of cytostatic antibiotics. The first measurement procedure concerns the highly sensitive determination of methotrexate using a bismuth based film electrode. The second measurement procedure concerns the determination of daunomycin using a bismuth bulk electrode. The presented results show that voltammetric methods can be successfully applied to high-sensitivity determination of selected cytostatic drugs. The bismuth sensors which are used, comply with the principles of green chemistry.

Key Words: cytostatic drugs, voltammery, bismuth electrodes

Acknowledgment: JL has been partly supported by the EU Project POWR.03.02.00-00-I004/16.

VOLTAMMETRIC METHOD FOR THE DETERMINATION OF METHOTREXATE

Justyna Lipińska, Bogusław Baś

AGH University of Science and Technology, Faculty of Materials Science and Ceramics,
al. Mickiewicza 30, PL-30059 Krakow, Poland

e-mail: justyna.lipinska@agh.edu.pl

Type: PRESENTATION

Abstract: Chemotherapy is the treatment of cancer with natural and synthetic anticancer drugs commonly called cytostatics. One of the groups of cytostatic drugs are antimetabolites, which are analogues of natural metabolites or coenzymes (vitamins, amino acids). Chemotherapy with antimetabolites is based on the difference in the kinetics of proliferation between cancerous and normal tissue. Methotrexate is the most commonly used drug from the group of anti-metabolites. Methotrexate is an anti-vitamin of folic acid, with tetrahydrofolate dehydrogenase binds a thousand times more strongly than folic acid, practically completely irreversibly. It is excreted in 90% with urine. This paper presents a novel, high sensitive analytical method for electrochemical determination of methotrexate at bismuth bulk annular electrode using differential pulse voltammetry. Preliminary research included optimization of the composition, concentration and pH of the supporting electrolyte and instrumental parameters of stripping cyclic voltammograms. The obtained results indicate that the developed method is analytically useful for the determination of methotrexate.

Key Words: methotrexate, voltammetry, drug determination

Acknowledgment: JL has been partly supported by the EU Project POWR.03.02.00-00-I004/16.

COMPARISON OF HCR GEARS COATED BY PVD COATING AlCrN WITH NON-COATED HCR GEARS LUBRICATED BY BIO-FRIENDLY LUBRICANT

8th International Workshop on Surface Engineering

Fürstenzeller A., Tóth F., Kadnár M., Rusnák J.

Faculty of Engineering, Slovak University of Agriculture in Nitra, Slovakia

e-mail: adam.furstenzeller@gmail.com

Type: POSTER

Abstract: The submitted scientific poster deals with application PVD coating AlCrN on HCR gears in conditions lubricated by eco-friendly lubricant and with the comparison of coated and non-coated HCR gears. HCR gears were made from material 16MnCr5. As lubrication environment was chosen eco-friendly lubricant OMV Biogear S150. Experimental tests were performed on the Niemann M01 FZG testing rig. In the experiment, we followed standard STN 65 6280. After each load level were measured values of the maximum height of the assessed profile Rz for tip and reference diameters. Results of experimental tests were statistically processed and on a basis on them were established relations between the maximum height of the assessed profile Rz and load level.

Key Words: bio-friendly lubricant, HCR gears, PVD coating AlCrN, FZG test rig

Acknowledgment: Contribution has been prepared within the solving of scientific grant project VEGA 1/0227/15 "Study of tribological characteristics of the new high hard coatings on materials suitable for gearings."

VERIFICATION OF HTC VIVE DEPLOYMENT CAPABILITIES FOR ERGONOMIC EVALUATIONS IN VIRTUAL REALITY ENVIRONMENTS

Z. Tůma, L. Kotek, J. Kroupa

Brno University of Technology, Faculty of Mechanical Engineering, Brno, Czech Republic

e-mail: tuma@fme.vutbr.cz

Type: PRESENTATION

Abstract: Musculoskeletal assessment of possible risks in the workplace of the future is difficult, because it is not possible to simply evaluate and predict the attitudes of workers. The virtual reality environment offers an initial insight into the future workplace. For better immersion in the environment, HTC Vive were selected. The ergonomic method selected for assessment is called RULA. Because of work in a virtual reality environment, it is necessary to measure in the real laboratory environment. As a reference device, the MS Kinect solution against occlusion has been selected. Measurements were performed in the laboratory according to a recently published article on RULA assessment using MS Kinect. The results show that HTC Vive can serve as an integral tool to assess a musculoskeletal risk in designing new workplaces.

Key Words: virtual reality, ergonomic studies, RULA method

Acknowledgment: This work is an output of research and scientific activities of NETME Centre, regional R&D centre built with the financial support from the Operational Programme Research and Development for Innovations within the project NETME Centre (New Technologies for Mechanical Engineering), Reg. No. CZ.1.05/2.1.00/01.0002 and, in the follow-up sustainability stage, supported through NETME CENTRE PLUS (LO1202) by financial means from the Ministry of Education, Youth and Sports under the "National Sustainability Programme I".

VOLTAMMETRIC DETERMINATION OF SUMATRIPTAN ON MODIFIED ELECTRODES

E. Wójcik, A. Górska, B. Paczosa-Bator, R. Piech

AGH University of Science and Technology, Faculty of Materials Science and Ceramics,
al. Mickiewicza 30, PL-30059 Krakow, Poland

e-mail: agorska@agh.edu.pl

Type: POSTER

Abstract: Migraine headaches are a very common condition that affects about 40% of the population [1]. Despite the fact that migraine does not directly threaten human life, it largely affects its comfort and quality, preventing normal functioning. This is a particularly difficult condition to treat, because the pathogenesis of migraine has not been fully understood [2]. Sumatriptan is a selective agonist of the 5-HT_{1D} and 5-HT_{1B} receptors, blocks the release of vasoactive peptides. Moreover, Sumatriptan is thought to block the activation of painful neurons, interrupting the process of nerve impulse transmission, thereby alleviating the symptoms of migraine [3]. The use of differential pulse voltammetry for the determination of sumatriptan on the glassy carbon electrode modified with a carbon black layer was proposed. Modification of glassy carbon electrode with carbon black allowed to significantly increase sumatriptan signal. The instrumental measurement parameters, the electrolyte solution composition and the influence of potential interferents were optimized. Additionally the limit of detection and the linearity range of the method were determined. The accuracy of the method was determined by the recovery test.

Literature:

- [1] The global burden of disease 2004 update. Geneva: World Health Organization, 2008
- [2] Elizabeth Loder, Triptan Therapy in Migraine, JMed 2010
- [3] Patrick P.A. Humphrey, The Discovery and Development of the Triptans, a Major Therapeutic Breakthrough

Key Words: voltammetry, glassy carbon electrodes, surface modifications, sumatriptan

METFORMIN DETERMINATION USING VOLTAMMETRY AND FLOW INJECTION ANALYSIS ON CB-RuO₂ GC ELECTRODE

Anna Górska, Beata Paczosa-Bator, Robert Piech

AGH University of Science and Technology, Faculty of Materials Science and Ceramics,
al. Mickiewicza 30, PL-30059 Krakow, Poland

e-mail: agorska@agh.edu.pl

Type: PRESENTATION

Abstract: Metformin is an antidiabetic drug which belongs to the group of the biguanides. It is a first line agent in treatment of diabetes mellitus type 2, which is a metabolic disorder characterized by increased sugar level in blood [1,2]. Statistics shown that Metformin is most commonly prescribed drug worldwide, therefore methods used for its determination should be developed [3]. In the literature various examples of methods used for determination of Metformin might be found. One of them is high performance liquid chromatography (HPLC) or liquid chromatography/high performance liquid chromatography coupled with mass spectrometry (LC-MS and HPLC-MS). Another methods used for Metformin determination are spectrophotometry and capillary electrophoresis. Mentioned methods might be very expensive or sample preparation process is long and complicated. That is why electrochemical methods, among them voltammetry is also a useful tool in MET determination. In our work we present different types of surface modification for glassy carbon electrodes used for Metformin determination. The best results were obtained for new type of modification - carbon black and RuO₂ (CB- RuO₂ GC). This type of electrode is easy to prepare and its lifespan is about few weeks what is a huge advantage compare to other solution presented in the literature. Constructed electrodes were used for Metformin determination using voltammetry. Developed method was optimized and interferences study was carried out (organic and inorganic ions). In order to verify the usefulness of the developed method analysis of pharmaceutical products was carried out. Obtained results were in a good agreement with producer's declaration. Accuracy of the method was estimated based on recoveries. Method was also adapted to hydrodynamic conditions and measurements of pharmaceutical samples using flow injection analysis have been successfully conducted.

Literature:

- [1] R. Sreedharan, *Anesthesiol. Clin.*, 36, 581–597 (2019)
- [2] C. M. Khoo, *Diabetes Mellitus Treatment*, Second Edi., p. 288–293, Elsevier, (2016)
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Key Words: metformin, voltammetry, surface modification, glassy carbon electrodes

NON-STOICHIOMETRY AND DIFFUSION IN (Co,Cr,Fe,Mn,Ni)₃O₄ HIGH ENTROPY OXIDE

M. Miszczak, G. Smoła, M. Stygar, J. Dąbrowa, M. Danielewski, Z. Grzesik

AGH University of Science and Technology, Faculty of Materials Science and Ceramics,
al. Mickiewicza 30, PL-30059 Krakow, Poland

e-mail: miszczak@agh.edu.pl

Type: PRESENTATION

Abstract: The deviation from stoichiometry and chemical diffusion in (Co,Cr,Fe,Mn,Ni)₃O₄ high entropy oxide were investigated as a function of oxygen pressure at 1273 K. (Co,Cr,Fe,Mn,Ni)₃O₄ was obtained by sintering the following mixture of starting oxides: Co₃O₄, Cr₂O₃, Fe₃O₄, MnO, NiO at 1273 K. The presence of a single-phase, high entropy solid solution structure was confirmed by means of combined SEM+EDS and XRD. It has been found, on the basis of marker studies, that the anion sublattice of the investigated high entropy oxide is predominantly disordered. This result, together with non-stoichiometry data determined using thermogravimetry, lead to the conclusion that the predominant point defects in the studied oxide are oxygen vacancies at low pressures and interstitial anions at high pressures. Consequently, the chemical formula of this oxide, taking into account the deviation from stoichiometry, can be written as (Co,Cr,Fe,Mn,Ni)₃O_{4±y}. The chemical diffusion coefficient of defects was determined using reequilibration method. The values obtained for the chemical diffusion coefficient strongly depend on oxygen pressure, suggesting the presence of a complex point defect structure in (Co,Cr,Fe,Mn,Ni)₃O_{4±y}.

Key Words: high entropy oxide, spinel structure, deviation from stoichiometry, chemical diffusion

INVESTIGATION OF THE COMPOSITION AND PROPERTIES OF ELECTROLYTES ON CHLORIDE AND NITRATE BASE DURIND ECM OF HEAT RESISTANT ALLOYS

8th International Workshop on Surface Engineering

V.I. Petrenko¹, S.P. Iushchenko¹, S.P. Sidelnikova¹, I.D. Rushica²

¹ Institute of Applied Physics, Academy of Sciences of Moldova,
Academiei str., 5, Kishinev, MD-2028, Moldova

² The Technical University of Moldova

e-mail: v_petrenko@phys.asm.md

Type: POSTER

Abstract: Electrochemical machining (ECM) as process of applied electrochemistry is metal anodic dissolution at high current densities and high rates of electrolyte flow through small interelectrode gap or the purpose of heat and reaction products removal from the treatment area. Considering particular ECM conditions for ECM application chloride-nitrate solutions are used as a rule. Composition and properties of such electrolytes vary in the course of their long-term maintenance owing to accumulation of electrode reaction products. The aim of present work is to investigate the dynamics of composition and properties of chloride-nitrate electrolyte changes under the conditions of Ni-Cr and Ni-Fe-Cr alloys anodic dissolution at high current densities during electrolyte long-term exploitation, as well as to determine the impact of these changes on the electrochemical machining rate and electrolyte localizing power. The final aim of this investigation was the development of methods of electrolyte purification (in particular, bichromates-ions) and stabilization of it composition and properties during long-term service.

Key Words: electrochemical machining, heat resistant alloys, chloride and nitrate electrolytes

PROPERTIES AND STRUCTURE OF NANOCRYSTALLINE IRON AND COBALT ALLOYS WITH TUNGSTEN DEPOSITED FROM GLUCONATE SOLUTION

8th International Workshop on Surface Engineering

Zh.I. Bobanova¹, V.I. Petrenko¹, G.F. Volodina¹, I.D. Rushica²

¹ Institute of Applied Physics, Academy of Sciences of Moldova,
Academiei str., 5, Kishinev, MD-2028, Moldova

² The Technical University of Moldova

e-mail: bobanova@phys.asm.md

Type: POSTER

Abstract: Electrodeposited alloys of iron group metals and tungsten have particular physical and mechanical properties. Evaluation of the functional properties of binary and ternary alloys allows expanding possibilities of their practical application. The effect of electrolysis conditions on the structure, mechanical characteristics of alloys deposited from gluconate electrolytes with characteristics comparable to those of chromium coatings was studied. Maximum deposition rates, tungsten concentrations, microhardness and low friction coefficients are achieved in the pH range of 6-7. The W content in the Fe-W alloys was ~20 at.%, and this of the Co-W alloys depends on the electrolyte pH. The electrolysis conditions and composition of the deposited alloy, affect the current density efficiency (CDE). The hardness of the Fe-W and Co-W alloys with 20 at% W is similar to the chromium coating hardness (the hardness Fe-W alloys was higher). Wear resistance of the coatings were tested under conditions of friction with lubrication. The friction coefficient for Co-Fe-W and Fe-W was higher as compared with the of the Co-W. The current density did not influence surface roughness of Fe containing alloys. Co-W alloy roughness changed to two times with a pronounced minimum at 2 A/dm².

Key Words: electrolytic deposition, Co-W, Fe-W, Co-Fe-W alloys, microhardness, friction

DETERMINING THE EXACT POSITION OF AUTONOMOUS ROBOTS USING A MULTICAMERA SYSTEM

Takáč Ondrej, Czakoóová Krisztina, Végh Ladislav
Faculty of Economics, J. Selye University, Slovakia
e-mail: takac.ondrej@gmail.com

Type: POSTER

Abstract: Determining the exact position is currently a major problem of modern robotics. To accurately determine the position in practice utilizes a combination of several sensor systems. In our work we deal with control and navigation the Roomba robots, controlled by multicameras system with own algorithm for control. Quality of navigation we evaluated by subsequent processing of graphical outputs (curves).

COMPARSION OF TOOL WEAR ON THE SELECTET INSERTS

8th International Workshop on Surface Engineering

Šramhauser, K., Náprstková, N.

Faculty of Mechanical Engineering, Jan Evangelista Purkyně University
in Ústí nad labem, Czech Republic

e-mail: Natasa.Naprstkova@ujep.cz

Type: POSTER

Abstract: The process of measuring cutting inserts wear allows to optimize the machining process in accordance with the specified cutting conditions and depending on the used machined material. Cutting inserts wear research is realized at the Faculty of Mechanical Engineering of Jan Evangelista Purkyně University in Ústí nad Labem. Part of this research is to monitor wear development on selected turning inserts that are used on different types of materials under the same cutting conditions.

SIMULATION OF IMPEDANCE SPECTRA – THEORY AND EXPERIMENT

Radosław Porada, Bogusław Baś

AGH University of Science and Technology, Faculty of Materials Science and Ceramics,
al. Mickiewicza 30, PL-30059 Krakow, Poland

e-mail: rporada@agh.edu.pl

Type: POSTER

Abstract: Electrochemical Impedance Spectroscopy (EIS) is a versatile technique, suitable for study of corrosion processes, materials' characterization or investigation of charge transfer and double layer structure at the electrode – solution boundary. In it the sample under test is excited by a sinusoidal potential of small amplitude and the current response is measured. The ratio of voltage to current, both represented in the complex domain, is called impedance. It's evaluation requires a pre-design electrical circuit, which models the behavior of a given system. By applying signals of different frequencies, various processes with distinguishable time-constant can be observed and investigated. This work presents the basic theory behind construction of an equivalence circuit and deriving their mathematical description, using the complex notation. The most common circuits are exemplified by a real-life electrochemical system.

Key Words: impedance, electrochemistry, charge transfer resistance, Warburg impedance

Acknowledgment: RP has been partly supported by the EU Project POWR.03.02.00-00-I004/16.

SIMULTANEOUS DETERMINATION OF THIAMINE AND NIACIN USING DERIVED DP VOLTAMMOGRAMS

Radosław Porada, Bogusław Baś

AGH University of Science and Technology, Faculty of Materials Science and Ceramics,
al. Mickiewicza 30, PL-30059 Krakow, Poland

e-mail: rporada@agh.edu.pl

Type: PRESENTATION

Abstract: Vitamins are defined as a heterogenic group of chemical compounds of exogenic origin, which in small amounts are essential for proper functioning of the body. Their absence or excess inside human organism can lead to various, toxic symptoms or chronic diseases. Therefore, it is of the essence to monitor the doses of those compounds, which are delivered with food products or pharmaceuticals. This presentation is devoted to voltammetric method for simultaneous determination of thiamine (vitamin B1) and niacin (vitamin B3) in diverse matrixes. The influence of the buffer type, its concentration and pH-value, alongside with parameters for differential pulse voltammetry were taken into consideration and optimized, to ensure high sensitivity, repeatability and wide linear range of excogitated procedures. The problem of overlapping peaks was resolved by differentiating of the recorded current-potential curves.

Key Words: vitamins, thiamine, niacin, voltammetry, derivative

Acknowledgment: RP has been partly supported by the EU Project POWR.03.02.00-00-I004/16.

EFFECT OF DEPOSITION CONDITIONS OF Al-Cr-N COATINGS ON THEIR PROPERTIES

B. Warcholiński, A. Gilewicz, P. Myśliński, K. Szafirowicz, Z. Galocz, D. Jakrzewski, J. Kwiatkowski

Faculty of Technology and Education, Koszalin University of Technology, Poland

e-mail: bogdan.warcholinski@tu.koszalin.pl

Type: POSTER

Abstract: Despite the use from many years the protective coatings on tools and machine parts, the works to improve them are still conducted. New types of coatings that can meet the growing demands of users are constantly being searched. The ternary, quaternary or even more complex systems are designed, synthesized and investigated. Great interest is directed to a coating based on titanium or chromium nitride doped with aluminum. This is due to the very good resistance of these coatings to oxidation. The aluminum oxide layer formed on the surface of the coating prevents diffusion of oxygen into the coating and protects it against damage. Al-Cr-N coatings were deposited on HS6-5-2 steel substrates using cathodic arc evaporation. Some deposition parameters, as nitrogen pressure, substrate bias voltage, arc current and substrate temperature as well as chemical composition of the cathode were applied to assess their effect on structural, mechanical and tribological properties of the coatings. The structure, microstructure, phase and chemical composition of the coatings were investigated using optical and scanning microscopy, Energy and Wavelength dispersive X-ray Spectroscopy, X-ray diffraction. Mechanical properties were investigated using indentation technique, adhesion tests as scratch test and Rockwell test. Ball-on-disc method was applied to assess tribological properties of the coatings as friction and wear. The analysis of the results indicate that the coatings synthesized from Al70Cr30 cathode show the most promising properties and can be applied in industry.

WINE PROFILING USING A VOLTAMMETRIC ELECTRONIC TONGUE

Szymon Wójcik, Magdalena Wójcik, Filip Ciepela, Bogusław Baś, Małgorzata Jakubowska

AGH University of Science and Technology, Faculty of Materials Science and Ceramics,
al. Mickiewicza 30, PL-30059 Krakow, Poland

e-mail: szwojcik@agh.edu.pl

Type: PRESENTATION

Abstract: The interdisciplinary research on the development of automatic devices for the recognition of complex liquid samples, which began at the end of the last century, he gained wide interest in recent years. One of the representatives of such systems is voltammetric electronic tongue (VET). The purpose of such constructed sensor sets integrated in multidimensional data analysis used for testing food products is primarily the effective assessment of the quality of such procedures. The development of VET devices would not be possible without the progress of artificial intelligence techniques. Nowadays, there is a common belief that knowledge of machine learning techniques is one of the more desirable competencies, and application of this methodology gives the opportunity to solve many problems in science and technology. When quality check of wines, sommeliers assess, among other things, the aroma, taste and color of wine. Considering that each of these elements of the assessment is associated with the complex matrices of chemical compounds contained in wine, it is difficult to independently classify wines only on the basis of the knowledge of the concentrations of specific chemical compounds in a wine. The other approach of the wine classification is the use of voltammetric measurements to create an electrochemical image of the alcoholic beverage tested. Data collected in this way, subjected to chemometric treatment, allow to regard the entire voltammogram as a fingerprint of wine. Then the interpretation and profiling will be based on the whole complex samples, not just on the concentrations of selected analytes. In this work VET consisting of 7 metallic electrodes for profiling 4 selected wines from the local store was applied. The measurements were made using the differential pulse voltammetry, and the collected data was subjected to chemometric treatment and presented in the form of PCA graphs.

Key Words: differential pulse voltammetry, voltammetric electronic tongue, chemometrics

Acknowledgment: This work was supported by the National Science Centre, Poland (Project No. 2015/19/B/ST5/01380).

CARBON PASTE ELECTRODES WITH VARIOUS BINDERS AND GLASSY CARBON ELECTRODE IN DPV EUROPIUM DETERMINATION

Szymon Wójcik, Jan Wyrwa, Małgorzata Dziubaniuk, Małgorzata Jakubowska
AGH University of Science and Technology, Faculty of Materials Science and Ceramics,
al. Mickiewicza 30, PL-30059 Krakow, Poland

e-mail: szwojcik@agh.edu.pl

Type: POSTER

Abstract: Typically, three electrodes are used in voltammetric systems. These are the working, the reference and the auxiliary electrode. The working electrode is undoubtedly the most important of the electrodes because oxidation and reduction reactions take place on its surface. The basic problem for electrodes is their surface characteristics, and the only electrode with a fully characterized surface is a mercury electrode. Currently, however, there is a trend of departing from the use of mercury in research, so attempts are being made to replace this electrode with others. An alternative to a mercury electrode are carbon paste electrodes. Carbon paste, a mixture of graphite powder with a binder, is one of the most popular electrode materials used to prepare electrodes in laboratory conditions. In order to create the electrode, the paste should be placed in a suitably prepared body, usually made of Teflon or glass. The polished electrode is ready for use, and if it is necessary to renew its surface it is possible to mechanically polish its surface or to replace the whole electrode paste in a simple way. In this work, a comparison of two electrodes made of carbon paste differing in the used binder to create them was done. Also glassy carbon electrode was applied in the experiments. Registration of the europium signals was done using the differential pulse voltammetry (DPV).

Key Words: differential pulse voltammetry, carbon paste electrode, glassy carbon electrode

Acknowledgment: This work was supported by the National Science Centre, Poland (Project No. 2015/19/B/ST5/01380).

THE ROLE OF SURFACE PREPARATION METHOD ON THE OXIDATION BEHAVIOR OF FE-BASED ALLOY

Wojciech J. Nowak, Daria Serafin, Bartek Wierzba

Rzeszów University of Technology, Department of Materials Science, Faculty of Mechanical Engineering
and Aeronautics, al. Powstanców Warszawy 12, 35-959 Rzeszów, Poland

e-mail: w.nowak@prz.edu.pl

Type: PRESENTATION

Abstract: The Fe-base materials are one of the most commonly used group of alloys. The steels possess good mechanical properties and relatively low price. However, using a non-alloyed steels at elevated temperature is limited due to their low resistance against high temperature oxidation. Therefore, addition of Cr and/or Al is commonly used to promote formation of protective oxide scales like Al₂O₃ or Cr₂O₃ which substantially extend the lifetime of the component exposed at high temperature. To provide a resistance against oxidation a protective coatings such as MCrAlY (where M is mainly Ni or Co) or β -NiAl which are an alumina forming materials are applied. However, coatings production is time consuming, results in additional component costs, and can negatively affect alloy mechanical properties, such as fatigue strength. Therefore, another, cheaper method to force material to form a protective oxide scale is proposed in the present study. Namely, a different surface preparation of a Fe-base alloys on oxide scale formation during exposure at high temperature will be presented. The obtained results demonstrate that the mechanical surface preparation influences oxidation kinetics as well as the microstructure of the oxide scale formed on the alloy at both studied temperatures. The most possible reasons responsible for such influence will be proposed as well.

Acknowledgment: This research was financed within the Marie Curie COFUND scheme and POLONEZ program from the National Science Centre, Poland. POLONEZ Grant No. 2015/19/P/ST8/03995. This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie Grant Agreement No. 665778.

ORGANIC FERTILIZER PELLET (CHICKEN MANURE)

8th International Workshop on Surface Engineering

Zdanowicz Agnieszka

Faculty of Mechanical Engineering, Koszalin University of Technology, Poland

e-mail: agnieszka.zdanowicz@s.tu.koszalin.pl

Type: POSTER

Abstract: In the article analyzes the geometric characteristics and chemical properties of the granulated composition of compost manure from chicken manure. The review and assessment of indicators defining the quality parameters of the substrate and chemical composition of the granulated compost fertilizer were carried out.

Key Words: chicken manure, compost, granulate

PRODUCTION FERTILIZER PELLETS MADE FROM COMPOSTED LIVESTOCK CHICKEN MANURE

4th International Workshop on Applied and Sustainable Engineering

Zdanowicz Agnieszka

Faculty of Mechanical Engineering, Koszalin University of Technology, Poland

e-mail: agnieszka.zdanowicz@s.tu.koszalin.pl

Type: POSTER

Abstract: The poster presents review of fertilizer pellets production chicken manure has been presented. Main emphasis is on review of technical parameters of pelletization. Fertilizer pellets applications in different areas have been discussed. Technical feasibility of pellets has been reviewed.

Key Words: fertilizer pellets, chicken manure, pelletizing system

I-MACHINING ADVANTAGES AND OPPORTUNITIES

8th International Workshop on Surface Engineering

S. Scaticailov¹, A. But²

¹ Technical University of Moldova, ² Polytechnic University of Timisoara

e-mail: serghei.scaticailov@mail.ru

Type: POSTER

Abstract: Modern technologies give to the CAM engineers more opportunities and benefits. The paper present the real results obtain using the i-machining strategies from SOLID CAM software. Was underline the modality how was implement and the time comparison between the classical CAM milling strategies versus the i-machining strategies adapt on real part.

DETERMINING THE EXACT POSITION OF AUTONOMOUS ROBOTS USING A MULTICAMERA SYSTEM

4th International Workshop on Applied and Sustainable Engineering

Takáč O., Czakoová K., Végh L.

Faculty of Economics, J. Selye University, Komárno, Slovakia

e-mail: takac.ondrej@gmail.com

Type: POSTER

Abstract: Determining the exact position is currently a major problem of modern robotics. To accurately determine the position in practice utilizes a combination of several sensor systems. In our work we deal with control and navigation the Roomba robots, controlled by multicameras system with own algorithm for control. Quality of navigation we evaluated by subsequent processing of graphical outputs (curves).

Key Words: mile rotics, navigation, intelligent space, optical methods

PASSWORD USAGE HABITS OF STUDENTS AFTER TAKING INFORMATION SECURITY COURSE

4th International Workshop on Applied and Sustainable Engineering

Kiss G., Árki Z.

Department of Mathematics and Informatics, J. Selye University,
Faculty of Economics Komárno, Slovakia

e-mail: kissga@ujs.sk

Type: POSTER

Abstract: In this article we examine the password usage habits of the mechanical engineering students. We have prepared a questionnaire for students asking them about the complexity of their passwords used in Internet services before and after the information security course. We have asked also how often they change their passwords. By evaluating the two questionnaires we were looking for an answer, if the traditional educational method (table, PowerPoint based lecture) supported with videos showing how fast the passwords can be deciphered with home computer, leads to more secure passwords usage by students. The results showed that significant changes were made only in the way the students stored their passwords, otherwise we did not make any changes in other aspects under review. To achieve more secure password usage for students, we need to choose a different didactical method.

Key Words: password, higher education, habit, didactics, information security, awareness

IMPROVING THE OXIDATION RESISTANCE OF Fe-16Cr FERRITIC STEEL TO BE APPLIED IN METALLIC INTERCONNECTS FOR SOLID OXIDE ELECTROLYTIC CELLS

Łukasz Mazur, Tomasz Brylewski

AGH University of Science and Technology, Faculty of Materials Science and Ceramics,
al. Mickiewicza 30, PL-30059 Krakow, Poland

e-mail: lmazur@agh.edu.pl

Type: POSTER

Abstract: In recent years, the development of technologies related to the storage of surplus electricity has become an increasingly significant subject. One of the solutions which might be used to store energy is the solid oxide electrolytic cell (SOEC). This device efficiently converts surplus electricity into fuel, which is made possible by electrolysis. A single cell consists of three main parts: a solid oxide electrolyte, a cathode and an anode. Another very important element of a SOEC is the interconnect, which has several functions. Most importantly, it allows the construction of stacks consisting of single cells connected in series. This increases power output significantly. Due to the temperature at which the electrolyzer operates (873-1073 K) as well as the aggressive nature of the operating environment, the interconnect is the component that is most prone to degradation as a result of high-temperature corrosion. Interconnects are often fabricated from metallic materials. The rigorous criteria for the selection of interconnect materials have made ferritic stainless steels with a chromium content of up to 25 wt% very popular in this application. However, metallic interconnects also have a weakness – they are susceptible to high-temperature oxidation. This process leads to the formation of a scale consisting mostly of Cr₂O₃ on the surface of the steel. As the thickness of the scale increases, so does area-specific resistance (ASR). When widespread application of SOECs is considered, economic factors are also important. Options include the use of less expensive ferritic steels for the production of interconnects with a chromium content below 17 wt% instead of steels designed specifically for this purpose. One of the ways in which the resistance of inexpensive species of ferritic steel to high-temperature oxidation may be improved is via the deposition of a layer of gadolinium oxide nanoparticles on the surface. The aim of the study was to check the effect of such a layer deposited via either dip-coating or electrolysis on the oxidation properties of the Nirosta 4016/1,4016 ferritic steel. For this purpose, pure and surface-modified samples were oxidized for 100 h in air at constant temperatures of 973, 1023, 1073 and 1123 K, and their oxidation kinetics were studied by means of thermogravimetry. To investigate how samples behave under more severe oxidation conditions, tests were also carried out in air with cyclic temperature changes from room temperature to 1073 K. A total of 1000 cycles were run, with each cycle lasting 1 h. Microscopic observations as well as analyses of the chemical and phase composition of the oxidation products were also performed.

Key Words: interconnect, SOEC, ferritic stainless steel, gadolinium oxide

Acknowledgment: Financial support from the National Science Centre, project No. 2015/19/B/ST8/01094, is gratefully acknowledged.

TECHNOLOGICAL PROBLEMS IN SOLDERING PROCESSES

8th International Workshop on Surface Engineering

Stanisław Pałubicki, Remigiusz Kołtonowski, Mikołaj Kołtonowski, Wiesław Czapiewski

Department of Production Engineering, Faculty of Mechanical Engineering,
Koszalin University of Technology, Poland

e-mail: stanislaw.palubicki@tu.koszalin.pl

Type: POSTER

Abstract: The article presents a soldering problem related to inadequate energy (too high or too low) brought into the soldered joint. Methods of cleaning surfaces from oxide layers and fluxes and their types in the paper are described. The types of devices used for soldering and types of solders are also presented. The most common defects in soldered joints and methods of their prevention are presented. The types of protective atmospheres used during soldering and desoldering methods have been described.

Key Words: soldering; low energy methods; soldering properties; process optimization

THE USE OF 3D PRINTING FOR THE DESIGN OF ELECTRONIC DEVICES

8th International Workshop on Surface Engineering

Stanisław Pałubicki, Remigiusz Kołtonowski, Mikołaj Kołtonowski, Wiesław Czapiewski

Department of Production Engineering, Faculty of Mechanical Engineering,
Koszalin University of Technology, Poland

e-mail: stanislaw.palubicki@tu.koszalin.pl

Type: POSTER

Abstract: Nowadays, electronic equipment is becoming more and more ergonomic. The article presents examples of improvement of selected electronic devices in terms of ergonomics, functionality, safety and aesthetics through the use of 3D printing. The use of 3D printing allows that the wires of the devices may be in the housing, which, for example, prevents the device from being operated with the housing open and eliminates the possibility of electrical short-circuits. The use of 3D printing allows the adaptation of electronic devices for disabled or elderly people. 3D printing also allows you to add new functions to your devices.

Key Words: 3D printed electronics, additive manufacturing, rapid prototyping, structural electronics

INCREASE OF THE 3D PRINTS DURABILITY

8th International Workshop on Surface Engineering

Stanisław Pałubicki, Remigiusz Kołtonowski, Mikołaj Kołtonowski, Wiesław Czapiewski

Department of Production Engineering, Faculty of Mechanical Engineering,
Koszalin University of Technology, Poland

e-mail: stanislaw.palubicki@tu.koszalin.pl

Type: POSTER

Abstract: The disadvantage of 3D printouts in FDM / FFF technology is that they are made of thermoplastics thus have low durability. The article describes some ways to increase the strength of 3D printed elements by using metal inserts and fiberglass plates. Metal and glass fiber are placed in the printout during the printing process. These inserts increase the bending and torsional strength. The way of designing objects and modifications of G Code for the purpose of applying additional elements is described. Aspecially designed test models with and without inserts are shown.

Key Words: 3D printing; product development; complexity; customization

AN ANALYSIS OF THE EFFICIENCY OF CLEANING A HEAT EXCHANGER USING A CIP SYSTEM WITH LOW-FREQUENCY PULSATING FLOW

Joanna Piepiórka-Stepuk, Sylwia Mierzejewska, Żaneta Zienkiewicz

Department of Mechanical Engineering, Division of Food Industry Processes and Facilities,
Koszalin University of Technology, Poland

e-mail: joanna.piepiorka@tu.koszalin.pl

Type: POSTER

Abstract: The paper determines the impact of pulsating flow on the efficiency of cleaning performed on the surface of heat exchanger plates. The tests were conducted on a laboratory CIP station for four low-frequency pulsation modes and for steady flow. The test results are represented graphically and followed by a broad analysis of the effect of pulsation at a specific frequency on the efficiency of cleaning individual exchanger plates and the entire heat exchanger. It has been proved that applying pulsating flow during CIP procedure with a frequency of 3.5÷7.0 mHz significantly ($\alpha=0.05$) improves the cleaning efficiency and, at the same time, shortens the cleaning time, up to 25%.

Key Words: pulsating flow, clean in place, plate heat exchanger

EVALUATION OF CHANGES THE SURFACE TENSION OF CHEMICAL SOLUTIONS USED FOR CLEANING IN THE CIP SYSTEM

Katarzyna Purzycka, Joanna Piepiórka-Stepuk, Sylwia Mierzejewska

Department of Mechanical Engineering, Division of Food Industry Processes and Facilities,
Koszalin University of Technology, Poland

e-mail: joanna.piepiorka@tu.koszalin.pl

Type: POSTER

Abstract: The aim of the work was to determine the physical-chemical stability of cleaning solutions used to CIP system during their storage. The alkaline and acid solutions, in various concentrations, were assessment as well as industrial solutions which were obtained from local brewery. The tests results were presented in graphically and followed the impact of storage time on the turbidity, surface tension, concentration and conductivity were analyzed. It has been shown that the storage time of cleaning solutions has a significant effect on their surface tension. On the basis of the obtained results, the regression functions $z = f(\%, t)$ for the tested preparations were developed. The functions allow to predict the changes in the wetting properties of the solutions during their storage.

Key Words: clean in place, cleaning solutions, storage, surface tensions

METHODS FOR MEASURING THE QUALITY OF SPRAYING ON TREES IN ORCHARDS

8th International Workshop on Surface Engineering

Pachuta A.

Faculty of Mechanical Engineering, Koszalin University of Technology, Poland

e-mail: apachuta@poczta.fm

Type: POSTER

Abstract: Examples of methods of testing the deposition of the sprayed plant protection product on the surface of leaves of fruit trees are presented. The main methods of measuring spray quality are samplers attached to the leaves. The evaluation of the droplet coverage is performed by computer image analysis.

THE USE OF ULTRASONIC SENSORS FOR PRECISE SPRAYING TREES IN ORCHARDS

4th International Workshop on Applied and Sustainable Engineering

Pachuta A.

Faculty of Mechanical Engineering, Koszalin University of Technology, Poland

e-mail: apachuta@poczta.fm

Type: POSTER

Abstract: Research is carried out to adjust the dose of liquid to the shape and volume of the crown. Research works are conducted on equipping the equipment for applying plant protection agents with devices for detecting the target objects of application and their shapes and dimensions, i.e. ultrasonic sensors.

THE NOISE OF WIND TURBINES

4th International Workshop on Applied and Sustainable Engineering

Katarzyna Wolniewicz

e-mail: kaja.wolniewicz@gmail.com

Type: POSTER

Abstract: Wind farm exploitation is connected with specific acoustic phenomena regarding wind turbines operation. Conducting local measurements of wind farms, minding the specificity of their work, requires generally applied and suggested modifications of noise measuring methods.

METHOD FOR WIND TURBINE SELECTION BASING ON IN-FIELD MEASUREMENTS

8th International Workshop on Surface Engineering

Katarzyna Wolniewicz

e-mail: kaja.wolniewicz@gmail.com

Type: POSTER

Abstract: The basic meteorological properties and characteristics obtained during measurement campaigns using necessary equipment as well as the used methodology are vital for successful investment in wind farm. The main goal of in-field investigation is to collect meteorological data using a measurement mast installed at the possible future wind farm location. The conducted measurement campaign provided wind directions, velocities and wind blast parameters.

THE IMPACT OF WIND FARMS ON THE ACOUSTIC CLIMATE

4th International Workshop on Applied and Sustainable Engineering

Adam Zagubień

e-mail: kaja.wolniewicz@gmail.com

Type: POSTER

Abstract: There are presented examples of own local measurements conducted at wind farms. It was proved that at the distance of more than 500m from the farm, lots of results of easurements are comparable to measurements of existing acoustic background. For cases when noise measurement results, including background noise, were unrecognizable when compared with only acoustic background and the values were lower than permissible level in the measurement point, some interpretations of such situations were suggested.

WOODEN CONSTRUCTION OF FLOWER STAND WITH THE WEDGE JOINTS

4th International Workshop on Applied and Sustainable Engineering

Szada-Borzyszkowski W.

Faculty of Wood Processing Industry in Szczecinek, Koszalin University of Technology, Poland

e-mail: wieslaw.szada-b@tu.koszalin.pl

Type: POSTER

Abstract: The article presents the design of a rack made of 18mm-thick MDF. Individual elements of the project as well as the stuff necessary for its implementation are presented. Each stage of the rack assembly is shown. Using the stand as a flower rack and other ideas of its adaptation are pointed out.

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