

National Scientific Conference  
**NOVEL TRENDS**  
OF POLISH SCIENCE

# 2019

December 5-6  
Zakopane

# The Book of Abstracts





**National Scientific Conference**  
**„Novel Trends of Polish Science”**  
**II edition**

**The Book of Abstracts**

**Zakopane, December 5-6, 2019**



National Scientific Conference  
"Novel Trends of Polish Science"

II edition  
December 5-6, 2019  
Zakopane



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## **CONFERENCE INFORMATION**

**The National Scientific Conference „Novel Trends of Polish Science”**  
is organized especially for you.

The Conference has an interdisciplinary character. It is addressed to young scientists, starting with first and second degree students, through Ph.D. students, to people who have obtained a doctoral promotion in the last 3 years.

Our initiative aims to create opportunities for exchange of experiences and good scientific practices by representatives of the scientific community. Additionally, it aims to underline the important role of young researchers in the development of Polish science.

In the Conference, two types of participation are possible: passive or active, with active participation giving the opportunity to choose an oral presentation or poster. The conference materials will be published in the form of the Book of Abstracts and Book of Conference Articles with assigned ISBN numbers.

Scientific part of the Conference is supervised by Scientific Committee which contains of doctors and independent research workers from various Polish and foreign universities and industry representatives.



## **CONFERENCE PLACE**

The Biały Potok Guesthouse is located in a quiet part of the city, but also a short distance from the center. It creates the perfect conditions to relax away from the city noise, while easily accessing the largest tourist attractions of Zakopane. The location at the entrance to the picturesque Dolina Białego, close to walking and mountain trails and many cycling routes makes it an ideal place for active recreation in the fresh air.

The Biały Potok Guesthouse was built in 1981-1984. Over the years, restored and refurbished. Currently it offer 75 standard equipped, spacious rooms, including studios and apartments; restaurant room; conference rooms; swimming pool; sauna; mini gym; jacuzzi; indoor tennis hall; garden with playground; children's playroom; skill games: billiards and table football; free wireless internet access; free parking and garages (for an extra charge).





## **CONFERENCE SCHEDULE**

**The Biały Potok Guesthouse**

**Droga Do Białego 7, 34-500 Zakopane**

**December 5-6, 2019**

<b>Day I</b> <b>(Thursday, December 5)</b>	
<b>13:00 – 14:00</b>	<b>Registration</b>
<b>14:00 – 15:00</b>	<b>Dinner</b>
<b>15:00 – 15:45</b>	<b>Accommodation</b>
<b>15:45 – 16:00</b>	<b>Opening of the Conference</b>
<b>16:00 – 17:00</b>	<b>Poster Session</b>
P-01	Korolevych Oleksandr PHOTOSTIMULATED CHARGE TRANSFER IN HYBRID PHOTOVOLTAIC MATERIALS
P-02	Mikołajczyk Aleksandra SYNTHESIS AND ANTITUMOR ACTIVITY OF NOVEL PYRIMIDINE DERIVATIVES
P-03	Baran Agata PEM FUEL CELLS AND ENERGY SYSTEMS BASED ON HYDROGEN TECHNOLOGY - A REVIEW
P-04	Ciołek Sylwia INDEXING OF METASTABLE HIGH ALUMINUM PHASES
P-05	Dworecka-Wójcik Julita THE INFLUENCE OF LENS PARAMETERS ON THE METALLURGICAL QUALITY OF GRADED CO6-WC COATINGS
P-06	Nowatorski Michał PATRON DROID - MOBILE DIAGNOSTICS OF PARKINSON'S DISEASE
P-07	Paciorkowska Małgorzata COMPARISON OF ONTOLOGIES
P-08	Rzeszotarska Magdalena STAINLESS STEEL AS A SUBSTRATE FOR THE REACTION OF MAGNESIUM-IRON HYDRIDE
<b>17:00 – 19:30</b>	<b>Conference attractions</b>
<b>20:00</b>	<b>Integration dinner</b>
<b>Day II</b> <b>(Friday, December 6)</b>	
<b>08:00 – 09:00</b>	<b>Breakfast</b>
<b>09:00 – 10:30</b>	<b>Workshop</b>
<b>10:30 – 10:45</b>	<b>Coffee Break</b>
<b>10:45 – 12:45</b>	<b>Plenary Session</b>
10:45 – 11:00	Szewczykowska Anna THE IMAGE OF ROMANTIC LOVE IN THE CORRESPONDENCE BETWEEN ZYGMUNT KRASIŃSKI AND DELFINA POTOCKA



11:00 – 11:15	Kluza Kamil EFFECT OF ASCORBIC ACID ON CORROSION OF ZINC OXIDE SURFACE – EXPERIMENTAL AND THEORETICAL INVESTIGATIONS
11:15 – 11:30	Moździerz Maciej SYNTHESIS AND MICROSTRUCTURE OF THE SPINEL-STRUCTURED HIGH ENTROPY OXIDES
11:30 – 11:45	Czepulkowska Weronika SURFACE CONDITION OF NI-CR ALLOY AFTER SIC ABRASIVE BLASTING FOR APPLICATION IN CERAMIC PROSTHETIC RESTORATION
11:45 – 12:00	Taczała Joanna INFLUENCE OF THE INHIBITOR ON THE PROPERTIES OF DENTAL ACRYLIC RESIN
12:00 – 12:15	Nakoneczna-Dąbrowska THE STABILITY OF SHEAR THICKENING FLUIDS
12:15 – 12:30	Petryniak Rafał THE USE OF PROJECTION TECHNIQUES AND IMAGE ANALYSIS ALGORITHMS TO BUILD USER COMPUTER INTERFACES ADJUSTED TO DEVELOPMENT NEEDS OF CHILDREN
12:30 – 12:45	Szałek Beata TEXTILES IN AUTOMOTIVE ENGINEERING
<b>12:45 – 13:00</b>	<b>End of the Conference and eviction</b>
<b>13:00</b>	<b>Dinner</b>



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# **POSTERS SESSION**





## PHOTOSTIMULATED CHARGE TRANSFER IN HYBRID PHOTOVOLTAIC MATERIALS

**Oleksandr Korolevych\*** (1), **Maciej Zalas** (2), **Waldemar Stampor** (3),  
**Malgorzata Makowska-Janusik** (1)

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### A few words about the authors:

Authors are physicists and chemists working on explaining the charge transfer occurring in hybrid photovoltaic materials. Krolevych is a PhD student working on the implementation of calculations of electronic properties of hybrid systems.

### Abstract:

Fast development of civilization needs more and more energy. One of the possible solutions to the problem is the use of renewable energy sources. In the present work, we investigate an influence of the isomerisation of the dyes on the performance of the DSSCs. The computer simulations applied for electronic properties prediction of dyes and hybrid systems explain the charge transfer phenomenon occurring between the dyes and the NPs.

The para-, meta- and ortho- isomers based on Tris(bipyridine)ruthenium (II) complex were investigated in isolated form and anchored on the surface of the TiO<sub>2</sub>-NPs. The most correct result, comparing the experimental and theoretical UV-Vis absorption spectra gives the DFT/B3LYP method. The performed calculations show that the best results for photovoltaic applications exhibit para- molecule. It is in good agreement with experimentally obtained data. Also the electronic properties of the para-, meta- and ortho- isomers on the surface of the TiO<sub>2</sub>-NPs were calculated to explain the role of an anchoring group position in DSSCs. Analysis of obtained data show that a position of the anchoring group affect the charge transfer between dye and NPs. Analysing the electronic properties of the investigated materials was shown that solar cells with the para-derivative as a sensitizer exhibits the highest photoconversion performance.

### Keywords:

photovoltaics, DSSC, dyes, quantum-chemical calculations, nanostructures



## SYNTHESIS AND ANTITUMOR ACTIVITY OF NOVEL PYRIMIDINE DERIVATIVES

**Aleksandra Mikołajczyk\* (1), Aleksandra Wolska (1), Marcin Stolarczyk (2),  
Agnieszka Matera-Witkiewicz (1)**

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### A few words about the authors:

As the employees of the Wrocław Medical University we are involved in synthesis and biological testing of new compounds which could serve in future as a treatment of diseases for which there is currently no effective cure.

### Abstract:

Despite many years of research in the area of drug development, cancer still remains one of the leading causes of death worldwide, thus the synthesis of new anticancer drugs is one of great importance. FDA databases reveals the significance of nitrogen-based heterocycles during the drug development – nearly 60% of small-molecule drugs contain such heterocycles.

In our lab two compounds (PUB2 and PUB3) have been synthesized. PUB2 belongs to 5-aminomethylpyrimidine derivatives and has a single bond between the amino group and carbon, whereas PUB3 is an imine or Schiff base with double bond at an analogous place in the molecule.

Screening cytotoxicity tests were performed using three tumor lines: A172 (glioblastoma), Hepa (hepatocarcinoma) and CaCo-2 (colon adenocarcinoma). Also mouse fibroblasts (L929) were used to determine the effect of new derivatives on normal cells. The analysis of the results showed a significant variation in the cytotoxicity of the compounds depending on the tumor line. Several sets compound-cell line have proved to be very effective, thus additional tests based on flow cytometry were applied to determine their mode of action.

The research was founded by Wrocław Medical University (project number: SONB.D250.18.00).

### Keywords:

anticancer agents, pyrimidine derivatives, drug discovery



## PEM FUEL CELLS AND ENERGY SYSTEMS BASED ON HYDROGEN TECHNOLOGY - A REVIEW

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### **A few words about the author:**

An author is a PhD student at Military University of Technology. Her main field of study is connected with hydrogen storage materials, hydrogen economy and a new source of energy.

### **Abstract:**

The hydrogen economy has gained much attention during past few years. A need for finding a new, renewable source of energy helped to introduce the revolutionary way of power producing. A fuel cell can be continuously supplied with a fuel, which reduces problems with the cell capacity. Hydrogen fuel cells are able to use hydrogen as a fuel by converting the chemical potential energy (energy that is stored in molecular bonds) into electrical energy. Their advantage is no pollutant emission (the only side products are heat and water), high efficiency and sustainability. PEM (Proton Exchange Membrane) fuel cells are able to produce high power density with low weight and volume. A solid polymer allows hydrogen ions to move through membrane layer. To start the electrochemical process, a platinum catalyst is needed. The fuel cell works at low temperatures (70 - 100 °C) which requires less warm-up time (works fast) and results in less system components wear and better durability. That technology is well suited for zero-emission vehicles but hydrogen storage is still a challenge. This poster is a current technology review in context of hydrogen economy, technical aspects of hydrogen systems and hydrogen storage problems.

### **Keywords:**

hydrogen, energy sources, fuel cell, PEMFC



## INDEXING OF METASTABLE HIGH ALUMINUM PHASES

**Sylwia Ciolek\*, Stanisław Józwiak**

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### **A few words about the author:**

I am a PhD student. My faculty is Material Engineering. My research area is intermetallic composites.

### **Abstract:**

Production of sinters from the Fe-Al binary system by powder metallurgy leads to the formation of a series of metastable phases with low symmetry of the unit cell. This necessitates the use of advanced description techniques. In addition to computer-based automatic matching, these cells require a indexing process. This involves assigning Miller indicators (hkl) to individual diffraction reflections. Then, by determining the parameters of the unit cell, specifically lattice constants (a, b, c) and the angles between them ( $\alpha$ ,  $\beta$ ,  $\gamma$ ), the crystallographic system in which a given phase crystallizes is identified. Indication of crystallizing substances in systems other than regular, tetragonal or hexagonal systems, in particular monoclinic and triple oblique systems, requires, due to the number of variables sought and the multithreaded calculation process, the use of computer algorithms for finding the most probable solutions. The work discusses in a systematic way the process of determining the crystallographic system of the crystallizing phase based on the diffractogram.

### **Keywords:**

FeAl, indexing, powder metallurgy, intermetals



## THE INFLUENCE OF LENS PARAMETERS ON THE METALLURGICAL QUALITY OF GRADED CO6-WC COATINGS

**Julita Dworecka-Wójcik**

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### **A few words about the author:**

I am a scientist and a teacher at Military University of Technology in Poland at the Faculty of Advanced Technologies and Chemistry in Institute of Materials Science and Engineering.

### **Abstract:**

Metal matrix composites like Co6-WC have found numerous industrial applications in the form of bulk parts or coatings because of their outstanding mechanical properties for cutting tools and other wear-resistant applications. This work presents an attempt of the fabrication of Co6-WC graded coatings by using one of the rapid manufacturing techniques - Laser Engineered Net Shaping (LENS TM). During LENS process coating is produced layer by layer on a substrate and the supplied powder is melted with a laser beam. Manufacturing techniques play a critical role in achieving the designed compositional and microstructural distribution. During production using LENS, control software allows to determine the deposition parameters such as laser power, layer thickness and powder feed rate.

A wide range of manufactured parameters was used to obtain coatings with variable content of WC. The distribution of WC particles in matrix, metallurgical quality of coatings and adhesion to substrate was examined on the basis of observations with a light microscope.

Acknowledgments: The research was financed by the Ministry of Science and Higher Education of Poland (RMN/08-841/2018).

### **Keywords:**

metal matrix composite (MMC), LENS technology, Co6-WC coatings



## **PATRON DROID - MOBILE DIAGNOSTICS OF PARKINSON'S DISEASE**

**Michał Nowotarski**

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### **A few words about the author:**

PhD student at Military University of Technology in Warsaw. Has been working as a programmer on diagnostic support systems for doctors for last 3 years. A fan of gadgets and technology.

### **Abstract:**

Parkinson's disease is very common. In the group of Poles over 65, symptoms of the disease were observed in 2.6 percent of respondents. Precise information on the patient's condition helps a doctor in the right choice of a treatment. Implementation of appropriate treatment can extend patients' life by up to 10 years compared to the natural course of the disease.

Typical devices used to test people with Parkinson's disease are difficult to access and very expensive. The ideal situation would be to use common and cheaper devices for diagnostics. To address these needs, work began on the Patron Droid tool. All it needs is a smartphone and a commonly available device control armband.

The ability to constantly monitor the patient's condition is an invaluable help for the doctor. Health information allows to assess the development of the disease and choose the appropriate therapy. Usually, the doctor has to rely on the patient's subjective feelings which may be incomplete or false. For diseases whose symptoms are dyskinesias (e.g. Parkinson's disease, epilepsy), information on the frequency of them and their intensity is very important.

Using the developed application, it is possible to conduct tests analyzing the patient's dyskinesias status and regular surveys. The band's accelerometer and electromyograph measurements are recorded in a mobile application and sent to the server part of the system to detect dyskinesias in the read signal.

The poster presents the Patron Droid tool.

### **Keywords:**

wearable sensors, telemedicine, neurological symptoms



## COMPARISON OF ONTOLOGIES

**Małgorzata Paciorkowska**

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### **A few words about the author:**

PhD student at the Military University of Technology in Warsaw. In my doctoral research I am working to solve the problem of ontology alignment. I am interested in issues related to an artificial intelligence.

### **Abstract:**

The word ontology comes from the Greek („óntos” - "existence" and „lógos” - "science"). In computer science the first time the concept of ontology was introduced by Tom Gruber in 1993 as a formal, explicit specification of shared conceptualization. The conceptualization refers to an abstract model of a phenomenon or existence that identifies the relevant concepts of the real object.

The ontology is built of concepts and relationships that exist between them. It can be easily represented as a graph in which the concepts are the vertices of the graph, and the relationships between concepts are edges of the graph.

The ontology comparison method can be used for semantic pattern recognition within knowledge bases which can be utilized by analytical tools especially in the security domain (criminal threat, financial fraud detection, detecting threats in technical infrastructures). The method uses a multi-criteria analysis during ontology models comparison and semantic similarity assessment. The method is implemented in the plugin for the Protégé OWL environment.

The poster will present method utilizing structural and lexicon comparison of compared ontologies to deliver multicriteria evaluation of concepts.

### **Keywords:**

ontology, semantic structural analysis, semantic similarity, ETOSE, OWL2



## STAINLESS STEEL AS A SUBSTRATE FOR THE REACTION OF MAGNESIUM-IRON HYDRIDE

**Magdalena Rzeszotarska**

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### **A few words about the authors:**

I am a PhD student. My faculty is Material Engineering. My research area is hydrogen storage, especially in solid phase. My interests are mainly science (materials science, chemistry, mechanics) but also sport and an active and healthy lifestyle.

### **Abstract:**

Magnesium-iron hydride ( $\text{Mg}_2\text{FeH}_6$ ) is one of the most commonly used compounds for storing hydrogen in a solid state. Its popularity is due to the very high volumetric hydrogen density and the gravimetric hydrogen density. This compound is usually produced as a result of mechanochemical synthesis of iron powder (very high purity) and magnesium hydride or pure magnesium. This work demonstrates the possibility of producing this valuable compound from steel powder - austenitic stainless steel. The iron contained therein, unlike pure iron ( $\alpha$ ), occurs in the form of austenite ( $\gamma$  iron). The use of steel powder instead of pure iron has many advantages, among others acceleration of the synthesis reaction, reduction of reaction costs as well as a positive ecological aspect (steel powder can be obtained in a very simple way by recycling).

### **Keywords:**

hydrogen storage, stainless steel, ternary hydride, magnesium-iron hydride,  $\text{Mg}_2\text{FeH}_6$

# **PLENARY SESSION**





## THE IMAGE OF ROMANTIC LOVE IN THE CORRESPONDENCE BETWEEN ZYGMUNT KRASIŃSKI AND DELFINA POTOCKA

**Anna Szewczykowska**

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### **A few words about the author:**

I am a student of literary science. The title of my master thesis was: Witness to the Epoch. Krasiński as an Epistolographer. I want to elaborate on the topic, so I decided to present romantic love in his letters.

### **Abstract:**

Delfina Potocka was undoubtedly the greatest love of Zygmunt Krasiński, as evidenced by their rich correspondence from that time. The emotional bond between Krasiński and Potocka, though doomed to failure from the outset, continues to fascinate to this day. Their letters and the love story they tell – written in the style of their epoch with its typical exaggerations that might even seem comical to modern readers – are nevertheless a beautiful testimony of their mutual feelings. Noteworthy is the structure of the letters itself – their form and the expressions and phrases used in them provide a lot of information about the relationship between the sender and the addressee. Moreover, one must emphasize the enormous literary value of the correspondence between Krasiński and Potocka. Its form brings to mind a novel describing the fate of Romantic lovers – Dąbrowski and Szymanowski. Perhaps first and foremost, it is also a valuable and, importantly, accessible and interesting source of knowledge about the morals and customs of the Romantic period.

### **Keywords:**

love, romanticism, letters, creation



## EFFECT OF ASCORBIC ACID ON CORROSION OF ZINC OXIDE SURFACE – EXPERIMENTAL AND THEORETICAL INVESTIGATIONS

**Kamil Kluza\*** (1), Lucia Mydlova (1), Maros Halama (2),  
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### A few words about the author:

Born in 1989. From 2016 PhD student of Physics, Jan Dlugosz University, Czestochowa, Poland. He is co-author of third scientific articles.

### Abstract:

Semiconductor nanostructures are of great interest for scientists because of their electronic properties significantly different from those of the corresponding bulk materials. In addition, the physical and chemical parameters of nanostructures can be changed by manipulating their size and shape, choosing the appropriate synthesis method. The specific physical properties make semiconductor nanostructures (NPs) studied for electronic, biological or medical applications.

In present work the effect of electrolyte on structural and electronic surface changes of the ZnO-NPs was studied. Using the electrochemical method, the rate of the ZnO-NPs degradation in the Hank solution, simulating human body fluid, was determined. The corrosion phenomenon occurring at the ZnO-NPs surface has been also studied in the presence of ascorbic acid (AsA). There was a dramatic change in the redox potential for ZnO-NPs after the addition of AsA to the solution, and inhibition of the NPS corrosion process was noted. AsA has been found to be a good corrosion inhibitor of NPs-ZnO. Quantum-chemical calculation performed for ZnO-NPs and ZnO-NP/AsA hybrids allowed to explain the physical mechanism of the observed phenomenon. It has been shown that the observed phenomenon affects the deceleration of the corrosion process of NPs-ZnO, which is important for the practical application of ZnO-NPs exposed to external factors.

### Keywords:

ZnO, nanostructures, corrosion, inhibitors, quantum chemical calculations



## SYNTHESIS AND MICROSTRUCTURE OF THE SPINEL-STRUCTURED HIGH ENTROPY OXIDES

**Maciej Moździerz\***, Juliusz Dąbrowa, Mirosław Stygar, Marek Zajusz

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### **A few words about the authors:**

The authors of these results are members of a team working in the Laboratory of High Entropy Materials at the Faculty of Materials Science and Ceramics.

### **Abstract:**

Quinary and ternary oxides were synthesized by a solid state reaction route from the Co-Cr-Fe-Mg-Mn-Ni-O system. Samples were free-sintered in air atmosphere at 1000 °C for 20 hours and quenched afterwards. Structural and microstructural studies were conducted by X-ray diffraction and scanning electron microscopy combined with energy dispersive X-ray spectroscopy. Three of synthesized quinary oxides resulted to be high entropy single-phase spinels, which can be described by  $(\text{CoCrFeMnNi})_3\text{O}_4$ ,  $(\text{CoCrFeMnMg})_3\text{O}_4$  and  $(\text{CrFeMgMnNi})_3\text{O}_4$  formulas, with the latter two being obtained for the first time. The rest of the oxides were characterized by two phases: Fd-3m (spinel) and Fm-3m (rocksalt). The impact of temperature and oxygen partial pressure on the phase weight fraction for these materials were also studied. For the single phase high entropy oxides, electrical measurements were carried out, showing that they are semiconductors with the electrons as the main charge carriers. Additionally, in-situ temperature X-ray diffraction study proved excellent stability of these materials within temperature range of 20-1000 °C.

### **Keywords:**

high entropy oxides, spinels, entropy-stabilized oxides



## **SURFACE CONDITION OF NI-CR ALLOY AFTER SiC ABRASIVE BLASTING FOR APPLICATION IN CERAMIC PROSTHETIC RESTORATION**

**Weronika Czepulkowska**

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### **A few words about the author:**

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### **Abstract:**

The condition of the metal surface is affected by process pressure, the type and size of abrasive, and the properties of the material being treated. In dental prosthetics, it is used to develop the surface of metal alloys, for connection with dental ceramics in crowns or prosthetic bridges. The purpose of this work is to analyze the surface condition of Ni-Cr alloy after silicon carbide treatment using variable sanding parameters. A Heraenium NA® alloy in form of cylindrical samples were used in this study. The surface of the material was sandblasted with SiC abrasive, where the abrasive grain size (50, 110 and 250  $\mu\text{m}$ ) and process pressure (0.2, 0.4 and 0.6 MPa) were variable. The lowest values of roughness parameters are obtained for surfaces after treatment of 50  $\mu\text{m}$  particle size and 0.2 MPa pressure, and the highest - 250  $\mu\text{m}$  and 0.6 MPa. The highest contact angle ( $93^\circ$ ) with polar liquid is observed for the surface after the smallest particle size treatment and pressure of 0.4 MPa. The lowest SFE ( $36.7 \text{ mJ/m}^2$ ) is recorded for this sample. The opposite is for the sample after sandblasting with 110  $\mu\text{m}$  particle at 0.2 MPa, where the contact angle with the polar liquid is the lowest ( $45.6^\circ$ ) and the SFE value is the highest ( $54.8 \text{ mJ/m}^2$ ). The percentage of abrasive particles penetrated into surface increases as grain size increases. Ultimately, the surface condition is affected by both the size of the abrasive grain used and the process pressure.

### **Keywords:**

Ni-Cr alloy, prosthetic, abrasive blasting, ceramic restorations, surface condition



## INFLUENCE OF THE INHIBITOR ON THE PROPERTIES OF DENTAL ACRYLIC RESIN

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Ph.D. student and researcher at Lodz University of Technology. I am graduated Dental Techniques on Medical University of Lodz on bachelor level. Then I continued this on MSc. I studied Computer Graphics and Multimedia Techniques too.

### **Abstract:**

The existence of an inhibitor could influence the useful molar ratios of the individual reagents, and this would translate into molecular weights, which could lead to change in the properties of the acrylic material. The purpose of the study was to check if the inhibitor affects the selected properties of the dental acrylic resin. Commercially available liquid to create dentures was recreated by the combination of methyl methacrylate, stabilized by hydroquinone, and ethylene glycol dimethacrylate as cross-linking agent. Two groups of specimens were made. The first one was with pure MMA (without inhibitor) and the second one- with MMA and inhibitor. Time of polymerization process, glass transition temperature by DSC method, 3-points bending test, and LapShear test were conducted. Unfortunately- LapShear test was not correctly conducted to measure adhesion between two polymerized PMMA. The presence of an inhibitor does not affect the properties of acrylic resin. Furthermore, enabling longer working time with the material allows obtaining samples with the correct shapes and dimensions.

### **Keywords:**

PMMA, hydroquinone, inhibitor, dentistry, acrylic resin



## THE STABILITY OF SHEAR THICKENING FLUIDS

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### **A few words about the author:**

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### **Abstract:**

Shear thickening fluids (STFs) are based on a suspension of solid particles in liquid carrier liquid and show an abrupt increase of viscosity beyond the critical value of shear rate. As a result, the fluid transforms from liquid-like to solid-like state. These changes are reversible. Good dilatant fluids have to exhibit appropriate rheological properties and protecting capability, as well as they have to maintain the properties over long time. The STFs are the materials that provide the opportunity to create energy absorption systems, which can be used in smart armours and sport protectors.

One of the most important property of the STFs is the structural stability of the fluid over time. In this study the stability was measured using the device for characterization of concentrated liquid dispersions – Turbiscan LAB Formulation. Turbiscan LAB was used with pulsed near infrared radiation ( $\lambda=880$  nm) as a light source. All the tests were carried out at room temperature. The transmitted and backscattered light was registered. The backscattered profiles were obtained for fluids fabricated on a basis of glycol with molar mass 400, 1000 and 2000 g/mol, respectively with 50 vol.% of fumed silica. All suspensions were examined after 3, 30 and 80 days. The STFs prepared on a basis of glycols having higher molar mass exhibit better stability.

### **Keywords:**

Shear thickening fluid, smart material, rheology, stability



## THE USE OF PROJECTION TECHNIQUES AND IMAGE ANALYSIS ALGORITHMS TO BUILD USER COMPUTER INTERFACES ADJUSTED TO DEVELOPMENT NEEDS OF CHILDREN

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### **A few words about the author:**

Owner of the LavaVision research and development company; a specialist in the field of designing algorithms of computer digital image processing.

### **Abstract:**

The paper presents the results of a research project carried out by the LavaVision R&D team in 2017-2019. The project named RPMP.01.02.01-12-0410/16 "Design of an interactive projection device that allows a person to control the user interface with move, light pens and touch gestures, with interaction scenarios for education applications" was implemented with the support of EU funds.

The research hypothesis was that it is possible to develop computer interfaces tailored to development needs of children and supporting the child's natural forms of interaction while dealing with the computer interface.

For conducting this experimental research, a floor surface was chosen as a natural space for children to play. Using available devices such as projectors and digital cameras, the project team took up the challenge of developing a prototype of a new multimedia device. The device that would allow people to interact with the computer just on the floor, using light pens, touch gestures and by the move of the whole body. At the same time research team developed the ergonomic user interfaces for educational applications taking into account the specific working conditions of the designed device.

The prepared device has been tested and evaluated in kindergartens and schools in cooperation with pedagogues and child carers.

Conducted tests confirmed the high potential of using interactive projection technologies for organizing multimedia games adjusted to development needs of children.

### **Keywords:**

natural user interfaces, education applications, interactive floor, multimedia devices



## TEXTILES IN AUTOMOTIVE ENGINEERING

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Doctor of technical sciences in the field of materials engineering. The subject of my doctoral dissertation was: "Modeling of structural and mechanical properties of unique knitted barrier mesh structures".

### **Abstract:**

Automotive engineering is one of many branches of industry that has been dynamically developing over the years. The main premise of the automotive industry is to ensure and increase the safety of users moving on the road infrastructure, both motor vehicles and two-wheelers (bicycles, mopeds, scooters). These are modern engineering solutions, striving to improve the applications of automotive systems not only in terms of design (mechanical and electronic systems), but also in terms of the use of these components, i.e. textile materials in the form of airbags, seat belts, child car seats or composites reinforcing the car structural system. In the collision of passengers vehicles, important decisions and the size of the injuries suffered are unicycles, including motorcyclists, overloads and the pressure force of the human body on the seat belts arising during a collision with an obstacle in the road infrastructure. The value of pressure exerted by the human body on the seat belts has the character of surface action. This is an important aspect determining the unit pressure forces, because when operating on a larger area of the belt this value will decrease. This simple principle is used in new, often innovative technological and design solutions in the context of seat belts. Textiles in automotive engineering are not only solutions in the form of cushions, seat belts, but also composite materials used in the construction of child car seats or adult seats.

### **Keywords:**

automotive engineering, airbags, seat belts



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