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Proceeding of the abstracts of the 7th International Workshop on Surface Engineering in Komárno

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Content

Parameters optimization of preliminary preparation process of amorphous metal surface

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Amorphous metal is a metallic material with long-range disorder in its structure, therefore it is called also metallic glass. It is three or more component alloy, while some of them are magnetic metals. As it possess high electrical conductivity and good magnetic properties (e.g. low-magnetization loss), it found an application as high-efficiency transformer core. Despite to the fact that that efficiency of such core is about 99%, work on it is still evolving. Before the main research would be implemented, a raw material has to be carefully prepared and characterized. Presented work contains results of complementary surface preparation and characterization of amorphous metal surface, namely Metglas 2605. Surface free energy measurements by means of Drop Shape Analyzer were applied in order to control cleaning process. In the second step, enhanced amount of useful oxides were obtained by annealing. It was verified with scanning electron microscopy, x-ray photoelectron spectroscopy and Raman spectroscopy. At the last stage, surface activation by plasma treatment was performed and controlled similarly as at the beginning with surface free energy measurements. Used methods allow to select an appropriate parameters for pretreatment process. As a result, well prepared surface of Metglas was obtained prior to further experiments on coupling to functional layers.

Presentation

Using Interactive Web-Based Animations for Teaching and Learning Computer Science Algorithms

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Learning and understanding computer science algorithms are one of the difficult tasks for first-year undergraduate computer science students. Algorithms use abstract concepts, which could be challenging to comprehend. Interactive animations, especially animations with conceptual view, can make a bridge between these abstract concepts and real world examples. To help novice computer science students, we collected and developed some web-base animations of computer science algorithms, and made these animations freely available at http://algoanim.ide.sk website. Some of our interactive animations we used to conduct pedagogical experiments during the academic year 2014/15 and 2015/16. The results showed that these animations helped students, they were able to understand the computer science algorithms quicker and easier.

Presentation

Preparing and characterization of silane layers on amorphous metal surface

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Metallic glass foil is nowadays a popular material for transformer core manufacturing, because of their excellent magnetic and electrical properties. Efficiency of that kind of core is very high, while core losses are lower in relation to previous silicone sheet core. Despite such a good features, researchers according to this material are still evolving, in example by covering with functional layers. As the surface of amorphous metal is full of oxides and hydroxides, metal-oxide bonding (M-O-Si) can be formed with attached layer. Due to this opportunity, hydrolysed silanes are a perfect candidates to film formation on metal surface. Presented work contains results of covering amorphous metal Metglas 2605 with tetraethoxysilane (TEOS) and dipodal 1,2-Bis(triethoxysilyl)ethane (BTSE). As the raw material is very reactive and prone to rusting, typical preparing methods cannot be applied. Obtained layers were characterized with scanning electron microscopy, confocal microscopy and Raman spectroscopy. Performed tests allow to compare obtained layers in relation to type of used precursor, amounts of applied layers and drying method. As the result, the best way to obtain smooth layer without cracks on amorphous metal surface was chosen.

Presentation

Programming tools in the primary school education

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Goal of the alternative learning strategies is to prevent a passive "sufferer" from acquiring knowledge. We have introduced this process through pupils' activity. As a result, it becomes fun to acquire new knowledge and become internal. Our goal is to showcase programming environments and interactive tools that enforced the alternative learning strategy "learning by doing" (learning from experiences resulting) through programming, giving place for the pupils creativity in programming to do what they really love.

Presentation

Solution for mobile robot navigation based on the laser and other optical data

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In this contribution we will focus on determining the exact position in the interior. Internal spaces depending on the structure (reinforced concrete structures, dusty environment, uneven floor ...) sometimes do not allow the use of other navigation principles as for example GPS and so on. In this case, the solution is to use navigation methods that do not depend on the GPS signal. It is true that such navigation methods have errors that we can successfully eliminate by combining multiple methods.

Presentation

Oxidation tests of black glasses coatings on intermetallic compounds

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One of the most problematic and expensive problems for materials such as steels or intermetallics, working in elevated temperatures reaching 1000°C combined with an aggressive gaseous environment, is the corrosion. In order to prevent against the material's degradation numerous approaches are considered, including i.e. the effect of additions or coatings application. In the end, the whole system should exhibit a range of useful properties including the high thermal stability in a different chemical environment and a broad range of temperatures, excellent mechanical parameters and resistance to creep and corrosion. Taking into consideration these requirements, the material which may exceed all of them are so-called black glasses based on SiOC. These are ceramic materials having a structure of an amorphous SiO_2, which are formed mainly due to the introduction of carbon C^{4-} anions in the place of some oxygen O^{2-} ones. Despite the decrease in a bond energy due to its lower value for Si-C than Si-O, the local bond density is increased. That is why a strengthened glass network can be characterized with interesting performance characteristics, primarily in higher temperatures. In this study, there were investigated protective coatings based on silicon oxycarbide glasses, applied on intermetallic compounds – titanium aluminide doped with chromium or niobium. Substrate material in the form of discs was grinded from one side and polished from another and degreased. On the other hand, the coating material was obtained by

using the sol-gel method and appropriate ladder-like polysilsesquioxanes precursors. After immersing and withdrawing the samples from the synthesized sol with the speed at the level of 30 cm/min, layers were dried and pyrolized in an argon atmosphere in 800°C. After the formation of black glass coatings they were, put into a furnace filled with a laboratory air atmosphere and heated for 100h in 1000°C. In the end, structure (XRD, EDS, Raman) and microstructure (SEM, Confocal) were evaluated in order to assess the performance of coatings in a highly corrosive environment.

This research was financed by Polish Ministry of Science and Higher Education from the budget for science in the years 2017-2020, as a research project under the program "Diamond Grant" (grant no. DI2016 004046). Also, Maciej Bik has been partly supported by the EU Project POWR.03.02.00-00-I004/16.

Poster

Black glasses as a new perspective for corrosion resistance improvement of materials used in automotive industry

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In recent years there has grown an interest in polymer-derived ceramics based on Silicon Oxycarbide with an amorphous silica network and its derivatives including additions of Al and N. One of the reasons is that black glasses are feasible to be used in different forms such as solid, coatings, porous or fibers because of possibility to choose appropriate material precursors. Such a tendency comes also from an extraordinary set of materials characteristics concerning excellent thermal stability even up to 1500°C, chemical and oxidation resistance in elevated temperatures together with high mechanical strength. Such versatile properties are determined by a replacement of the defined number of oxygen ions with carbon anions resulting in a local increase in the bond density leading to a reinforcement of the glass structure. Hence, one of the possible application may concern an automotive industry. Nowadays, simultaneously with an increasing demand for the higher efficiency of any vehicle, the biggest emphasis is put on low costs of theirs production and especially the maintenance. The second issue becomes much more complicated, when harsh hot gaseous working conditions leading to the corrosion of materials for i.e. turbine blades or compressor discs, are taken into account. One of the most promising group of materials for parts used in automotive industry, investigated throughout last 30 years, are so-called intermetallics. Amongst them, TiAl alloys were used to be perceived as the most fitting due to the combination of low density and satisfactory

mechanical parameters within broad range of the temperature. However, due to problems with an oxidation resistance over 700°C there are still sought a new solutions including i.e. application of anticorrosive coatings. That is why, a new coating material based on black glassed has been investigated. The main objective of this study was to evaluate the oxidation resistance of black glasses in the form protective coatings on TiAl alloy. The sol-gel method has been used in order to synthesize the coating material which was then deposited on alloy samples using the dip-coating technique. Structural (XRD, MIR, EDS) and microstructural (SEM, Confocal) studies confirmed the formation of black glasses and allowed to assess integrity and quality of layers, respectively. After that, TGA analyses in a laboratory air atmosphere for 100h in 800°C were conducted to check the influence of coatings on the system corrosion behavior. Obtained oxidation kinetics with an evaluation of structure (EDS, XRD) and microstructure (Confocal, SEM) of samples after oxidation tests, revealed the considerable improvement in the corrosion resistance of TiAl samples due to much less mass gain and slower growth of a scale under the coating.

This research was financed by Polish Ministry of Science and Higher Education from the budget for science in the years 2017-2020, as a research project under the program "Diamond Grant" (grant no. DI2016 004046). Also, Maciej Bik has been partly supported by the EU Project POWR.03.02.00-00-I004/16.

Presentation

Wort technology and possible modifications

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Beer is the oldest recorded recipe in the world. The ancient Egyptians first documented the brewing process on papyrus scrolls around 5,000 B.C. Beer eventually made its way from the Middle East across the Mediterranean to Europe, where it became an integral part of life. This was especially true in Northern Europe where abundant barley crops provided ample raw ingredients for brewers. Beer was valued both for its nutritional value and because it was a safe alternative to drinking water. Short history of beer provides insight into development and change over the years with a main focus on the technological and technical aspects of beer production. This multistage process consists of many different operations, such as wort boiling, clarification or fermentation to name few. Over past years aspects of wort clarification were analyzed. Focal point of the research is residue precipitation in a cycling vat called Whirlpool. Here wort clarification is possible due to a gravitational force and a rotating flow of the wort. Theories for modeling rotating flow originally developed from attempts to understand fluid flow phenomena on the Earth's surface and its oceans. Heritage of this research now can be applied anywhere this motion appears. Extensive analysis of the phenomenon resulted in modifications of the tanks bottom to intensify the flow in the so-called Ekman layer, where residue accumulation happens. To ensure correct conditions for beer fermentation high wort clarity is required, but the clarification cannot last too long. Thus it is necessary to find solutions to expedite residue precipitation. Aside technical aspects a short characterization of the non-intrusive laser

optical measurement technique for research and diagnostics of flow – Particle Image Velocimetry will be covered.

Presentation

Intelligent Space environment of J. Selye University

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Recently the intelligent space (iSPace) applications have become increasingly beneficial considering robot control. In the presentation we introduce the intelligent space environment developed at the Intelligent Robotic Center of J. Selye University. This environment is using an OptiTrack camera system consisting of 24 cameras, which can track the movements of various robot agents in real time using markers.

Presentation

Potencial applications of acoustic's emission ssignal in the electodischarge machining technology

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Electrodischarge machining (EDM) process is one of the most commonly used nonconventional machining method, which allows to machine all of the conductive or semi-conductive materials, regardless of its mechanical properties. During EDM material removal is connected with occurrence of complex and intense processes which causes significant difficulties with the in-situ observation. It is crucial to be able to observe, identify and analyze the phenomena during material removal to improve the machining conditions. There is a group of methods which are used for monitoring, especially during single discharge, however these methods are too sophisticated and as a result are ineffective for monitoring during manufacturing in real conditions. Therefore there are carried out works to develop a technique which will improve existing methods and allow for real-time monitoring of EDM process and at the same time enable surface integrity assessment after electrodischarge machining. Referring to this, the basis of acoustic emission method as well as also the state-of-the-art of acoustic emission method application in electrodischarge machining will be presented. Recently acoustic emission method supports commonly used techniques of EDM process monitoring and provides additional, important information, particularly in the aspect of the dielectric flow control, electrical discharges localization and the material's structure inspection after machining. Nevertheless, it should be mentioned that there is still a huge lack of knowledge connected with the acoustic emission method

application during EDM. There are a lot of potential research question which should be addressed, especially related to the real-time estimation of amount of melted and evacuated from machining crater material or surface changes during single or sequential discharges. Answering these questions allows in future to developed acoustic emission based system to predict changes on the machined surface after EDM process.

Presentation

The origin of residual stresses and their measurements by non-destructive x-ray diffraction method

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During machining process number of complex phenomena take place which influence the properties of surface layer. These properties determine the utility features of elements of machines and devices. Stresses are generated in the workpiece as a result of the mechanical treatment of materials. The process of residual stresses formation is uneven in the entire volume of the element. As a result of residual stresses formation the areas with poor cohesiveness are generated and they mainly depend on the applied forces and geometrical boundaries. Residual stresses are irreversible and are most often revealed when the element is irreversibly damaged (during material breakage). Residual stresses can be divided based on the cause of their formation into three types: thermal, mechanical and structural. Due to the significant impact on the strength properties of the workpiece (resistance to brittle fracture, fatigue strength), tribological and corrosion properties the knowledge of the distribution of residual stresses is very important. Many methods have been developed to measure residual stresses and they can be divided into three main groups: destructive, semi-destructive and nondestructive methods. It is possible to use the X-ray diffraction method to measure residual stresses because they cause changes in the state of the crystal lattice. The results obtained from carried out research will be presented during presentation.

Presentation

Characterization of materials' pores microstructure. Modeling of liquid flow in a real geometry

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Pores microstructure determines many processes in material science: from manufacturing of composite materials to degradation of refractory or building materials. Knowledge of pores structure allows for better design of materials. There are several methods for the description of pores and their microstructure in materials. Average porosity may be measured using Mercury Intrusion Porosimetry (MIP), while the information about pores morphology can be obtained using optical microscopy (OM, in 2D) or Micro-Computed Tomography (μCT, in 3D). There are also other parameters which describe the pore structure e.g., tortuosity or permeability (measured by Gas Permeability, GP). The promising tool for the description of pores materials is modeling. Calculations of liquid flow in pores materials can be performed for the real materials' microstructures. The flow in real microstructures (2D or 3D) can be described using e.g. Stokes equation (micro model) or modified Brinkman equation (hybrid model). In this work several methods for the description of materials porosity in 2D and 3D are presented. Experimental results of permeability obtained from Gas Permeability will be compared with the calculated results for real pores microstructures obtained by MIP, OM or μCT. Numerical calculations were performed using the COMSOL Multiphysics software.

Presentation

Preliminary results of plasma electrolytic oxidation treatment of 6061 Al alloy under soft sparking conditions

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Plasma electrolysis comprises a large gamut of techniques, which are aimed at modification of the physicochemical state of a treated metallic surface. It is an extension of the conventional electrochemical process whereby the anodic or cathodic processes are assisted by the presence of plasma, either in a continuous gaseous envelope state or as microdischarges. The variant of the process that combines the anodic oxidation of the passivating metal substrate and the formation of microscopic discharges (originating from the dielectric breakdown of the passive layer) is called plasma electrolytic oxidation. This method allows for the formation of relatively thick oxide coatings on valve metals that can be highly enriched with electrolyte solution components, provided that the process parameters are suitable. When PEO is conducted under DC regime, it is often the case that the obtained oxide films are cracked and penetrated by large pores. This is the case when the surface discharges acquire high intensity due to combined thermal and impact ionization mechanisms. The improvement in the coatings' quality can be achieved when the pulsed or AC current or voltage waveforms are applied for the treatment instead. The aim of the research presented here was to study the AC PEO process of 6061 Al alloy in the commonly known electrolytic baths (silicate-, phosphate- and aluminate-based) in the context of obtaining the process regime that allows for the attaining of "soft-sparking"

conditions. This was attempted by applying the PEO conditions (including tweaking of various AC parameters) that limited the intensification of the process at high voltages, which is typically detrimental for the coating's barrier properties during the DC variant of the treatment.

Poster

Synthesis and characterization of *para*-functionalized polyhedral oligomeric phenylsilsesqiuoxanes with 3,5-dimethylphenyl groups

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Silsesquioxanes are a class of organosilicon compounds which are represented by $[RSiO_{3/2}]_x$ formula (R = H, alkyl, aryl). Besides random or ladder-like structure, they can form polyhedra which usually consist of 8, 10 or 12 $SiO_{3/2}$ units. The rigid, inorganic cores can be readily functionalized with a variety of organic moieties. Presence of conjugated fragments (e.g. polyaromatics) allows for self-assembly phenomenon due to the influence of π-π stacking effect. In this work, octaphenyloctasilsesquioxane (OPS) and dodecaphenyldodecasilsesquioxane (DPS) were symmetrically *para*- functionalized with 3,5-dimethylphenyl groups. Selective iodination of phenyl groups attached to the Si-O core by iodine(I) chloride resulted in the formation of *para*-iodophenylsilsesquioxanes in good yields (>90%). Suzuki-Miyaura cross-coupling reactions between thus obtained compounds and 3,5-dimethylphenylboronic acid, catalyst generated *in situ* from tris(dibenzylideneacetone)dipalladium(0) and tri(*o*-tolyl)phosphine as well as silver(I) oxide as a base at ambient conditions resulted in formation of final products with nearly stoichiometric yields. All products were characterized by MALDI-TOF-MS, FT-IR, ^{1}H NMR spectroscopy, scanning electron microscopy imaging (SEM), X-Ray diffractometry, elemental analysis and thermogravimetry.

Presentation

Porous material obtained by cross-linking of poly(methylvinylsiloxane) with 1,3,5,7-tetramethylcyclotetrasiloxane as a matrix for deposition of palladium nanoparticles

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Porous polymers are an easily processed group of porous materials, which find their applications in microelectronics, membrane processes, gas storage, encapsulation of drugs, water purification, catalysis or fabrication of ceramic materials to name just a few. There are many methods for preparation of polymers with controlled porosity. They involve direct templating and further removal of templates, block copolymer self-assembly with successive removal of one of the components, direct synthesis involving monomers with targeted (usually microporous) structures, and high internal phase emulsion polymerization (HIPE) with subsequent removal of internal phase (usually water). In this work, high internal phase emulsion templating was used to create highly porous material (polyHIPE) by hydrosilylation of poly(methylvinylsiloxane) (PMVS) with 1,3,5,7-tetramethylcyclotetrasiloxane (D_4^H). In the first step, PMVS was synthesised by kinetically-controlled anionic ring opening polymerization of 1,3,5-trimethyl-1,3,5-trivinylcyclotrisiloxane (V_3) resulting in the polymer of low molecular weight distribution (molecular weight distribution index determined by gel permeation chromatography, Mw/Mn=1.2). It was characterized by FT-IR, ^{1}H, ^{13}C, ^{29}Si NMR spectroscopies and MALDI-TOF-MS. In the second step, Pt^0 catalyzed cross-linking of thus obtained PMVS by D_4^H in HIPE conditions was performed using 0.02M aqueous NaCl solution as an internal phase, chlorobenzene as secondary porogen

and DBE-224 as a non-ionic surfactant. Emulsion was cured at 80°C in PTFE crucible to create a monolithic material whose morphology was then characterized by SEM studies. Its chemical structure was determined using FT-IR and ^{29}Si CP/MAS NMR spectroscopy. Presence of unreacted Si-H groups in the material allowed to introduce palladium nanoparticles by reduction of Pd^{2+} ions from palladium(II) acetate tetrahydrofuran solution. X-ray diffractometry confirmed the presence of metallic palladium nanoparticles. Future work will be focused on testing catalytic properties of this material in hydrogenation of furfural.

Poster

Preliminary tests of electric discharge machining in the air with and without additional water-cooling of the workpiece

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Electrodischarge machining (EDM) is becoming more and more important manufacturing technology. The universality of its application results from the possibilities of machining of difficult to cutting alloys. Recently, ecological and financial considerations force to develop new dielectric fluids than those used so far (carbon based or water based fluids). The goal of tests carried out was to check how air pumped through a copper tube electrode works as dielectric during electrodischarge drilling. The tests were carried out in two variants: without and with the use of additional cooling by deionized water. The aim of the preliminary research was understanding of the influence of voltage value, current amplitude, pulse time, pause time and polarity of electrodes on tool wear , surface layer quality and material removal rate. On the basis of the obtained results it can be concluded that the application of cooling of the processing zone and the workpiece with deionized water positively influences the stability and effects of the machining.

Presentation

New generation of thin coatings in protection against high temperature corrosion

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This work presents experimental results obtained for the oxidation rates of four valve steels (X33CrNiMn23-8, X50CrMnNiNbN21-9, X53CrMnNiN20-8 and X55CrMnNiN20-8), covered by protective coatings with 1 micrometer thickness. Coatings built of pure chromium, as well as of chromium-nickel alloys (Cr-50%wt. Ni, Cr-10%wt. Ni) were deposited by means of ion sputtering. Additionally, silicon carbide coatings were obtained via plasma-enhanced chemical vapour deposition using electromagnetic waves with radio frequency (RF CVD, 13.56 MHz). Oxidation tests were performed in air atmosphere at a constant temperature (1173 K) and in thermal shock conditions (298-1173 K). Initial studies on the corrosion of valve steels covered by 1 micrometer thick coatings consisting of pure chromium or silicon carbide were also carried out during a 200-hr durability test of a 0.9 SGE TC80 CNG engine powered by natural gas. It was determined that coated steels exhibit greater resistance against oxidation than steels with unmodified surfaces. The positive effect of the coatings on increasing scaling-resistance of studied materials was noted during tests performed both in isothermal and thermal shock conditions. In the case of metallic coatings based on chromium, the obtained result is due to the formation of chromium-rich oxides (e.g. Cr2O3, NiCr2O4, MnCr2O4) during oxidation of surface modified steel. These oxides exhibit better protective properties than the compounds grown on

unmodified steels (namely Fe3O4 and Fe2O3). During oxidation of steels with silicon carbide coatings, the presence of chromium-containing oxides was also determined, which were not observed in oxidation products formed on steels without this coating. Furthermore, the presence of Mn7SiO12 was noted. However, iron oxides with poor protective properties were not detected. Corrosion studies carried out on coated valve steels in real exhaust gas atmosphere during the above-mentioned engine durability test demonstrated that the chromium protective coating with around 1 micrometer thickness does not completely degrade, but its remains are still present in the engine valve. The entirety of the obtained experimental results confirms the possibility of increasing the scaling-resistance of valve steels by using around 1 micrometer thick chromium-rich protective coatings or silicon carbide coatings. This indicates the unnoticed up to now potential of thin coatings, which enables their application as a means of protection against high-temperature corrosion in several branches of modern industry.

Presentation

Layers on metallic substrates based on black glasses modified with bioelements

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Black glasses or silicon oxycarbide (SiOC) are amorphous materials of the structure of amorphous silica (ν-SiO_2) with part of the oxygen ions replaced by carbon ions. Due to the difference in valency, one C^{4-} ion replaces two O^{2-} ions. It causes densification and stiffening of the structure. This phenomenon has a strong impact on the material properties, especially black glasses may be characterised by good mechanical properties, fracture toughness, thermal and chemical stability, corrosion resistibility. Black glasses might be obtained by the sol-gel method by hydrolysis and polycondensation of proper organosilicon compounds containing silicon-carbon bond. Through this method, preceramic polymers are obtained in the form of the alcoholic solution. They might be deposited on any surface with the use of simple methods, such as dip-coating or spin-coating. Moreover, the application of the sol-gel method enables the control of the amount of introduced carbon ions and modification of the material with another anions and cations to obtain tailored properties. These make the material a perfect one for the application as protective functional coatings. In this work, the layers of black glasses modified with bioelements, such as phosphorus and calcium ions were proposed to enhance bioactivity of the material. Via the sol-gel method, preceramic precursors were obtained in the form of ladder-like oligo-and polysilsesquioxanes modified with proper ions. In the following step, layers were deposited on the metallic (titanium) surfaces with the use of the dip-coating technique, dried and ceramized in 800°C in the protective atmosphere of argon as the inert gas. The obtained materials were examined using various spectroscopic methods (e.g. MIR, Raman, EDS) to obtain

information about the structure and the path of implementation of phosphorus and calcium ions into the glass matrix in the obtained coatings. To examine the surface properties, such as morphology, roughness, contact angle and surface free energy, multiple techniques were used, such as scanning electron microscopy (SEM), laser confocal microscopy (LCM) and goniometry. The last stage of the examination contained bioactivity examination – the so-called Kokubo test.

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Presentation

Application of modified ladder-like silsesquioxanes in Additive Manufacturing – preliminary study

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Additive Manufacturing (AM) is the name of all the methods in which the three-dimensional objects made from polymers, metal or ceramics are solidified from liquids or powders. Among these methods, stereolithography and fused deposit modelling might be distinguished. The building process is under the 3D modelling software control. In this work, the advantages of the use of AM techniques in the manufacturing of ceramic materials and novel preceramic precursors. Due to the most characteristic properties of ceramic materials, during machining cracking and fragmentation may take place. The precision of AM layer-by-layer manufacturing allows obtaining most complicated shapes. It is required to use the proper polymeric preceramic precursors which need to be further ceramized. In most cases, the commercially available macromolecular compounds are used. Unfortunately, most of them possess low ceramic yield, which causes uncontrolled shrinkage of the material and then pores, cracks and inhomogeneities. To avoid their creation, the self-synthesized preceramic precursors – ladder-like polysilsesquioxanes – are proposed. Undoubted advantage of these precursors is easiness of tailoring in a wide range with emphasis on the introduction of functional groups capable to cross-link under UV or visible light irradiation, such as vinyl, acrylate or thiol moieties and relatively high ceramic yield. These precursors might be used for fabrication of polymer-derived silicon oxycarbide (SiOC) based ceramics – so-called black glasses. The material is nowadays in the spotlight, not only of additive manufacturing. The

application in distant industries and technology branches, for example, biomaterials, catalysts, fuel cells, protective layers, is being studied. The interest is caused by their durability, good mechanical properties, chemical and thermal stability, corrosion and oxidation resistibility. It is the result of the unique structure of black glasses binding amorphous silica (ν-SiO_2) and silicon carbide (SiC) networks. In this work, the preliminary study of the application of ladder-like silsesquioxanes in additive manufacturing is presented. The preceramic precursors were obtained via hydrolytic polycondensation (the sol-gel method) from appropriate organosilicon monomers. The structure of the preceramic precursors and the based on them black glasses was examined with the use of spectroscopic methods such as middle infrared, Raman spectroscopy and X-ray diffractometry. The homogeneity of the obtained material was verified applying scanning electron microscopy.

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Poster

Wort technology and possible modifications

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Beer is the oldest recorded recipe in the world. The ancient Egyptians first documented the brewing process on papyrus scrolls around 5,000 B.C. Beer eventually made its way from the Middle East across the Mediterranean to Europe, where it became an integral part of life. This was especially true in Northern Europe where abundant barley crops provided ample raw ingredients for brewers. Beer was valued both for its nutritional value and because it was a safe alternative to drinking water. Short history of beer provides insight into development and change over the years with a main focus on the technological and technical aspects of beer production. This multistage process consists of many different operations, such as wort boiling, clarification or fermentation to name few. Over past years aspects of wort clarification were analyzed. Focal point of the research is residue precipitation in a cycling vat called Whirlpool. Here wort clarification is possible due to a gravitational force and a rotating flow of the wort. Theories for modeling rotating flow originally developed from attempts to understand fluid flow phenomena on the Earth's surface and its oceans. Heritage of this research now can be applied anywhere this motion appears. Extensive analysis of the phenomenon resulted in modifications of the tanks bottom to intensify the flow in the so-called Ekman layer, where residue accumulation happens. To ensure correct conditions for beer fermentation high wort clarity is required, but the clarification cannot last too long. Thus it is necessary to find solutions to expedite residue precipitation. Aside technical aspects a short characterization of the non-intrusive laser

optical measurement technique for research and diagnostics of flow – Particle Image Velocimetry will be covered.

Presentation

Plasma-based processes in surface engineering – design of functional coatings

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The surface of engineering materials has attracted much attention in the past decades since inevitable interactions between the surrounding and substrate surfaces take place during their exploatation under different conditions. To increase their usability many modification techniques, including mechanical and thermo-chemical treatment, as well as coatings deposition and introducing chemical functional groups to surface have been applied. This allows to improve the surface properties and produce functionalized materials with promising physicochemical and biological properties, and with hope for their successful application. Modern materials science, including plasma assisted technologies (*i.e.* based on chemical and/or physical vapour deposition), is a powerful tool in surface engineering materials. Their applications enable improvement of mechanical, chemical, and biological properties to meet all of the engineering and medical requirements. In this presentation, the fabrication and characterization of materials such as metallic alloys (*incl.* Ti6Al7Nb) and selected polymeric substrates (*incl.* polyethylene) after their surface modification in plasma conditions will be reviewed.

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Presentation

Thin Films of Carbides and Carbon-based Nanocomposites

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Binary, ternary and more complex carbides form a group of compounds offering diverse, sometimes unique mechanical, tribological and electrical and thermal properties. They are main constituents of advanced cutting tools, high-power electronics or high temperature ceramics. These materials gain new properties when deposited in thin film form. In particular use of PVD methods, where coatings are grown in conditions which are far from thermodynamic equilibrium, opens new possibilities for design of carbon-based composites and fine tuning their properties. Thin films of binary metal carbides and carbon-based nanocomposites derived from them had found numerous applications as wear resistant and selflubricating coatings. Addition of third element has led to formation of nanocomposite structures where release of free amorphous carbon can be controlled to meet various application needs. In the talk properties and structural features of binary and ternary carbides or carbide-amorphous carbon thin film composites are reviewed and discussed.

Presentation

Measurements and monitoring of arc welding parameters

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The quality of the joint made in the welding process can only be assessed after it has been made and tested. In many cases, especially on mechanized and robotic welding stations, the quality of the joint should be evaluated during its execution, directly at the welding station. The method of monitoring the arc welding process, consisting of data recording and analysis of welding parameters, is an indirect method, because the welding process is monitored, not the quality of the welded joint. Such a procedure assumes that there is a relation between the quality of the welding process, which can be equated with the stability of the arc welding process, and the quality of the welded joint. Analysis of signals recorded in the arc welding circuit allows detection of changes in the welding arc condition characteristic for the transition from stable arc glow (in the admissible range of welding parameters) to unstable welding arc glow. By analyzing the values of statistical characteristics of the recorded arc welding parameters, it is possible to locate the areas in which the welding process is disrupted. On the other hand, it is not possible to determine on this basis the type of welding incompatibility related to the disruption.

Poster

Effect of heat input to changes in cross-sectional area of square-groove butt welds

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The knowledge of real parameters values of an arc welding is to be necessary for real-time control, checking compliance with WPS instructions, implementation of new welding procedures, etc .. The linear energy of welding is a measure of the amount of heat delivered to the unit of the length of the weld, it is one of the basic welding parameters. The current method of calculating it does not correspond to modern technological requirements, because the linear energy of welding calculated according to the formula given in the standard does not take into account many factors significantly affecting the welding conditions. These factors change the volume of remelting, weld shape factor, HAZ width, maximum hardness in weld, degree of mixing and other parameters. An unambiguous measure of the linear energy of welding is the volume of melted metal and, at a constant speed of the process, the cross-sectional area of the weld within the connected elements. Measurement fields transverse joints allows comparison of actual thermal efficiency of different welding methods.

Poster

The influence of addittional printed elements on the quality of 3D printing

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Cheap 3d printers are gaining more and more popularity. Their low price causes construction defects, which affect the quality of printing. The article presents ways to improve the quality of printouts by using additional printed parts. The quality of test printouts and final results have been described.

Poster

Investigations on surface integrity after electrical discharge machining

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Many scientific centres are focused on the exploitation properties of machine parts. The conducted research has shown that a fatigue strength of devices depends on the condition of the surface layer of components. Electrical discharge machining is precision methods of manufacturing hard, complex shape, conductive materials. Removal mechanism of the material in EDM is mainly the result of the electrical discharge which causes melting and evaporation in local surface layers of both the workpiece and the working electrode. Properties of manufacturing material changed in result of the impact of the thermal and chemical processes form electrical discharges. The quality of surface after EDM process does not always meet the expectations. Additional technological operations are used to change the surface integrity. However, the use of additional operations significantly increases production costs. Therefore in this work analyses of the impact, the main EDM parameters discharge current, pulse time and pulse interval on surface integrity was conducted. Furthermore, the developed regression models of EDM allow the selection of the most favourable processing conditions to reduce the use of additional treatments to the minimum necessary.

Presentation

Novel coatings with developed stereometric structures on titanium substrate by Plasma Electrolytic Oxidation

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By using of Plasma Electrolytic Oxidation (PEO)/Micro Arc Oxidation, it is possible to form, on titanium and its alloys, the developed stereometric structures, which may be characterized as pores-in-pores system. The porous coatings can be obtained under DC, AC, and IMPULS regime, what results in different their chemical composition, thicknesses, and corrosion resistance. The performed studies clearly show that the use of AC-PEO processes result in thinner coatings with closed and less sharp pores, compared to those obtained under DC-PEO. It was also found out that by increasing of PEO voltage, it is possible to form coatings with higher amount of electrolyte elements inside. In addition, the possibility of built-in the elements like calcium and magnesium in phosphate structures is higher than it appears with copper and zinc.

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Presentation

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