



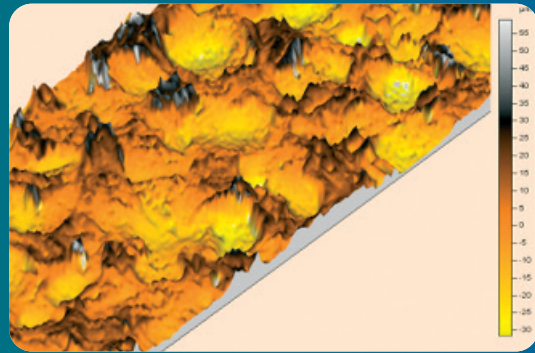
Research monograph

- 121.** The state of the art analysis and methodological assumptions of evaluation and development prediction for materials surface technologies  
A.D. Dobrzańska-Danikiewicz (Poland)



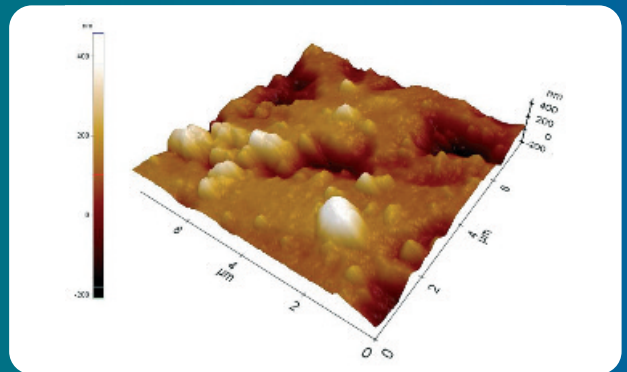
Materials

- 142.** Microstructure characterization of Ni-Ta-Al alloy with high carbon content  
P. Bala (Poland)
- 150.** Prediction of surface roughness by experimental design methodology in Electrical Discharge Machining (EDM)  
S. Ben Salem, W. Tebni (Tunisia), E. Bayraktar (France)
- 158.** Surface modification of sialon ceramics and cemented carbides by PVD coating deposition  
L.A. Dobrzański, M. Staszuk (Poland)
- 166.** The investigation of microstructure and hardness of archaeological alloys  
J. Konieczny, Ł. Kondziółka, I. Młodkowska-Przepiórowska (Poland)
- 180.** Wear mechanisms of fibre reinforced composite materials based on 2024 and 7075 aluminum alloys  
K. Naplocha, J.W. Kaczmar (Poland)
- 188.** The kinetics of phase transformations of undercooled austenite of the Mn-Ni iron based model alloy  
E. Roźniata, R. Dziurka, J. Pacyna (Poland)



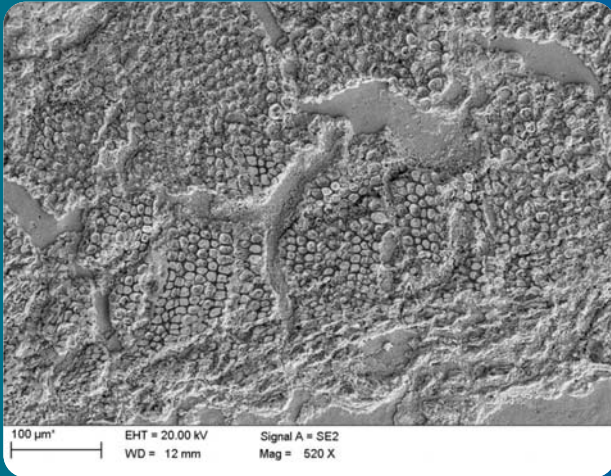
150

In the paper entitled "Prediction of surface roughness by experimental design methodology in Electrical Discharge Machining (EDM)" by S. Ben Salem, W. Tebni and E. Bayraktar on a **page 150** the models of the Ra parameter as a function of current intensity (I), the electrode material and the work material are presented. The surface is directly related to the average intensity (I) during machining. If the intensity is increased to 25 A, the roughness of the room rises dramatically to 15 microns. The mathematical model, which precisely determines surface roughness, is a tool for cutting parameters and has been obtained by the experimental design method. It enables a high quality range in analysing experiments and achieving optimal exact values. A relatively small number of designed experiments are required to generate useful information and thus develop the predictive equations for surface roughness. Depending on the surface roughness data provided by the experimental design, a first-order predicting equation has been developed. The experimental design was proposed for predicting the relative importance of various factors (composition of the steels and electrical discharge machining (EDM) processing conditions) to obtain efficient pieces. This model gives detailed information on the effect of parameters of cutting on surface roughness. Experimental data was compared with modelling data to verify the adequacy of the model prediction. As shown in this work, the factor of intensity has the most important influence on surface roughness.



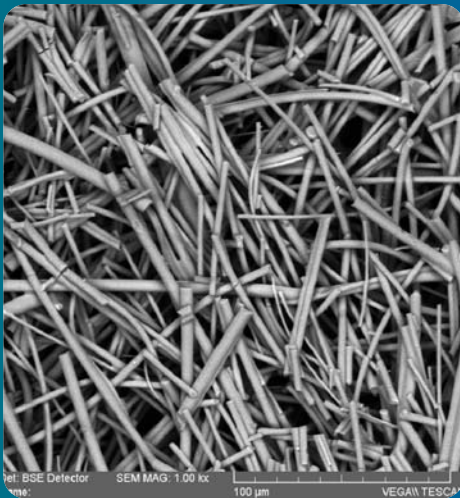
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The Materials section represented by L.A. Dobrzański and M. Staszuk on "Surface modification of sialon ceramics and cemented carbides by PVD coating deposition" on a **page 158** presents the investigation results of structures and mechanical properties of coatings deposited by the physical vapour deposition (PVD) techniques onto both sialon tool ceramics and sintered carbides. The paper includes two kinds of coating materials, isomorphous containing phases with TiN and AlN. In the paper some observations of coating structures, before carried out in the scanning electron microscope were presented. Phases composition analysis was carried out using a XRD and GIXRD method. The roughness of surface measurements, microhardness tests and adhesion coatings to substrates tests were carried out. It was found out that some coatings showed a fine-grained structure. Cutting ability were defined on basis of technological cutting trials. Coatings, which had contained a AlN phase about hexagonal lattice showed a considerably higher adhesion to substrate from sialon ceramics rather than a coating contained a TiN phase about cubic lattice. As a result of setting coatings onto substrates, a significant increase of both coatings hardness and surface roughness was found out. The coatings containing a TiN phase shows a low adherence to substrate ceramic, what is the consequence of low cutting ability. Whereas, coatings containing a AlN phase about hexagonal lattice show very good adherence to ceramic substrate as well as very good cutting ability.



In the paper entitled "The investigation of microstructure and hardness of archaeological alloys" by J. Konieczny, Ł. Kondziolka and I. Młodkowska-Przepiórowska on a **page 166** the investigation of the microstructure and hardness of archaeological metal is presented. Metallographic studies were carried out on archaeological finds that have been extracted from the ground during excavations on the market in Częstochowa (Poland) during the summer of 2009. In addition to the remains of buildings discovered under the level of market research objects were excavated in the area. Preliminary dating of the material shows a broad interval. In the examined finds the main component is copper, but they also contain other elements, sometimes in large numbers that indicates a very low-purity metallurgical material and thus proves that this is not a typical bronze which was manufactured at that time. The metal nails are characterized by high metallurgical purity. The presented results are an important contribution to the accurate characterization of found objects and also can help to determine more accurately their age and use in daily life of ancestors.

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Authors: K. Naplocha and J.W. Kaczmar in the paper entitled "Wear mechanisms of fibre reinforced composite materials based on 2024 and 7075 aluminum alloys" on a **page 180** discuss the determination of fibre reinforcement influence on wear rate and wear mechanisms. Wear mass loss for composite materials reinforced only with Saffil  $Al_2O_3$  fibres decreased with increase of fibre content in the matrix. The largest wear rate in relation to the unreinforced alloy exhibited composites containing 20 vol. % of Saffil  $Al_2O_3$  fibres, tested under the largest applied pressure of 1.5MPa. The graphite fibres enhance the wear resistance of composite materials under all applied pressures. The lubricant medium originated from worn graphite fibres prevented composite from seizure and adhesive wear. Composite 2024 and 7075 materials reinforced with hybrid preforms produced from alumina and graphite fibres exhibit good wear resistance. Manufactured composite materials will be considered as the friction materials for the high duty brakes.



## Properties

- 193.** Influence of Cr and Co on hardness and corrosion resistance CoCrMo alloys used on dentures  
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- 200.** Hyper capacity of mcm-41 <nematic> supramolecular structure in the radio-frequency range  
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- 204.** Effect of retardants on the heat release during setting of bone cement-type composites  
D. Pijocha, G. Łój, W. Nocuń-Wczelik, A. Ślósarczyk (Poland)
- 210.** Effect of grain size and tungsten addition on microstructure and magnetic properties of Nd-Fe-B type magnets  
A. Przybył, I. Wnuk, P. Gębara, J.J. Wystocki (Poland)
- 215.** The wear mechanism of hybrid layer "PN+CrN" during the hot forging process  
J.A. Smolik (Poland)
- 224.** Surface morphology of thin films polyoxadiazoles  
J. Wieszka, M.M. Szindler, M. Chwastek-Ogierman, M. Bruma, P. Jarka, B. Tomiczek (Poland)



## Analysis and modelling

- 233.** Hypergraphs of simple beams - models of their analysis in synthesis of complex beam-systems  
A. Buchacz (Poland)

**243.** Six Sigma methodology applied to minimizing damping lag in hydraulic shock absorbers

P. Czop, D. Sławik, T.H. Włodarczyk, M. Wojtyczka,  
G. Wszolek (Poland)

**251.** Virtual examinations of alloying elements influence on alloy structural steels mechanical properties

L.A. Dobrzański, R. Honysz (Poland)

**259.** FEM modelling of internal stresses in advanced PVD coatings

L.A. Dobrzański, L.W. Żukowska, A. Śliwa,  
J. Mikuła (Poland)

**269.** Design of damping systems with required frequency spectrum

A. Dymarek, T. Dzitkowski (Poland)

**275.** Active synthesis of multi-axial drive systems using a comparative method

T. Dzitkowski, A. Dymarek (Poland)

**285.** Efficiency of the computer tomography algorithms in examination of the internal structure of materials with non-transparent elements by using the incomplete information

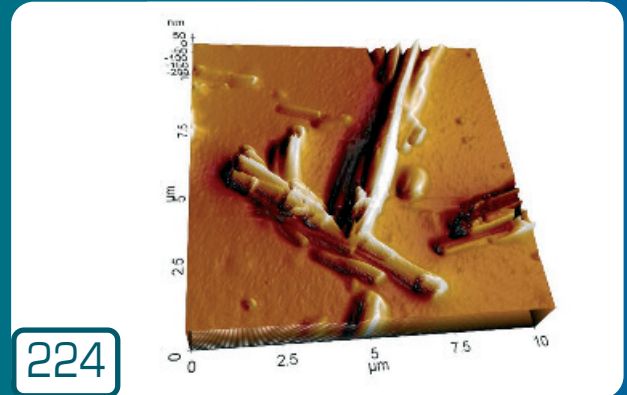
R. Grzymkowski, E. Hetmaniok,  
M. Pleszczyński (Poland)

**299.** Reconstruction of the thermal conductivity coefficient by using the harmony search algorithm

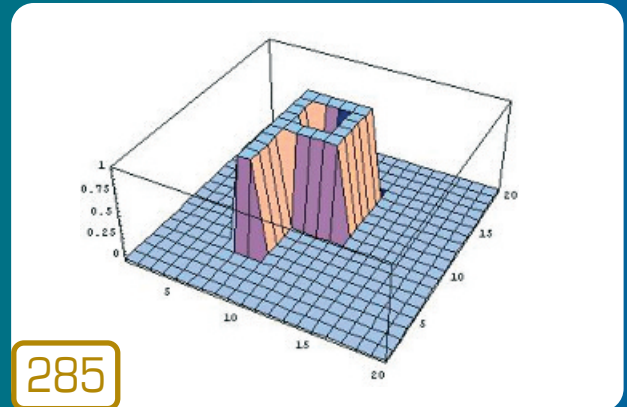
R. Grzymkowski, E. Hetmaniok, D. Słota,  
A. Zielonka (Poland)

**305.** Identification of the selected parameters of the model in the process of ballistic impact

K. Jamroziak (Poland)

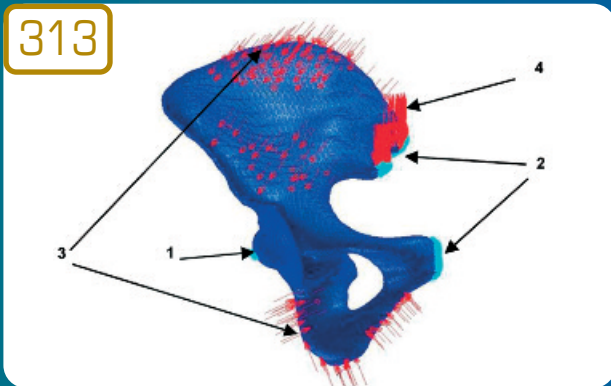


The properties area is shown in the paper on "Surface morphology of thin films polyoxadiazoles" by J. Weszka, M.M. Szindler, M. Chwastek-Ogierman, M. Bruma, P. Jarka and B. Tomiczek on a **page 224**. The purpose of this paper was to analyse the surface morphology of thin films polyoxadiazoles. The analysis of images has confirmed that the quality of thin films depends upon the used polymers. It was also observed that the parameters of the spin coating method have significant effect on morphology and surface roughness. The speed of the spin has got a strong impact on the topography of the obtained thin films. The value of this paper is defining the optimal parameters of spin-coating technology for six polyoxadiazoles. The results allow for choosing optimal parameters of the deposition process. Spin coating is a very good method to obtain thin films which are obligated to have the same thickness over the whole surface. Conductive polymers may find applications in photo-voltaics or optoelectronics. It is important to study this group of material engineering and to find a new use for them. Materials from which thin films are made will have an impact on the properties and characteristics of electronics devices in which they are to be applied.



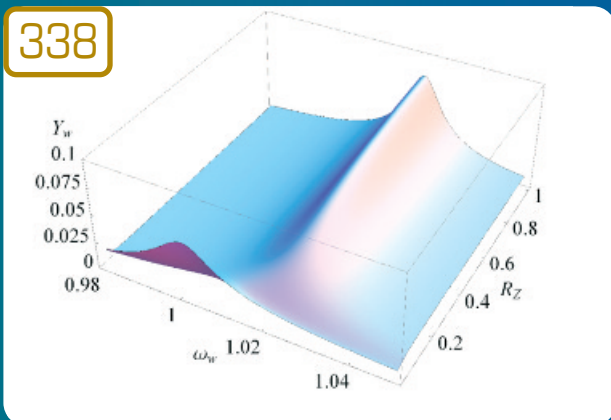
Authors: R. Grzymkowski, E. Hetmaniok and M. Pleszczyński in the paper entitled "Efficiency of the computer tomography algorithms in examination of the internal structure of materials with non-transparent elements by using the incomplete information" on a **page 285** discuss the effectiveness of computer tomography algorithms applied for reconstructing the internal structure of objects containing the non-transparent elements. A problem of the internal structure examination of an object with non-transparent elements, without its destruction, is considered by means of the classical and non-classical algebraic algorithms of computer tomography used in standard approaches and in cases of incomplete projection data. Computer tomography algorithms, known from literature and designed by the authors, are tested in solving the problems of reconstructing the discrete objects of high contrast with non-transparent elements, with regard to their precision, convergence and utility. Carried out research indicates that the chaotic algorithms are more efficient, for the same values of parameters, in comparison with the corresponding classical algorithms. Problems considered in the paper can arise in some technical issues, for example, in exploring the coal interlayers in looking for the compressed gas reservoirs which can be dangerous for human life and health, in which application of the standard algorithms of computer tomography is impossible for some reasons (like size of the examined object, its localization or its accessibility).

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The analysis and modelling area is shown in the paper on "Computer aided diagnostic of risky state in human pelvic bone" by A. John and P. Wysota on a **page 313**. This paper is to raise the issue of recognition of dangerous states in human pelvic bone. These states can lead to damages of bone. On the basis of obtained data the numerical model of pelvic bone was created. A very important stage was to determine the values of a material parameters. In the paper two methods were described. The first method has a direct basis in the data from radiology. In regard to difficulties with tomography data the second method was applied – the numerical simulations. The computer programme was developed to obtain the distribution of material parameters in a numerical model of pelvic bone on the basis of decreasing of bone mass. Decreasing of bone mass occurs in a whole bone, the stresses grow up continuously at the time. When decreasing of bone mass appears in an individual region only the stresses decrease at the beginning and the next increase while the bone mass still decreases. It could be one of the reason of lack of the symptoms in a primary stage of osteoporosis. The originality of researches consists in a complex approach to a problem of osteoporosis in human pelvic bone and applying the numerical simulations to create the numerical model of pelvic bone with osteoporotical changes.

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The paper entitled "Indication of the suitable model of a mechatronic system as an introduction to the synthesis task" by M. Płaczek on a **page 338** demonstrates the identification of the optimal mathematical model that meets the assumed criteria. Assumed criteria are to provide the accurate analysis of the system together with maximum simplification of used mathematical tools and minimize required amount of time. The correct description of a given system by its model during the design phase is a fundamental condition for proper operation of it. Therefore, the processes of modelling, testing and verification of used models were presented. On the basis of outcarried analysis the optimal (in case of assumed criteria) model was selected and it will be used to realize the task of synthesis in future works. A series of mathematical models with different simplifying assumptions was created. Using the created models and corrected approximate Galerkin method the dynamic characteristics of the considered system was designated. The analysis of an influence of parameters of the system's components on obtained characteristics was conducted. The approximate method was verified to check its accuracy and decide if it can be used to analyse such a kind of mechatronic systems. A presented method of mechatronic system's analysis can be used in a process of designing of technical devices where both, simply and reverse piezoelectric effects can be used. The main result of the work is an indication of the suitable mathematical model of the considered system.

**313.** Computer aided diagnostic of risky state in human pelvic bone  
A. John, P. Wysota (Poland)

**323.** Numerical and experimental true strain assessment on sheet forming using mapped versus free meshing  
S.F. Lajarin, J.S.F. Magalhães, P.V.P. Marcondes (Brazil)

**331.** Critical points of hypoeutectoid steel - prediction of the pearlite dissolution finish temperature  $A_{c1f}$   
B. Pawłowski (Poland)

**338.** Indication of the suitable model of a mechatronic system as an introduction to the synthesis task  
M. Płaczek (Poland)

**350.** Databases and computer programs selection of technological features  
R. Rzaściński (Poland)

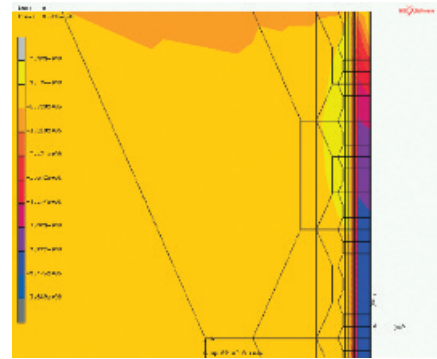
**360.** An analysis of discrete-continuous mechanical systems with conjugations  
A. Sękala (Poland)

**369.** Prediction of quenched and tempered steel and cast steel properties  
B. Smoljan, D. Iljkić, H. Novak (Croatia)

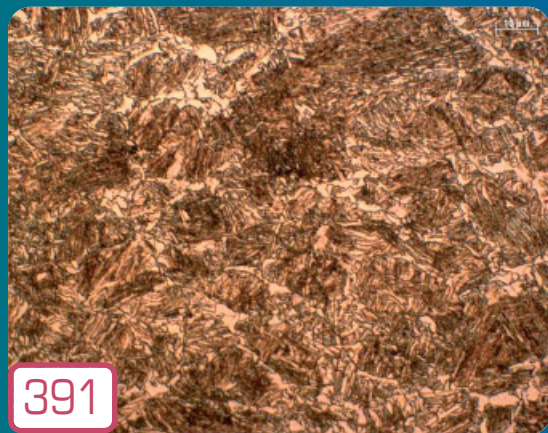
**375.** Innovative method of properties determination for tools covered with PVD coatings using computer simulation  
A. Śliwa, L.A. Dobrzański, W. Kwaśny (Poland), M. Tisza, L. Toth, S. Szabolcs, S. Pudmer (Hungary)

- 383.** The elements of artificial intelligence and the logic programming in the semi-automatic programming of the robot  
K. Foit (Poland)
- 391.** Effect of isothermal holding temperature on retained austenite fraction in medium-carbon Nb/Ti-microalloyed TRIP steel  
A. Grajcar, H. Krztoń (Poland)
- 400.** Laser repair hardfacing of titanium alloy turbine  
A. Klimpel, D. Janicki, A. Lisiecki, A. Rzeźnikiewicz (Poland)
- 412.** Basic features of the laser acceleration of charged particles  
M.J. Małachowski, A. Dubik (Poland)
- 421.** Theoretical basis of Al-Si coat crystallization on gray and nodular cast iron and making the layered items using it  
S. Pietrowski, T. Szymczak (Poland)
- 440.** Investigations on the machine parts treatment by non-bound blast particles  
Z.A. Stotsko, T.O. Stefanovych (Ukraine)
- 460.** Performance of deep cryogenically treated and non-treated PVD inserts in milling  
S. Thamizhmanii, Mohd Nagib, H. Sulaiman (Malaysia)
- 467.** Experimental study and modelling of mixed particulate lubrication with MoS<sub>2</sub> powder solid lubricant  
H. Wiśniewska-Weinert (Poland)

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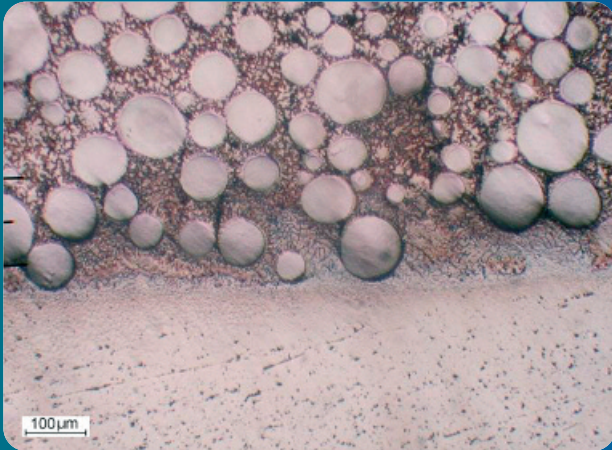


The paper written by A. Śliwa, L.A. Dobrzański, W. Kwaśny, M. Tisza, L. Toth, S. Szabolcs and S. Pudmer on "Innovative method of properties determination for tools covered with PVD coatings using computer simulation" on a **page 375** determines residual stresses of coats obtained in PVD process with the use of finite elements method and comparative analysis with results obtained by laboratory investigations. The presented model meets the initial criteria, which gives ground to the assumption about its usability for determining the stresses in coatings, employing the finite element method using the MARC programme. The computer simulation results correlate with the experimental results. The paper introduces the usage of finite elements method for simulation of stresses measurement process in TiN Ti(C,N) and TiC coats obtained in magnetron PVD process on high-speed steel PM H56-5-3-8. Modelling of stresses was performed with the help of finite element method in MARC environment, and the experimental values of stresses were determined basing on the  $\sin^2\psi$ . From results of the simulation based on the finite element method it is possible to compute the mechanical properties of coatings obtained in PVD process.



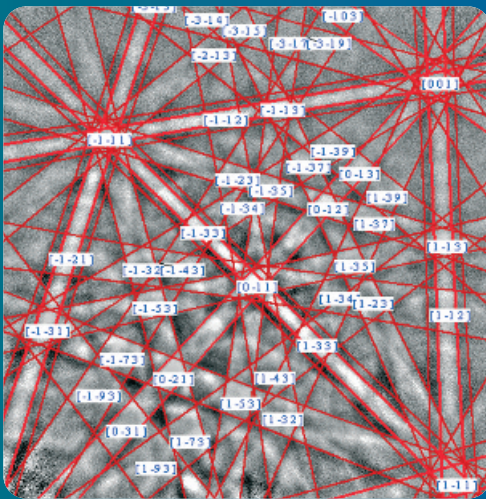
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The manufacturing and processing area represented by A. Grajcar and H. Krztoń on "Effect of isothermal holding temperature on retained austenite fraction in medium-carbon Nb/Ti-microalloyed TRIP steel" on a **page 391** presents the effect of the isothermal holding temperature in a bainitic transformation range on a fraction of retained austenite for a new-developed medium-carbon TRIP steel containing Nb and Ti microadditions. It is possible to obtain a high fraction of retained austenite characterized by the high thermodynamic stability in a C-Mn-Si-Al steel containing 0.43% C. The maximal fraction of austenitic phase equalling above 20% was obtained for the wide temperature range of isothermal holding from 350 to 450°C. The maximal carbon content in the retained austenite equalling 1.84 wt.% presents for the temperature range from 350 to 400°C. Below 350°C due to relatively low carbon diffusivity and high  $M_s\gamma_2$  temperature, a part of austenite transforms to martensite. Above 400°C there is still a high fraction of retained austenite but it contains a lower C content. The research was performed on a new-developed medium-carbon Si-Al steel microalloyed with Nb and Ti. There is a lack of data on microstructure and stability of retained austenite in such an advanced group of high-strength TRIP steels. The obtained austenite volume fraction and carbon content in a  $\gamma_2$  phase determined as a function of isothermal holding temperature can be useful in optimization of thermo-mechanical processing conditions for medium-C TRIP steels.



400

Authors: A. Klimpel, D. Janicki, A. Lisiecki and A. Rzeźnikiewicz in the paper entitled "Laser repair hardfacing of titanium alloy turbine" on a **page 400** discuss outworking repair technology of worn abutments of aircraft jet engine blades forged of titanium alloy WT3-1. The study was based on the analysis of laser HPDL powder surfacing of titanium alloy plates using wide range chemical composition consumables of titanium alloys and mixtures of pure titanium and spherical powder of WC indicated that very hard and highest quality deposits are provided by powder mixture of 40-50%Ti+60-50%WC. It was found out that it is possible to repair the worn areas abutments of blades of zero compression stage of aircraft engine turbine by HPDL laser surfacing with using composite powder mixture of 50%Ti+50%WC as an additional material. The technology can be applied for repair worn abutments of aircraft jet engine blades.



421

The paper from manufacturing and processing area made by S. Pietrowski and T. Szymczak on "Theoretical basis of Al-Si coat crystallisation on gray and nodular cast iron and making the Layered items using it"

on a **page 421** presents studies of crystallisation and the construction of the coat consisting of Al-Si alloys, also with alloy additives: Ni, Cu and Mg, deposited on gray and nodular cast iron, and the connection through this coat the layered item. On this basis, a model of creating a coat and layered item was developed. The originality of the paper consists in elaborating of the theoretical model of forming the diffusion layer made of Al-Si-M silumin on iron alloys. A theoretical basis of layers production were also elaborated. They are significant for collar fillings production in high-pressure combustion engines pistons, as anticorrosive layers and for layered items production. In this paper the influence of the most important technological factors on the thickness and phase construction of the silumin coat and connection quality in the layered item was presented. Dip coats are used as protective coats or intermediate coat of a layered item. The paper presents an example of the implementation for the manufacture of the layered items low-alloyed gray cast iron-silumin coat-silumin reciprocating compressor body for room air conditioning.

477. Intelligent cutting tool condition monitoring in milling  
U. Zuperl, F. Cus, J. Balic (Slovenia)



## Industrial management and organisation

487. Using control charts X-R in monitoring a chosen production process  
M. Dudek-Burlikowska (Poland)

499. Minimization of environmental risk by optimization of the end-of-pipe processes  
T. Karkoszka (Poland)

507. Influence of safety culture on the safety level in chosen enterprise  
W. Wolany, M. Spilka (Poland)



## Education and research trends

514. Report on the main areas of the materials science and surface engineering own research  
L.A. Dobrzański (Poland)

550. Conceptual study on a new generation of the high-innovative advanced porous and composite nanostructural functional materials with nanofibers  
L.A. Dobrzański, M. Pawlyta, A. Hudecki (Poland)



## Technical paper

**566.** Automatic and conventional system for feeding calves  
M. Janzekovic, B. Mursec, I. Janzekovic (Slovenia)

**573.** Geothermic Power Plants of high capacity - how far?  
R.H. Kozłowski (Poland)

**577.** Strength tests of sandwich composite materials connected by means of screw joints  
S. Żółkiewski (Poland)



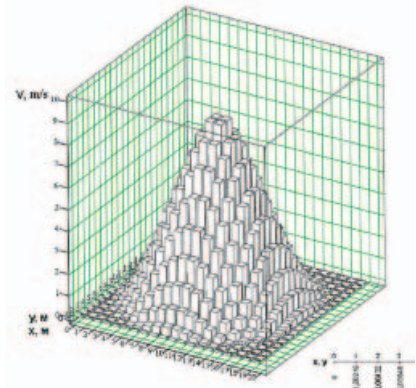
## Point of view

**585.** Workings of auxetic nano-materials  
Y.T. Yao (United Kingdom),  
M. Uzun (Turkey, United Kingdom),  
I. Patel (United Kingdom, Egypt)

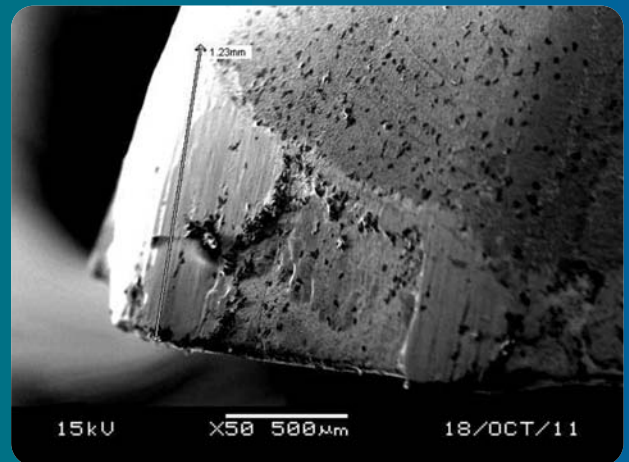
**594.** Author index

**596.** Keywords index

**599.** Index of Authors publishing in the Journal of Achievements in Materials and Manufacturing Engineering in 2011 (Vols. 44-49)

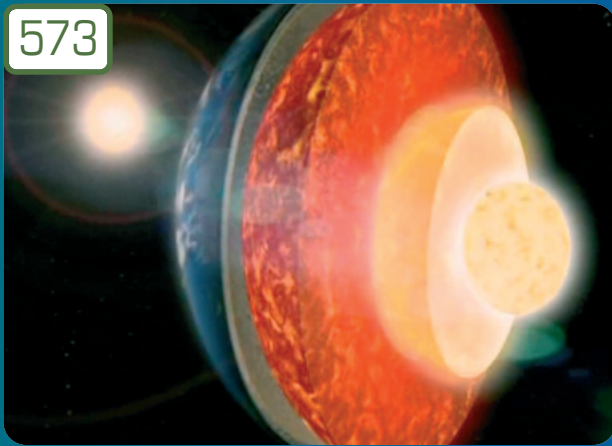


Authors: Z.A. Stotsko and T.O. Stefanovych in the paper entitled "Investigations on the machine parts treatment by non-bound blast particles" on a **page 440** discuss the mathematical models of the methods of treatment by non-bound blast particles. Analysis of non-bound blast particles behaviour is carried out for modelling. The operating factors such as geometrical parameters of a nozzle, distance to the treated surface, and pressure of compressed air and outlet factors such as a level of strengthening, depth of hardened layer are determined. It is proposed to put into basis of the mathematical models the energy conception that permits the unification and simplification of mathematical description of processes. The level of strengthening, and depth of hardened layer are estimated for the plain surfaces by means of created mathematical models. A method of mathematical modelling for treatment by non-bound blast particles is developed basing on energy conception. A mathematical model that allows for calculating the characteristics of surface quality depending on the technological modes of treatment is created. It is pioneered receiving functional dependences between the depth of hardening layer, changing of microhardness, a degree of hardening and the parameters of equipment, blast, and working medium. Created functional dependences takes into account the distribution of characteristics of working medium (mass and velocity) all along the cross-sections of the blast.



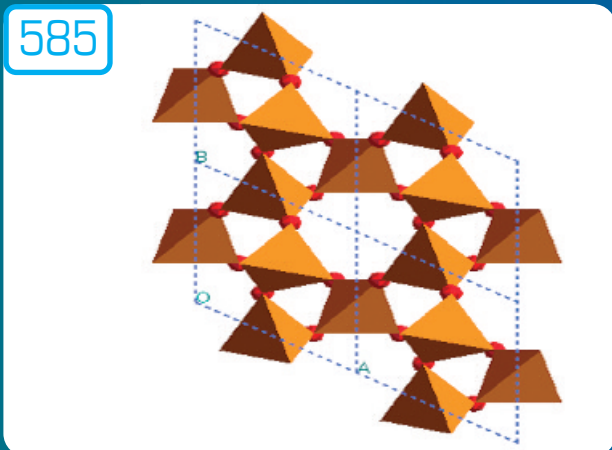
**460** The paper from manufacturing and processing area made by S. Thamizhmanii, M. Nagib and H. Sulaiman on "Performance of deep cryogenically treated and non-treated PVD inserts in milling" on a **page 460** presents the analysis of the tool performance between cryogenic treated and non-treated PVD inserts by milling process on Inconel 718 material in terms of surface roughness and tool wear. From the experimental work, the results were encouraging and performance is analysed on surface roughness and tool wear. Cryogenic treated inserts performed better than non treated inserts. The adopted methodology is milling process with various cutting parameters like cutting speed, feed rate and constant depth of cut. This experimental work will help other researchers to follow on flank and crater wear using cryogenic treatment. This process can be used for difficult to cut materials like Titanium.

573



The paper entitled "Geothermic Power Plants of high capacity – how far?" by R.H. Kozłowski on a **page 573** informs that over the past two hundred years, the mankind has exploited more than 50 percent of all natural resources, including energy minerals. The twenty-first century will be, out of necessity the period of intensive development of energy based on renewable resources. Geothermic power plant of high capacity characterized by the fact that the steam superheater section, which is traditional in a conventional power plants, is replaced by the system of heat exchanger in the form of u-tubes with a single length ranging from 1000 meters to up to several thousand meters, initially placed in a metal casing with a transition to the rock layers of high temperature. The role of a condenser can be fulfilled by a cascade system of thermal energy utilization (heat engineering, production of drinking water through desalination process, horticultural greenhouses, recreation, water pools, balneotherapy, heating sport fields, runways at airports and other transportation hubs). The subject invention is the use of geothermic energy using a closed water cycle in heat exchangers, made of high-temperature creep resisting steam superheater steel tubes or titanium pipes. Thermal energy of water vapour, which is obtained in this way, is transformed into mechanical energy in the turbine, powering the generator.

585



The paper entitled "Workings of auxetic nano-materials" by Y.T. Yao, M. Uzun and I. Patel on a **page 585** informs that the human mind is consistently interested in new materials having unique properties. Recently, a relatively new field which exhibits a negative Poisson's ratio (NPR) is being investigated, and consequently auxetic materials are termed. One of the main reason for interest in auxetic materials is due to the possibility of enhanced mechanical properties such as shear modulus, plane strain fracture toughness and indentation resistance compared to non auxetic material. Auxetic materials were described concerning their classification, characteristics, properties and potential applications. The paper shows the possibilities of auxetic materials application resulting from their mechanical properties.

604. Index of Keywords publishing in Journal of Achievements in Materials and Manufacturing Engineering in 2011 (Vols. 44-49)

610. List of Professors elaborating reviews in 2010-2012 for Journal of Achievements in Materials and Manufacturing Engineering

612. Template

616. Events 2012

624. Publisher's notice

625. Editor's notice



Photo essay

626. Memories of the 19<sup>th</sup> International Scientific Conference on Achievements in Mechanical and Materials Engineering AMME'2011, 29<sup>th</sup> May - 1<sup>st</sup> June 2011 in Gliwice – Wrocław, Poland

The Organising Committee  
of the AMME'2011 Conference