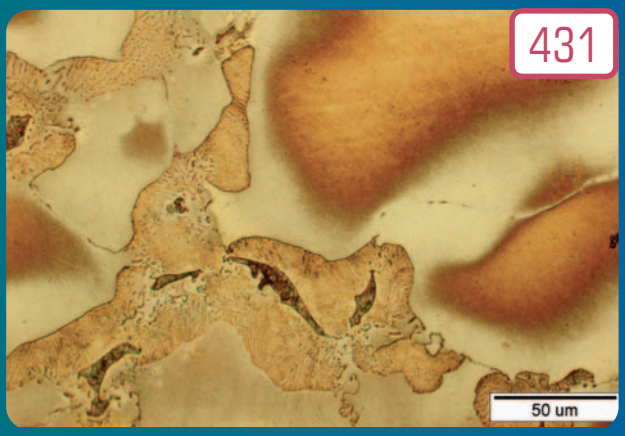
Opening lectures

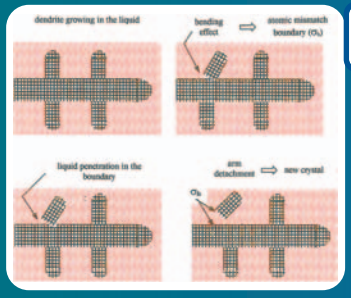
Occasional paper

Research paper

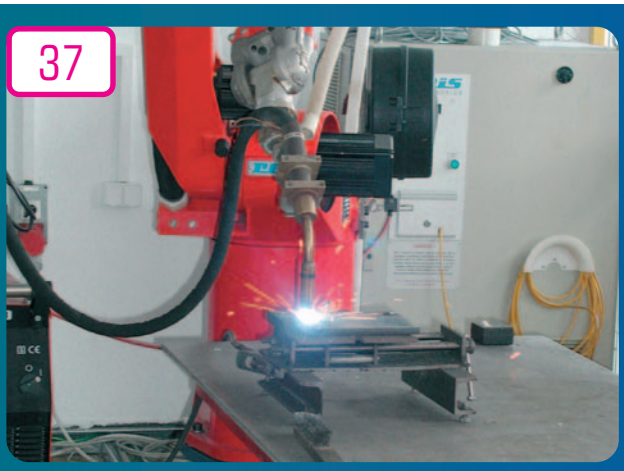
Selected materialographical photo



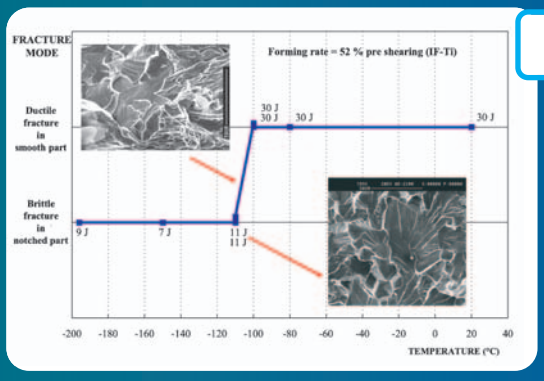
The Manufacturing and processing section represented by L.A. Dobrzański, T. Tański and L. Čížek on "Heat treatment impact on the structure of die-cast magnesium alloys" on a **page 431** presents the structure and properties of the MCMgAl6Zn1 magnesium cast alloy as-cast state and after a heat treatment. According to the alloys characteristics, the applied cooling rate and alloy additions seems to be a good compromise for mechanical properties and microstructures, nevertheless further tests should be carried out in order to examine different cooling rates and parameters of solution treatment process and aging process. The undertaken examinations aim at defining the influence of chemical composition and precipitation processes on the structure and casting magnesium alloy properties in its as-cast state and after heat treatment with a different content of alloy components. The results of the EDS chemical composition analysis confirm the presence of magnesium, aluminum, manganese, and zinc, constituting the structure of α solid solution with the $Mg_{17}Al_{12}$ placed mainly on the grain order in the form of plates, also the phase AlMnFe with irregular shape, occurred often in the shape of blocks or needles and the Laves phase Mg_2Si.



19 The research paper entitled "Producing thixotropic semi-solid A356 alloy: microstructure formation x forming behaviour" by M.H. Robert, E.J. Zoqui, F. Tanabe and T. Motegi on a **page 19** discusses the phenomena involved in the formation of the microstructure of semi-solid thixotropic alloy A356 produced by different techniques and the relation between microstructure and forming behaviour of the material. Results show that different production techniques activate different mechanisms, leading to distinct structure features in the semi-solid slurry, and, as a consequence, in its forming characteristics. Techniques which promote formation of isolate globules of primary phase, like those involving nucleation stimulation and recrystallisation, result in a semi-solid with better flowing behaviour. On the other hand, techniques based on crystal multiplication during growth lead to more interconnected globules in the slurry and poorer forming behaviour. The knowledge of the phenomena involved in the formation of thixotropic metallic slurries produced by different techniques, and their consequences in the material structure and flow behaviour, allow the decision of the adequate slurry production method for a specific application, in order to take the best advantage of the semi-solid technology.

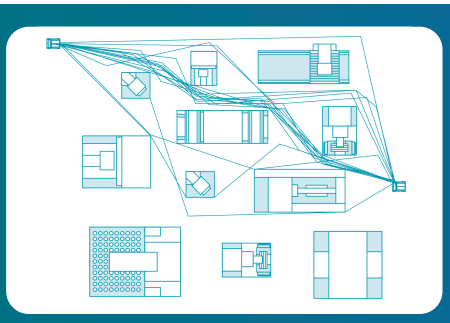


The paper from Manufacturing and Processing area made by A. Klimpel, D. Janicki, A. St. Klimpel and A. Rzeźnikiewicz on "Abrasive and erosive wear resistance of GMA metal cored wire cermetal deposits" on a **page 37** determines influence of GMA metal cored wire surfacing parameters on the abrasive and erosive wear resistance of the one layer and three layer weave bead cermetal deposits. Hardness of deposits tested is in the range from 453-517 HV10 (44,5-47,9 HRC) and is a function of the value of heat input of surfacing. WC carbides population density, size and distribution in nickel alloy matrix of deposits tested is a function of GMA heat input of surfacing. Low heat input of surfacing insures uniform distribution of WC carbides on the cross section of deposits. The low heat input GMA surfaced weave bead deposits provide 10 times higher abrasion wear resistance and 4,2 times higher erosion wear resistance than HARDOX 400 steel plate. The results of this paper is to increase quality of GMA cermetal deposits.



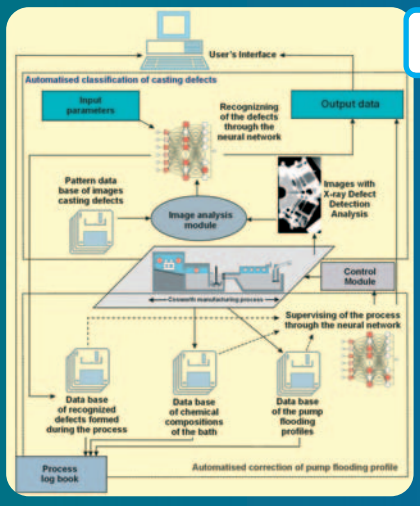
The Properties section represented by E. Bayraktar, M. Grumbach and D. Kaplan on "Effect of forming rate on the impact tensile properties of the steels under crash test" on a **page 55** presents the examination of the mechanical and metallurgical behaviour of the tailored blanks and base metals for thin sheet steels used in the car industry by using a new type of crash test/impact (ITT). It exposes the effect of forming rate on the toughness of thin welded joints (tailored blanks) for Interstitial Free (IFS) steels used in the automotive industry. This research used a new developed test called a simplified crash test for evaluating the effect of forming rate on the toughness of thin welded joints (tailored blanks) / mechanical assemblies in high formability steel sheets for stamping submitted to dynamic loads such as experienced in real crash tests. This study gives very useful data for the crash test. This is a new conception of specimen and of the impact/crash machine. It is easily used in automotive industry for practical and economic reason to give rapid answers to a designer and also steel makers for ranking the materials.

Materials



61

In the research paper entitled "Intelligent motion of mobile robot in the production area" by B. Vaupotič and J. Balič on a **page 61** intelligent motion of the mobile robot in the production area has been presented. The robot is self-learning and gathers the data from the environment by means of sensors. It processes the acquired information and utilizes it for making decisions. The concept imitates the natural selection of living organisms, where in the struggle for natural resources the fit individuals become more and more dominant and adaptable to the environment in which they live, whereas the less fit ones are present in the next generations rarely. Some of the improved genetic operations were used for the robot motion. Original value is the implementation of the non-deterministic principles in the decision making strategy of the mobile robot.



69

The Methodology of research section represented by L.A. Dobrzański, M. Krupiński and J.H. Sokolowski on "Methodology of automatic quality control of casting" on a **page 69** presents the employment of the artificial intelligence tools for development of the methodology of the automated assessment of quality and structural defects in the Al and Mg alloys and the custom made computer software will make it possible to determine the quality of the manufactured element based on the digital images registered in the X-ray flaw detection examinations. The merit of the project consists in the interdisciplinary joining of the knowledge in the area of light metal alloys, including Al and/or Mg, in the area of materials processing connected with the entire scope of problems connected with manufacturing of products and their elements, in the area of the automated low-pressure die casting, and also in the methodology of structure and properties assessment of the engineering materials with, among others, the X-ray flaw detection and computer image analysis methods. The developed methodology of the automated assessment of quality and properties of the light Al and Mg based alloys may be used by manufacturers of subassemblies and elements of engines (e.g., car engine bodies made from the light alloys with the low-pressure casting in the sand moulds).

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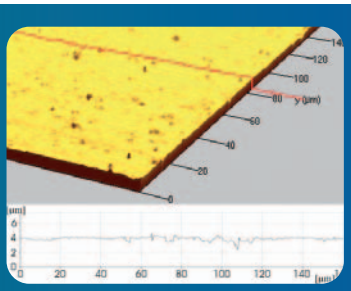

The paper entitled "Structure of nanostructural and gradient PVD wear resistant coatings" presented by L.A. Dobrzański, L. Wosińska, K. Gołombek and J. Mikuła on a **page 99** shows that the investigated materials have dense, compact structure and their fracture surface topography attests their high brittleness, characteristic especially for the oxide ceramic materials. The coatings were put down uniformly onto the investigated substrate materials. They have a columnar, fine-graded structure. The application of multicomponent (Ti,Al)N and gradient Ti(C,N) types of coatings onto sintered tool materials in order to improve cutting properties of the tools is presented.

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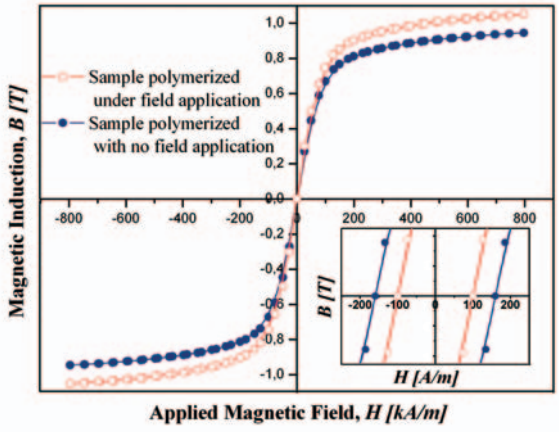
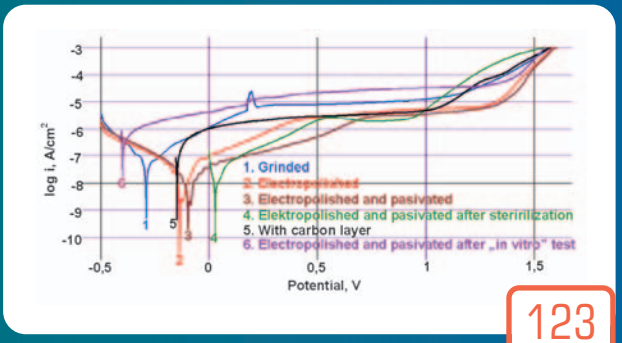


In the research paper entitled "Magnetic properties of polymer bonded nanocrystalline powder" by P. Gramatyka, R. Nowosielski and P. Sakiewicz on a **page 115** the dielectromagnetic based on nanocrystalline $Fe_{73.5}Cu_1Nb_3Si_{13.5}B_9$ powder bonded with organo-silicon polymer and to investigate the powder particle size and content of polymer response of the magnetic properties is presented. It was found from the experimental studies that nanocrystalline powder cores proved to be suitable for high frequency applications. Their frequency dependences are comparable to that of carbonyl iron powder cores but show smaller power losses. Further studies should be undertaken in order to produce high density composites with good soft magnetic properties and to find a good compromise between mechanical and magnetic properties for power electronics applications.

Properties



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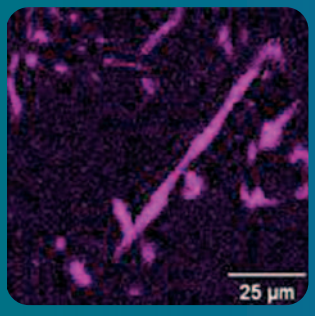
In the research paper entitled "Surface modification and corrosion resistance of Ni-Ti alloy used for urological stents" by W. Kajzer, M. Kaczmarek, A. Krauze and J. Marciniak on a **page 123** the influence of the surface treatment of Ni-Ti alloy, intended for implants applied in urogenital surgery on their corrosion resistance is presented. The tests were carried out in the simulated urine at the temperature 37±1°C and pH = 5,6÷6,4. In particular, the pitting and crevice corrosion resistance tests were carried out. The corrosion tests were realised by recording of anodic polarisation curves with the use of the potentiodynamic method. The VoltaLab® PGP 201 system for electrochemical tests was applied. The tests were carried out in electrolyte simulating urine (pH = 5,6 ÷ 6,4) at the temperature of 37±1°C. On the basis of the obtained results it can be stated that Ni-Ti alloy can be applied in urology.



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The paper entitled "Microstructure of AE44 magnesium alloy before and after hot-chamber die casting" by A. Kiełbus on a **page 127** demonstrates that the AE44 magnesium alloy allows attractive high temperature mechanical properties, as well as die-castability and good corrosion resistance. It contains magnesium, aluminum, cerium and lanthanum. Typically, it is used in automotive industry for structural components working at elevated temperature (150÷175°C). The aim of this paper is to present the results of investigations on the microstructure of the AE44 magnesium alloy before and after hot chamber die casting. Future researches should contain investigations of the influence of the hot chamber die casting process parameters on the microstructure and mechanical properties of AE44 magnesium alloy. The results of the researches make up a basis for the investigations of new magnesium alloys containing rare earth elements for hot chamber die casting designed to service in elevated temperature.

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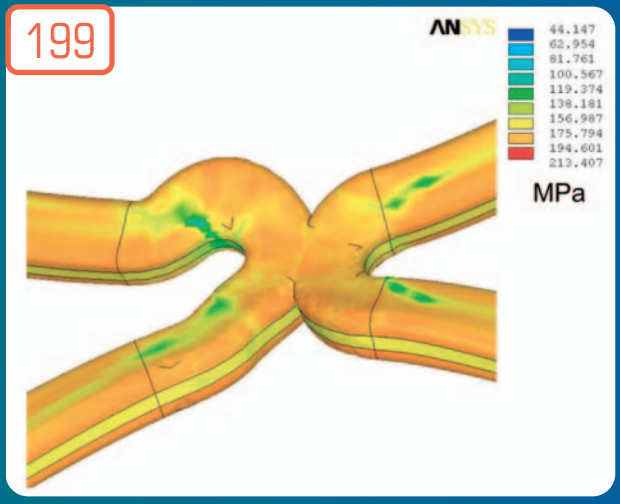

The paper from Materials area made by W. Walke, Z. Paszenda and W. Jurkiewicz on "Biomechanical behaviour of coronary stent design with OCC Technology" on a **page 199** shows results of stresses and strains of three-layer vascular stent (Cr-Ni-Mo – Ta – Cr-Ni-Mo) and one-layer uniform one (Cr-Ni-Mo) used in operative cardiology. The numerical analysis of the three-layer stent showed diverse distribution of stresses and strains in the individual layers. Minimum stresses in the analysed range of expansion diameters (d = 2,25÷3,50 mm) were observed in the middle layer made of tantalum. Maximum stresses were observed in the layer made of the stainless steel. The obtained results are valuable for selection of surface layer which is mainly responsible for ensuring proper hemocompatibility of the stent. The deformable surface layer is an effective way to reduce the surface reactivity of the stent in blood environment and in consequence coagulation.

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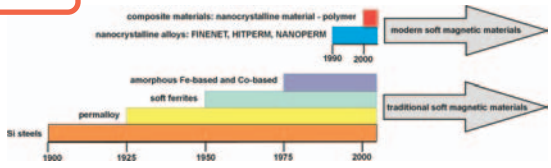
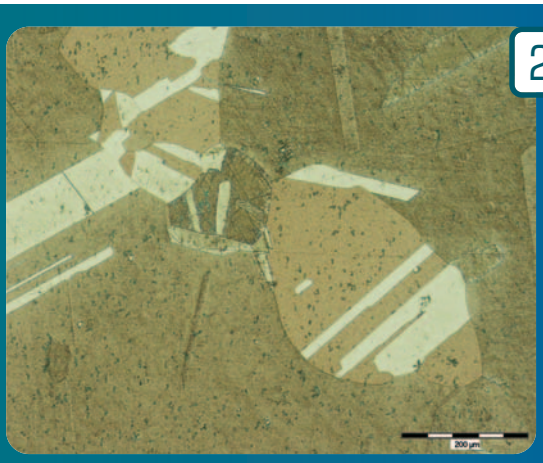


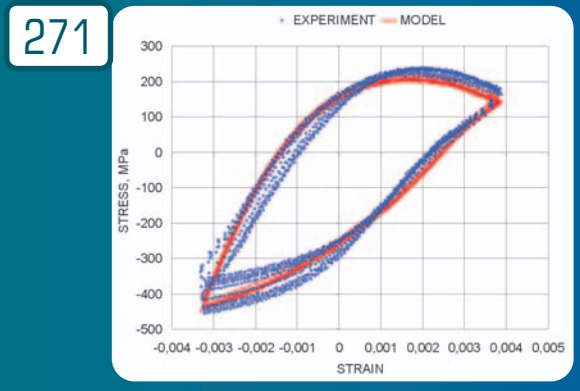
Authors: B. Ziębowicz, D. Szewieczek and L.A. Dobrzański in the paper entitled "New possibilities of application of composite materials with soft magnetic properties" on a **page 207** present properties and application possibilities of modern soft magnetic materials and show the influence of them on the developed of modern technology in different branches of techniques. Another aspect involved in the paper is to present the material and technological solution which makes possible obtaining soft magnetic composite materials: nanocrystalline material – polymer type. The paper is the review of modern magnetic materials development and shows the material and technological solution which makes possible obtaining magnetic composite materials with assumed properties. The usability of modern soft magnetic materials as inductive component in electronic industry depends upon further investigations.

Methodology of research

Analysis and modelling



Authors: M. Greger, R. Kocich and L. Čížek in the paper entitled "Grain refining of Cu and Ni-Ti shape memory alloys by ECAP process" on a **page 247** inform that SPD techniques as ECAP process can be used for non-ferrous metals like Ti, Cu. It was approved that elevated temperature provide successful conditions for obtaining fine grained final materials. Deformation forces were measured during extrusion, resistance to deformation was calculated and deformation speed was approximately determined. After individual passes there an accumulation of deformation strengthening (τ_3 = 745 Mpa) occurred. Cross-section of original samples was 8 x 8 mm and their length was 32 mm. The samples of Cu were extruded at room temperature. The two-stage pressing was used for the samples of Ni-Ti alloys, when the samples were extruded at temperature of approx. T1 = 520°C and T2 = 420°C. In order to increase the concentration of deformation in a volume of the sample, the samples were turned around their longitudinal axis by 90° after individual passes and they were extruded again. An analysis of structure was made by using of light microscopy.



In the research paper entitled "Stres-strain characteristics under mechanical and thermal loading" by J. Okrajni, A. Marek and G. Junak on a **page 271** the description of a deformation process under the conditions of mechanical and thermal interactions is presented. The mathematical modelling has been used to describe the stress-strain behaviour of materials. The method of fatigue testing has been adopted to determine experimentally stress-strain characteristics. The method based on the long term own experience in thermo-mechanical investigations and new European Code-of-Practice for Thermo-Mechanical Fatigue Testing was described. The developed description should be useful in problems of fatigue behaviour predictions of materials under different mechanical and thermal loadings in industry practical applications and in research problems connected for instance with fatigue life criteria description and validation.

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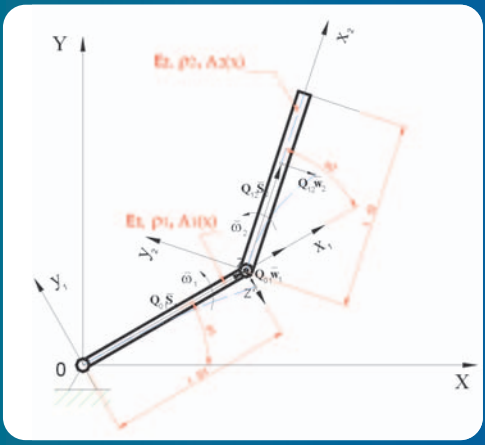
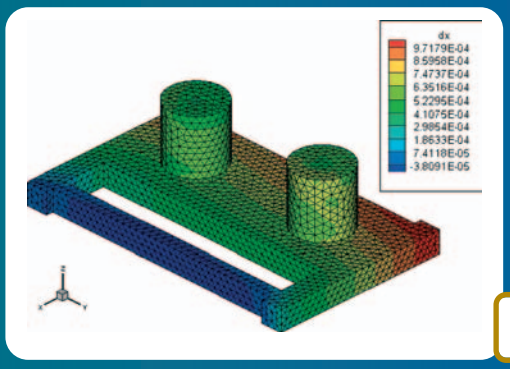


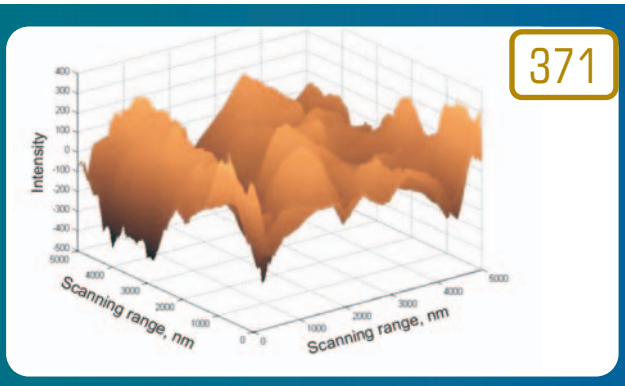
The research paper entitled "Dynamic analysis of the mechanical systems vibrating transversally in transportation" by A. Buchacz and S. Żółkiewski on a **page 331** shows the analysis and modelling of mechanical systems in transportation. The contemporary technical problems are lashed with high work demands such as high speeds of mechanisms, using lower density materials, high precision of work, etc. The main objective of this thesis was the dynamical analysis with taking into consideration the interaction between main motion and local vibrations during the model is loaded by transverse forces. Presented mathematical model of the transversally vibrating systems in planar transportation can be put to use to derivation of the dynamical flexibility of these systems, moreover those equations are the starting point to the analysis of complex systems. In particular we can use those equations to derivation of the substitute dynamical flexibility of multibody systems. Results of this thesis can be put to use into all machines and mechanisms running in transportation such as wind power plants, high speed turbines, rotors, manipulators and in aerodynamics issues, etc. Some results ought to be modified and adopted to appropriate models.



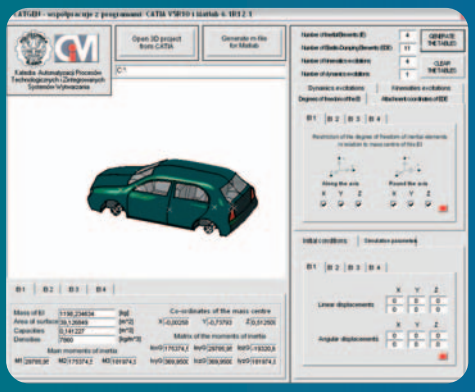
335

The Analysis and modelling area is shown in the paper on "A management on mesh modelling for finite element analysis in casting simulation" by C. Cho, W. Kim, B. Choi, S. Kwak and Q. Pan on a **page 335**. In this study the authors terminated and eliminated the finite elements representing molten materials on the element list. When they became cooler than the liquidus temperature, the deleted elements were recreated. Conventional casting process simulations do not consider stress due to complex rheological behaviour of molten metals until the cast completely solidifies. Achieving a uniform cooling rate in a whole cast body while solidifying must be an ideal casting process to avoid undesirable thermal distortion and stress in product which may induce hot tear and crack. Conventionally many prototyping tests should be conducted to this end and necessitate expensive costs.

Manufacturing and processing



The paper from Analysis and Modelling area made by W. Kwaśny, D. Pakuła, M. Woźniak, L.A. Dobrzański on "Fractal and multifractal characteristics of CVD coatings deposited onto the nitride tool ceramics" on a **page 371** describes the fractal and multifractal characteristics of the TiN+Al_2O_3 and Al_2O_3+TiN coatings obtained in the CVD process on the Si_3N_4 tool ceramics substrate. Investigations carried out confirm that the fractal dimension and parameters describing the multifractal spectrum shape may be used for characterising and comparing surfaces of coatings obtained in the CVD processes and of the substrate material from the Si3N4 nitride tool ceramics. Investigation or a relationship between parameters describing the multifractal spectrum and physical properties of the examined materials call for further analyses.



The paper entitled "Example of the analysis of mechanical system vibrations in GRAFSIM and CATGEN software" by J. Świder, G. Wszołek, K. Foit, P. Michalski and S. Jendrysik on a **page 391** demonstrates the possibilities of GRAFSIM software used for modelling of vibrations of two- and three-dimensional linearly coupled mechanical systems. Options of CATGEN application supporting the user in the transfer of data on the model generated in CATIA programme to GRAFSIM are also discussed. The paper is focused on modelling of vibrating systems in the form of a passenger car. Time responses of the vibrations of the system model evoked by various types of excitations are presented, as well as the amplitude-frequency-phase characteristics (a-c-f). For the analysis of mechanical vibrations the software applies the matrix hybrid graphs and block diagrams method. On the grounds of the data derived from the examined dynamical system and entered into the programme by its user, matrices characterising the model are generated. In the course of numerical calculations the system is represented as a block diagram, and exposed to detailed analysis in Matlab-SIMULINK environment. GRAFSIM and CATGEN software packages enable easy analyses of the vibrations of mechanical systems or of their parts. The tests may be run, for example, in view of the selection of elastic-damping connections between the inertial elements of the system.

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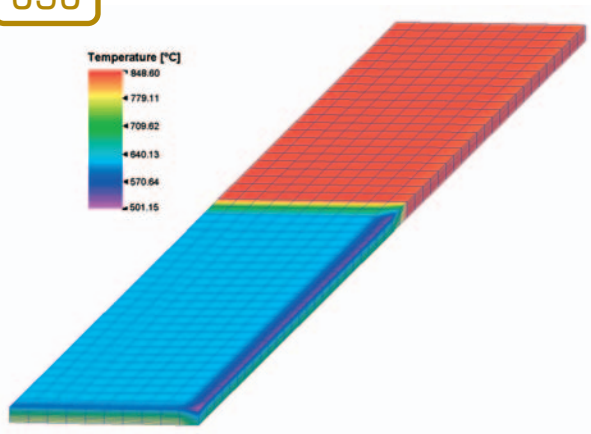

The paper written by P. Šimeček and D. Hajduk on "Prediction of Mechanical Properties of Hot Rolled Steel Products" on a **page 395** shows that the model for prediction of mechanical properties of rolled steel products after final cooling from exit rolling temperature is one of the basic component of any software for complex computer simulation of rolling technologies. Theoretical background and implementation of such software tool is described. Results of verification showed that the software tool MECHP is implementable as a postprocessor into off-line rolling process simulation software or can be used as a mechanical properties predictor in software for on-line control of cooling.

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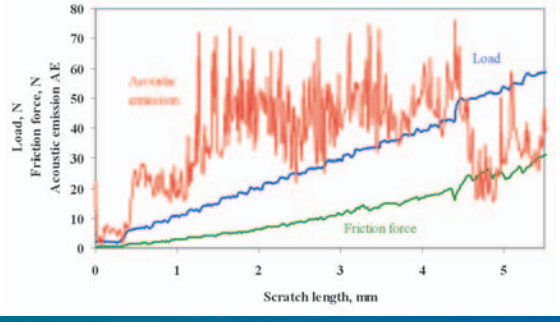


The paper written by L.A. Dobrzański, K. Lukaszkowicz and A. Zarychta on "Mechanical properties of monolayer coatings deposited by PVD techniques" on a **page 423** shows mechanical properties of monolayer coatings (Ti/CrN, Ti/TiAlN, Ti/ZrN, CrN, TiAl/TiAlN, Zr/ZrN, TiN) deposited by PVD technique (reactive magnetron sputtering method) onto the substrate from the CuZn40Pb2 brass. A thin metallic layer was deposited prior to deposition of ceramic monolithic coatings to improve adhesion. The paper contributes to better understanding and recognition of the structure of thin coatings deposited by PVD techniques. It should be stressed that the mechanical properties of the PVD coatings obtained in this work are very encouraging and therefore their application for products manufactured at mass scale is possible in all cases where reliable, very hard and abrasion resistant coatings, deposited onto brass substrate are needed.

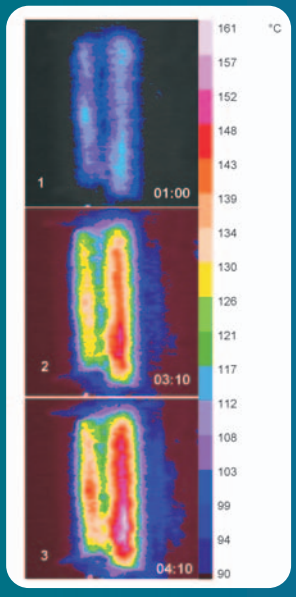
Cleaner production

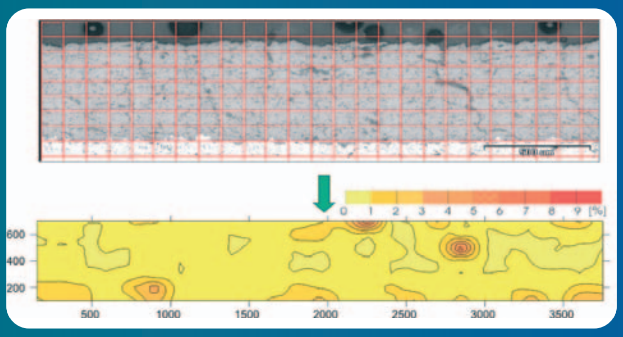
455

In the research paper entitled "Character of diphase stream force in powder injection technique" by J. Jezierski and J. Szajnar on a **page 455** the measurement and recording of time-changing diphase stream force value with use of dedicated laboratory stand is presented. The recorded data made possible to show character of force in form of graphs and calculation of stream parameters. The last step was the formulating of statistical equations joining all important parameters of the process. The invented lance can be used for powders pneumatic injection but only for small its quantities (e.g. microalloying) because non-immersed lance should be used with low stream concentration. The usage of that lance can decrease liquid alloy heat losses (not introducing carrier gas into liquid) and lance consumption (non-immersed in liquid bath). Originality of the researches is a computer recording and analysing of the diphase stream force. The results should interest everyone who wants to learn more about pneumatic powder injection.

471

Authors: B. Kosec, G. Kosec and M. Sokovic on the paper entitled "Case of Temperature Field and Failure Analysis of Die-Casting Die" on a **page 471** present that for economical production of aluminium and aluminium alloys die-castings it is important that the dies have a long working life. The replacement of a die is expensive in both: money and production time. Beside, the die design, the material selection and the process thermal stress fatigue course, which is the consequence of the working conditions, the inhomogeneous and to low initial temperature of the die, contribute to the cracks formation. It is clearly seen from the presented thermographs that the required temperatures and homogeneity of the temperature field of the discussed case are not possible to reach without the changing both: the heating method and the die design. Therefore in the first stage a solution of the problem should be in the changing of the position of heating and/or cooling channels, i.e. their closer shifting to the working surface of the die.





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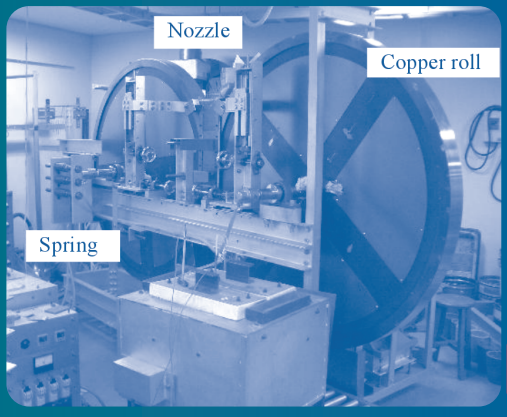
The paper from Manufacturing and processing area made by G. Moskal on "The porosity assessment of thermal barrier coatings obtained by APS method" on a **page 483** describes the outline of methods and range of microstructural assessment of ceramic coatings, using the example of thermal barrier coatings. The major structural parameters describing the quality of the barrier layers have been characterised as well as the problems related to the correct metallographic specimen preparation and the methodology of their assessment. This type of assessment enables obtaining more than just the absolute value of the porosity of the given area: it provides the means for determining a number of other quantitative parameters, e.g. the surface area of the pores, their elongation and shape together with the whole statistical analysis. It was found that the application of the quantitative metallographic methods combined with automatic image analysis can form an effective tool of both quantitative and qualitative assessment such parameters of structural ceramic layers as porosity. The description of procedure of porosity assessments in APS TBC system by use of the quantitative metallographic methods combined with automatic image analysis, and possibility of applications special techniques of scanning microscopy.



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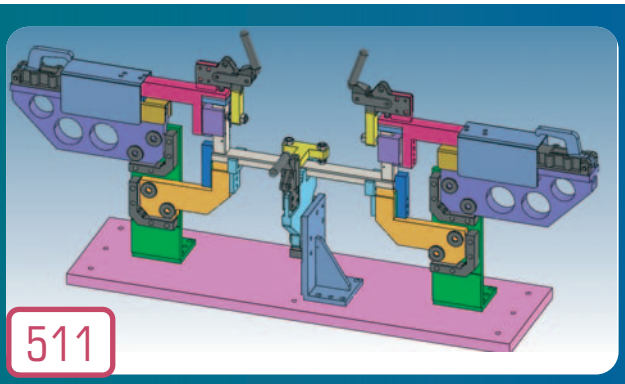
The paper written by H. Sakaguchi, T. Haga, H. Watari and S. Kumai on "High speed twin roll casting of 6016 aluminum alloy strip" on a **page 495** shows that the mechanical properties of the roll-cast 6016 were enough for the sheet metal for the automobile. The low productivity of the twin roll caster could be improved. The 6016 alloy could be cast into the strip continuously at the speed of 60 m/min. The thickness of the strip was 3.4 mm. The microstructure at as-cast and after T4 heat treatment was shown. The mechanical properties were investigated by the tensile test and 180 degrees vending test. The as-cast strip could be cold rolled without homogenisation to 1mm. A result of a tensile test was that tensile strength was 230 MPa, 0.2% proof stress was 118 MPa and elongation was 33%. 6016 strip of T4 heat treatment could be bent 180 degrees without occurrence of crack at the outer surface or breaking.

Industrial management and organisation

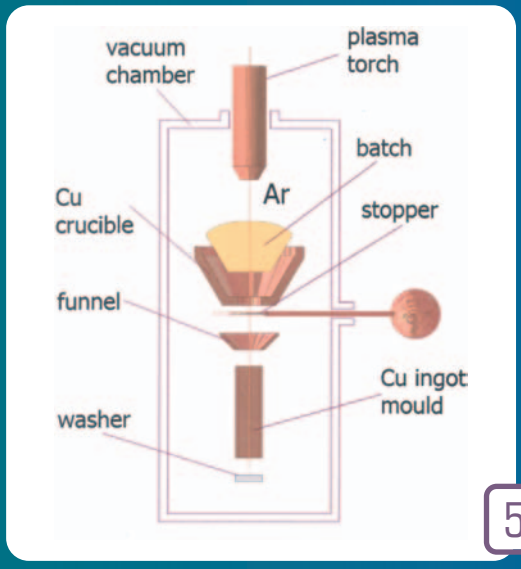
Education and research trends

Technical papers

Indexes



Authors: M. Vural, H. F. Muzafferoglu and U.C. Tapici in the paper entitled "The effect of welding fixtures on welding distortions" on a **page 511** present the effect of welding fixture used to prevent the distortions during cooling process utilizing a robot controlled gas metal arc welding method on a cooling rate and distortions of welded structures. Using a specially designed welding fixture for a welded steel structure, six different types of AISI 1020 steel specimens are tested in three different welding speeds and two different cooling conditions either at fixture or without using fixture. The fixture design has an important effect on cooling rate of the welded parts.



The paper entitled "Metamorphosis quality preparing of alloy Ti64 in laboratory conditions" by M. Žitňanský, Ľ. Čaplovič and S. Demian on a **page 567** shows the method for preparing titanium alloy (Ti64 ELI) by remold in laboratory conditions on the research workplace. The objectives were achieved by using differently sources heating of remolded titanium alloy Ti64 ELI, by using of differently conditions by vacuum melting and pouring in to ceramics or copper moulds. Remolding, purification, casting in the vacuum and than special heat treating by HIP processes were used as a main method for the research. The quality of microstructure was investigated by an electron microscopy and tested by Charpy impact test. The main aim was to get microcastings of very intricate shapes and with very high quality of casting material. Through application of four different conditions of remolding it have been found that in the authors' workplace there is good ability to prepare the microcastings with very good quality, which is the main conclusion. The result of this work is that some changes in practice e.g. as savings of turning and lastly the using of Rapid Prototyping method should be made.