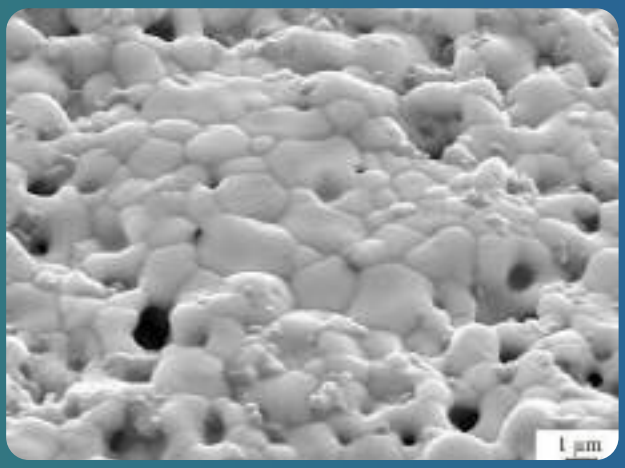
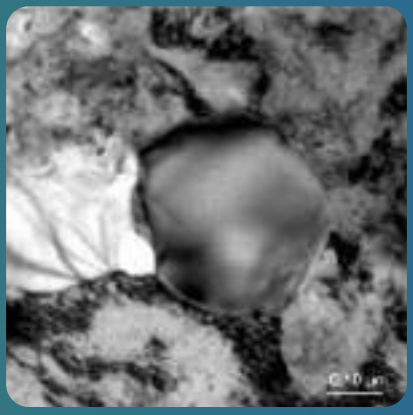
Materials



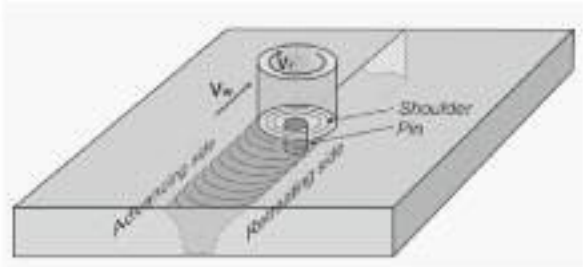
307

The Properties section represented by L.A. Dobrzański, M. Musztyfaga, M. Giedroć and P. Panek on "Investigation of various properties of monocrystalline silicon solar cell" on a **page 307** presents the application of Sherescan instrument, which is a valuable tool used for fault detection, error diagnosis and process optimization by cell manufacturers, paste suppliers, institutes and universities all over the world. Screen printed front side contacts and next to co-fired them in the infrared conveyor furnace were carried out at 920°C temperature. A commercial silver paste to form front side metallization was applied into investigations. The investigations were carried out on monocrystalline silicon wafers. Front side metallization of solar cell was formed on textured surface with coated antireflection layer. Both surface topography and cross section of front contacts using the SEM microscope were investigated. The size of textured silicon surface was measured using the AFM microscope. The thickness of tested front contacts was measured using SEM and CLSM microscope and the metal resistance of solar cells using the 'Sherescan' instrument. The I-V characteristics of solar cells were investigated. The technological recommendations for the co-firing technology in order to produce a uniformly melted structure, well adhering to the substrate, with the low resistance of the front electrode-to-substrate joint zone were made. The influence of the obtained front side metallization features on electrical properties of solar cell was estimated.



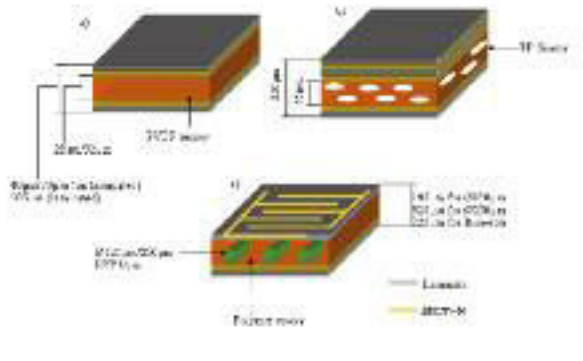
331

In the paper entitled "Influence of cold working on microstructure and properties of annealing CuTi4 alloy" by J. Konieczny and Z. Rdzawski on a **page 331** the effect of cold plastic deformation of the supersaturation on the structure and properties of the CuTi4 alloy after aging is presented. The results confirmed that the temperature within the range 500-600°C, the hardness increases with increasing aging time until reaching the maximum, but then with increasing aging time the hardness decreases. By using methods of electron microscopy (SEM, EDS, EBSD, TEM) after aging at 550°C after 1 minute of modulated microstructure was observed – characteristic for the spinodal transformation and lamellar, formed by nucleation and growth. On the basis of conductivity, the influence of cold plastic deformation and subsequent aging on the hardness and electrical conductivity of the alloy CuTi4. It was found out that with increasing aging time and with increasing aging temperature increases electrical conductivity of the alloy. On the basis of X-rays it can be concluded that in alloyed copper containing 4%Ti and precipitation hardening metastable phase β'-Cu4Ti, which occurs both in the previously deformed and undeformed cold worked alloy is separated.



339

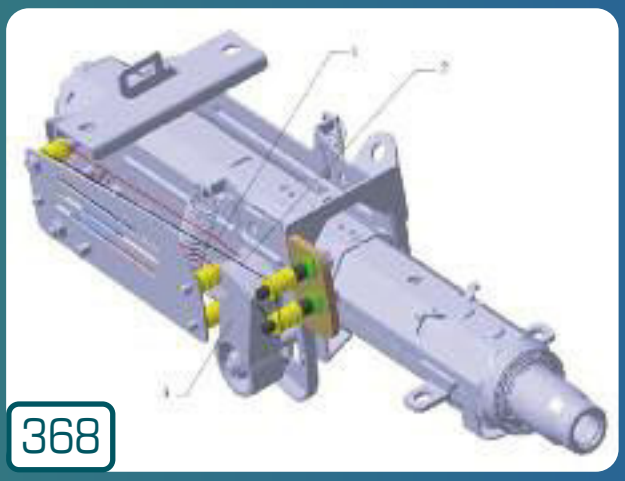
Authors: P. Kurtyka, I. Sulima, A. Wójcicka, N. Ryłko and A. Pietras in the paper entitled "The influence of friction stir welding process on structure and mechanical properties of the AlSiCu/SiC composites" on a **page 339** discuss the influence of the friction stir welding on the size and distribution of reinforcement particles in the composite AlSiCu/SiC_p, as well as determine its mechanical properties. In the resulting joints (welds) significant changes in the distribution of SiC particles, precipitation which was characterized by macro-heterogeneity were observed. However, in micro scale, a few typical distributions and areas of fragmentation of the reinforcing particles were identified. Differences in the sizes of the ceramic particles were 15 microns in the initial material and 2-3 micron in the welded material, respectively. The analysis of these regions using the new RVE theory shows that the coefficient of mechanical properties anisotropy was varied from 0.500328 to 0.016961. Mechanical testing of selected parts of joints showed significant differences in the values of the plastic flow stress in advancing and retreating sides, approximately from 400 to 450 MPa. The obtained results can be used to optimize the welding process composites by friction stir welding. In addition, the analysis results may be used to design new methods to modify aluminium matrix composites reinforced with ceramic particles. The work provides information on the influence of the FSW process on the change distribution and fragmentation of reinforcing particles and mechanical properties of composites joints.



355

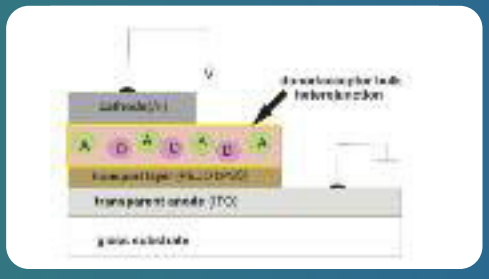
The Properties area is shown in the paper on "Evaluation of piezoelectric smart materials subjected to impact test over range of temperatures" by I. Patel and E. Siores on a **page 355**. As the demand for technological advances increase on daily basis, so does the dependency on existing fossil fuels, which is depleting at an alarming rate. The work presented in this paper addresses key solutions to energy management, and particularly energy harvesting for powering electronic devices and sectors in general, particularly applications where components are exposed to severe subzero temperatures. This research compares the energy output in terms of voltage for 3 piezoelectric smart materials, ceramic based PZT (Lead, Zirconate Titanate), polymer membrane PVDF (Polyvinylidine Fluoride) and foam based PP (Polypropylene). Impact analysis using concentrated mass of 1.02kg from a fixed height of 17mm was allowed to drop roughly in the centre of piezoelectric material samples as the temperature was increased from approximately -33°C to room temperature. Voltage output was recorded at various temperature increments using pico-scope software, which indicated that generally, voltage increased for all 3 materials as temperature decreased.

Properties



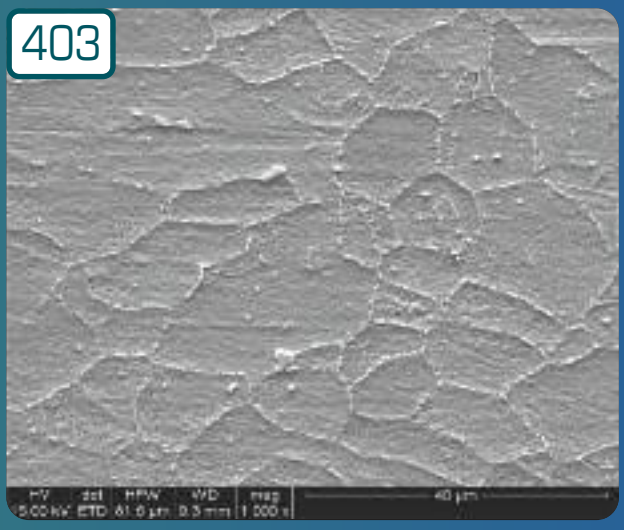
368

The paper entitled "Indication of the suitable model of a mechatronic system as an introduction to the synthesis task" by J. Strittmatter, P. Gümpel and V. Gheorghita on a **page 368** demonstrates that the martensitic phase change shape memory alloys can revert to their original shape by heating when they undergo an appropriate treatment. Actuator elements with this shape memory effect can show a significant design change combined with a considerable force. Therefore, they can be used to solve many technical tasks in the field of actuating elements and mechatronics. These intelligent materials will play an increasing role in the next years, especially within the automotive technology, energy management, power and mechanical engineering as well as medical technology. In order to use the potential of these materials in an optimal way it is necessary to know and understand the extraordinary and unconventional properties of shape memory alloys.
This paper presents the commonly used systems of shape memory alloys of today including their performance characteristics and explains the basics of the shape memory effect in a vivid way. A multitude of application possibilities of shape memory actuators is presented, in particular the research and development projects that have been carried out at the Konstanz University of Applied Sciences during the last years. In this way a solid state heat engine and an intramedullary nail for bone elongation is presented as well as various adaptive systems for automotive safety and comfort systems, driven by shape memory elements. Regarding the applications in the automotive field a special focus will be given to different electrical activations to enable very fast contraction times of the shape memory components.

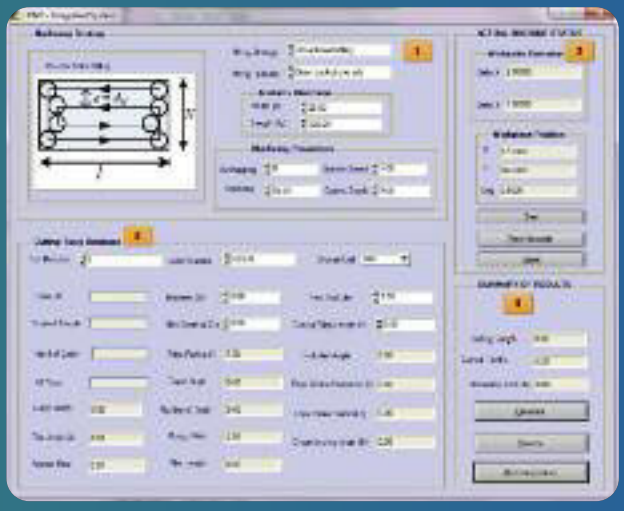


396

The paper written by J. Weszka, P. Jarka, B. Hajduk and M. Chwastek-Ogierman on "Investigations of morphology and optical properties of thin films of TiOPc/PTCDA donor acceptor couple" on a **page 396** determines surface topography and optical properties of organic thin films of TiOPc and PTCDA blends deposited by thermal vacuum evaporation. Thin films of blends of organic materials are provided as donor/acceptor couples in bulk heterojunction based organic solar cells. Thin films of TiOPc – PTCDA mixture have been deposited by thermal vacuum evaporation from one source with various ratios of blends components and deposition rates used. Both the chemical composition and technological parameters of the deposition process have appeared to influence on optical properties, UV-Vis absorption spectra in particular, and surface morphology of the as-prepared thin films. The paper reveals the methodology of deposition thin films of TiPc-PTCDA donor/acceptor blends and the influence of deposition parameters on their properties. Thin films of such blends can be used for the research on the planar heterojunction solar cells based on donor–acceptor couple active layers. Results of these investigations suggest that blends of TiOPc and PTCDA can be suitable materials for preparing organic photovoltaic devices. The goal of this paper is also to define relations connecting the surface morphology and optical properties of thin films of TiOPc-PTCDA blend prepared with their composition and parameters of the evaporation process.



The Properties area represented by A. Zieliński on "Structure and properties of Super 304H steel for pressure elements of boilers with ultra-supercritical parameters" on a **page 403** presents the material condition assessment with regard to required utility properties of Super304H austenitic steel for operation at elevated temperature. The structural and mechanical testing at room and elevated temperature after annealing at 650°C and 700°C for 1000 and 3000 h was carried out. The presented method can be used for evaluation and qualification of structural changes in power station boiler components operating in creep conditions. The presented results of changes in the mechanical properties, structure and in the precipitation processes are applied to evaluate the condition of the elements in further industrial service. The effect of temperature and duration of long-term annealing on mechanical properties, hardness and structure of tested was determined.

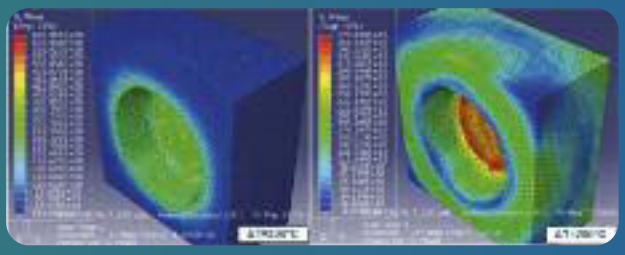


Authors: A.Z. Abdul Kadir and X. Xu in the paper entitled "iHFMS – an integrated system for predicting and monitoring up-to-date tool life status based on high-level CNC data" on a **page 421** discuss an integrated High-Fidelity Machining Simulation (iHFMS) system with the intention to predict and monitor up-to-date tool information status based on high-level CNC data through the evaluation of historic Post-Machining analysis. The system consists of three components which include; tracking and recording mechanism of Cutting Tools Database (CTD) via barcode identification, remaining tool life predictive model, as well as development of a Machining History Database (MHD). A case study was designed to demonstrate how the system is utilised in tracking the remaining tool life of a mounted cutting tool, together with variety machining configurations. The outcome shows the integrated system may fasten the process planning activity and perform machining efficiently by providing dynamic tool life values based on the shop-floor status.

421

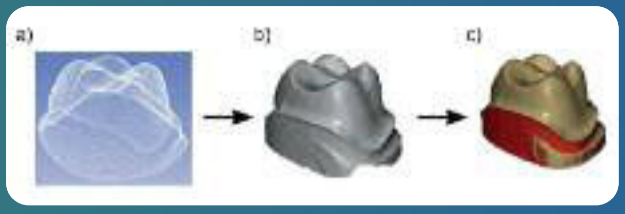
Methodology of research

Analysis and modelling



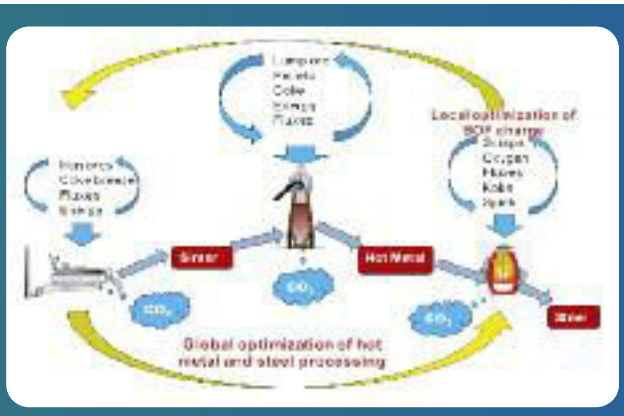
439

The paper from Analysis and modelling area made by D. Concer, N. Woellner and P.V.P. Marcondes on "Approach to the prediction of thermal fatigue of aluminium high pressure die casting (AISI H13) using the Basquin equation and finite elements" on a **page 439** presents the influence of thermal fatigue on the AISI H13 die surface during the aluminium high pressure die casting process. Taking in account the divergences found in the solutions for determining the number of life cycles to die failure and guided by technical data and commercial experience of life cycles for the AISI H13 steel it was possible to propose coefficients of correction for the equation of Basquin. The dies play an important role in the aluminium high pressure die casting process. During the die manufacturing process the die design and the steels behaviour are a major concern on efficient manufacturing, i.e. related to maximize the life cycle. During the injection process the thermal fatigue is one of the responsible factor of onset of cracks – estimated to be approximately 80%. The behaviour of the steel used for the dies are dependent of the temperature and density, elastic modulus, Poisson's ratio, coefficient of thermal expansion, hardness, thermal conductivity and yield strength and an incorrect steel selection can lead to thermal stresses amplitude favorable for the onset of the cracks.

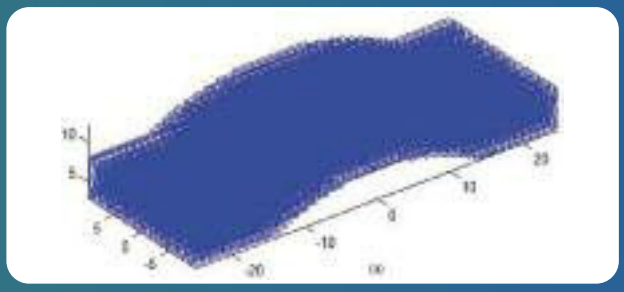


469

The paper entitled "Digitization procedure of creating 3D model of dental bridgework reconstruction" by L.A. Dobrzański and Ł. Reimann on a **page 469** informs that the still growing patient requirements concerns on the aesthetics but also on strength of the prosthetic restorations. Resistance on stresses depends among others on the shape, so it is necessary to transfer the dentures physical model to computer environment and simulation of the work conditions. The aim of that work was to study the methodology of digitization of the plaster model into the numerical model, using CAD/CAM dental system and CAD application, which can be in the next step imported to ANSYS application in order to realize stress analysis. To realize the transfer of a physical model of the dental bridge to computer environment the 3i Incise Renishaw scanner which saved the plaster model by probe about 1 or 3 mm diameter, moved in the scanner arm and contacted with it was used. Scanned plaster mode was exported into STL file and next opened in DentCAD Delcam application. Then using the CAD module the preparation line was marked, a pontic was orientated in right position and connectors of the pillar teeth and the pontic. Geometry and the cross section of the connectors depend on the bridgework strength. Designed bridge reconstruction was imported to CAD application and there curves were firstly drawn, then changed into NURBS surfaces and finally surfaces was merged into one solid model. The ready model can be imported up to ANSYS software in order to realize the stress analysis. A prepared dental case from a physical one was changed into a numerical model in following steps: scanning a plaster mode by a contact scanner, designing the bridgeworks in CAD dental software environment, importing in CAD application, building the solid model and on the end import in ANSYS software. Selected digitization procedure let to make all engineering calculations and analysis without manufacturing the physical model, what considerably reduced cost of the research investigations. The paper presents that it is not necessary to have a physical reconstruction model, to check the resistance on stress because it is possible to use the CAD/CAM dental system to design the dentures and then model the boundary conditions and observe the stress analysis.



483 The paper entitled "Optimization algorithms in the charge planning for the BOF Plant" by M. Gawron and Cz. Adamczyk on a **page 483** demonstrates the possibilities of reducing the cost of steel processing in the BOF Plant by using optimization algorithms in the charge planning. A lot of production factors and technological relationships impact the BOF processing costs. Practically any change in charge material parameters, like chemistry and temperature of hot metal, scraps and fluxes, as well as market prices of materials and cost of carbon dioxide emission, have to be considered to find an optimum charge mix, which generates the minimum cost and simultaneously complies with all technological and steel quality constraints. A linear optimization task including a simplified version of a BOF static model has been defined and a few examples of typical industry charge planning problem have been solved and presented. The optimization model has been a base for developing the application for the Steel Plant and Purchase Department to optimize charge mix and plan the charge materials purchasing. Critical price and amount of a given charge material for current technological conditions, stocks and market situation is the basic information for the Steel Plant management as well as for the Purchase Department. The relationship between material prices, CO_2 emission price and material consumption for a given production and logistic constraints have been identified. The optimization algorithms has been adapted for a specific operation problem in steel making, i.e. calculation of charge for BOF.

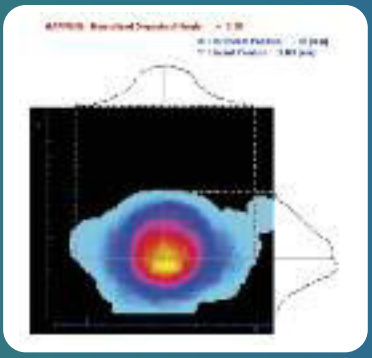


511 The paper entitled "Alternate slicing and deposition strategies for fused deposition modelling of light curved parts" by B. Huang and S. Singamneni on a **page 511** demonstrates a fused deposition modeling (FDM), as one of the additive manufacturing (AM) techniques, has been widely used in the manufacturing industry from the 1990s. It is relatively cheaper than other AM methods and there are other advantages such as being able to process a variety of other polymers. Currently, FDM is more likely to be suitable for direct production of the terminal-use parts, in some cases challenging traditional process such as injection molding. Research evidences indicate that change of road and layer structure would have significant influence on the meso-structure and thus impact the mechanical properties of the resulting polymer parts. Adaptive flat layer deposition and curved layer deposition have been introduced to improve the mechanical properties of terminal-use product. It is necessary that an appropriate deposition scheme is essential to ensure the best inter-road and inter-layer connectivity. Uninterrupted connections are likely to result in a continuous network of polymer chains, as in the case of the conventional processes. The current research proposes conventional flat layer deposition, adaptive flat layer deposition and curved layer deposition for FDM. In particular for curved parts, curved layer deposition in expected to ensure fiber continuity and better meso-structure. Mathematical models are developed for curved slicing, practically implemented to print physical parts and test results suggest marked improvement in the mechanical characteristics of curved parts.

Manufacturing and processing

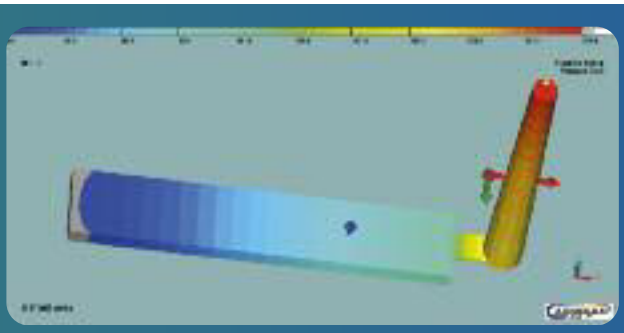
523

The Analysis and modelling section represented by G. Kokot, T. Burczyński and A. John on "Advanced numerical simulations of selected metallurgical units" on a **page 523** presents numerical simulations of large structures in metallurgical industry. Some examples of finite element analysis are presented. The calculations were performed for the determining the stress effort of the metallurgical units mainly blast furnace, throath's gas pipelines, hot blast stoves, etc. during the working conditions and for the repairing purpose. Performing the numerical analysis the changes in the structures design were applied what extremely influenced on the state effort and the durability of considered structures. Presented results show the possibility of application of the advanced computational methods in the computer-aided engineering processes of designing and analysing the large structure as the metallurgical units are. It can dramatically influence on the recognizing of the effort stets and helps in the monitoring, overhauls and redesigning process. Those methods give the global very precise information which cannot be obtained in other ways (analytical solutions, experimental methods). The paper presents the original research results coming from the complex numerical simulations of the main metallurgical units in the blast furnace train. The original value of the paper is the introduction of the advanced finite element simulation in the field of iron steel industry structures design and developing.

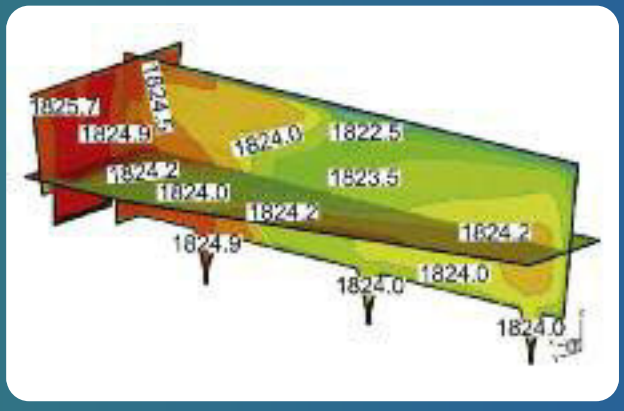


547

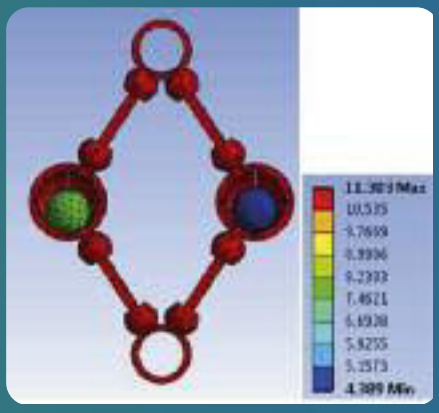
In the paper entitled "Modelling and simulation of plasma spraying process with a use of Jets&Poudres program" by S. Kotowski, J. Sieniawski and M. Góral on a **page 547** the model of plasma spraying process and a description of the simulation of the process with a use of Jets&Poudres software is presented. It is based on the GENMIX code (GENral MIXing) developed by B. Spalding and S. Patankar for analysis of the two-dimensional, parabolic flows characterized by large values of Reynolds and Péclet number. Plasma spraying is one of the basic methods of coating deposition used in many branches of industry, especially in aviation and power industry. The process is applied in the aircraft engineering for obtaining the sealing coats, anti-abrasive coatings and, above all, metallic layers, ceramic layers as well as thermal barrier coatings. The comprehensive characterisation of the plasma spraying process requires taking into consideration 50-60 parameters, which confirms its complexity. The purpose of this article is to describe the functioning of the programme, presentation of its simulation capabilities, including the parameters of the plasma spraying process, which can be controlled in the programme. Jets&Poudres enables determination of parameters of plasma spraying process in order to obtain better coating thickness distribution and improve the coating efficiency – ratio between the weight of the spray pattern deposited on a big flat plate and the weight of powder injected. Jets&Poudres enables tracking the current position, velocity and the fusion process of powder particles as well as conducting the basic analysis of obtained coating formed during the plasma spraying process. Jets&Poudres is one of few available tools based on a comprehensive model of plasma spraying under atmospheric pressure which makes possible to perform simulation of the whole process.



556 In the paper entitled "Simulation of powder injection moulding conditions using cadmould programme" by G. Matula, L.A. Dobrzański and M. Ambroziak on a **page 556** the application of powder injection moulding to manufacturing of high speed steel matrix composites is presented. The development of a new generation tool materials on the basis of high speed-steel manufactured by Powder Injection Moulding. To investigate formability of the polymer-powder slurry in which the HS12-1-5-5 (T15) high-speed steel powder was used, as well as the HD-PE polyethylene and paraffin, the "Cadmould" commercial software was employed, developed mostly for simulation of the powder injection moulding of the thermoplastic and composites. Simulation of powder injection moulding was preceded by the rheological tests, which made possible obtaining the data indispensable for modelling, pertaining to the polymer-powder slurry viscosity. The portion of particles reinforcing the composite is usually lower than powder portion in mixtures used for forming and next binding agent degradation and sintering. The big powder portion is often the reason for the high viscosity of the mixture and problems with its forming. However, simulation results revealed that the fabricated polymer-powder mixture may be injected, which was confirmed by carrying out powder injection moulding on a typical Arburg injection moulding machine using in the industry. Application of powder injection moulding to manufacturing of high speed steel matrix composites gives the possibility to obtain tool materials with the relative high ductility characteristics of steel and high hardness and wear resistance typical for cemented carbides. Application of symulation of powder injection mouling conditions using cadmould program gives the possibility to reduce cost of expensive injection mould and control the injection conditions.



Author: T. Merderin the paper entitled "Numerical simulation of liquid flow and mixing steel in multi-strands tundish" on a **page 561** 561 presents the estimation of working multi- strands tundish used in the domestic steel industry for the casting of medium size-products. Findings of research concerns for casting spatial velocity fields of temperature and intensity of steel turbulence. They were complemented by F and E types residence time distribution curves. Basing on these curves percentage participation of flows were calculated and kinetics of steel mixing in tundish was determined. There is practically no possibility to study metal movement on a real object, therefore the solution of this problem was to use modelling techniques. The numerical analysis based on mathematical model was chosen. The calculations were carried out in AnsysFluent. Practical implications presented results of research can be used for improving the hydrodynamic conditions occurring in industrial tundish. Originality of this research works out the characteristics of tundish working. The obtained results can improve considerably the effectiveness of CC process.

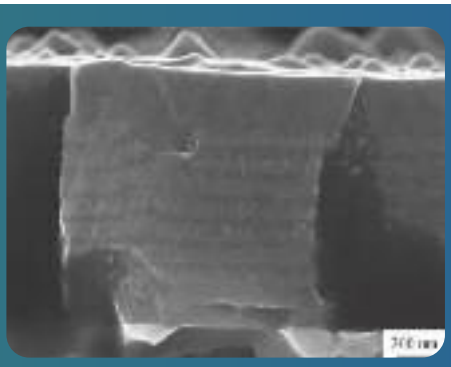


584

The Analysis and modelling area is shown in the paper on "Elastic metamaterials: some initial experiences with the Milton-Willis structure based on a rapid prototyped model and a numerical analysis" by H.J. Sutandie, S. Singamneni and B. Banerji on a **page 584**. Elastic metamaterials attract quite a bit of research attention of late. Theoretical models such as those proposed by Milton and Willis suggest possibility of physically realizing the structures leading to elastic metamaterials. The main stumbling block being the limitations of fabrication methods, considering the complex geometries and material requirements. Rapid prototyping and of-late rapid manufacturing offer solutions for the production of physical shapes of unlimited geometrical complexities direct from digital files, employing a variety of materials. Considering the requirements of metamaterial structures and the capabilities of rapid manufacturing, the need to bring these two together has been envisioned, and the experimental and numerical work presented in this paper is an initial step towards this goal.

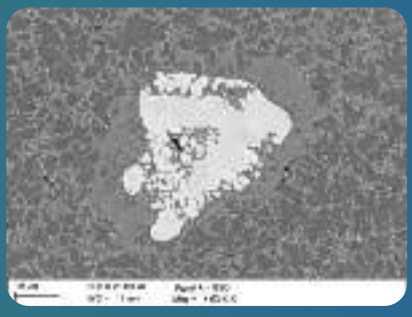
600

The paper entitled "Study on carbide cutting tool life using various cutting speeds for α-β Ti-alloy machining" by K.B. Ahsan, A.M. Mazid, R.E. Clegg and G.K.H. Pang on a **page 600** informs that the current experimental studies have yielded that cutting speed, using carbide cutters, has no significant influence on surface roughness obtained for machining the α-β Titanium alloy Ti-6Al-4V. This paper presents results of experimental investigations carried out on the widely used titanium alloy Ti-6Al-4V using variable cutting speeds as well as different cutting tools at a constant feed rate and depth of cut. The effects of varying cutting speeds on the tool life have been analysed by inspecting the surface roughness of the machined samples and the tool wear observed during machining. As the cutting speed increases, the tool life drops off very rapidly and at higher cutting speed the chips start to ignite because of high heat generation at the cutting zone which is mainly caused by the low thermal conductivity of titanium alloys as postulated. Consequently higher cutting speeds may be used to dramatically reduce the production costs, but the currently available cutting tools will have a very poor tool life. According to this study, it has been identified that the uncoated carbide tool life is comparatively better than that of coated ones at lower cutting speeds whereas the coated ones are preferable at higher cutting speeds. It is expected that the metal manufacturing industries will be highly benefitted by this outcome in selecting the appropriate cutting tool as well as cutting speed according to their desired surface finish and tool life.



607

In the paper entitled "Evaluation of an AlCrN coated FSW tool" by G.F. Batalha, A. Farias, R. Magnabosco, S. Delijaicov, M. Adamiak and L.A. Dobrzański on a **page 607** the wear performance of a physical vapor deposition (PVD) coating on cemented carbide (WC) tool used in friction stir welding FSW processing of Ti alloy sheets is presented. The tool degradation was evaluated by scanning electron microscopy in order to observe the main tool wear mechanism. The real contribution of the (Al,Cr)N coating layer could not be correctly evaluated, since there is no residual trace of its components at the worn tool. What was probably found left from the coating layer was the N component which formed the nitride TiN observed by EDS mapping. The parameter conditions were probably too severe, overcoming the layer limit strength. FSW process is gaining importance as an industrial joining method, but the tool wear is still an important challenge to achieve efficient and economic operation. Because of the low thermal conductivity and high chemical reactivity of Ti, tools wear rapidly due to high temperature and strong adhesion. In order to achieve higher processing speeds, reducing heat at the interface tool/work material is required, as is the use of tool materials that have little or no chemical affinity. The research was carried out as a preliminary evaluation and this initial results in the need of a further analysis that should be performed looking for a suitable tool material and coating optimization for the FSW processing of titanium alloys. Despite being successfully used in other manufacturing applications like machining operations in which friction and temperature are also high, the WC tool material and the coating had an unsatisfactory wear resistance, and the AlCrN coating was totally worn during the FSW processing. This suggests that new materials and coatings are still needed for FSW tools.



623

The Manufacturing and processing area represented by M. Bonek on "Characterization and performance of laser alloyed commercial tool steels" on a **page 623** presents the influence of carbides particle on the functional properties of surface layers. The experiments were made on specimens made from the HS6-5-3-8 high speed steel remelted and alloyed. The technological part of this work was made using the HPDL Rofin DL 020. Therefore all experiments were made at the constant remelting rate, varying the laser beam power in the range from 0.7 to 2.5 kW. It was established experimentally that the argon blow-in with the flow rate of 20 l/min through the 12 mm circular nozzle oppositely directed in respect to the remelting direction provides full remelting zone protection. The structure of the solidified material after the laser remelting is characterized by the diversified morphology connected with the multiple changes of the crystal growth direction from little dendrites to tiny equiaxed grains in the near-surface zone. The main axes of the dendrites are directed according to the heat abstraction directions on the border of the solid and liquid phases with the carbides' clusters arranged according to the whirls caused by a convectional movement in the pool of the metallic liquid as well as partly unremelted conglomerates WC as a melting material in the middle area of the remelted zone. The material behaviour for the HPDL processing has been found to be different from the other high-power lasers in the following aspects: fewer cracks and less spallation for surface glazing/sealing, more uniform melt/heating zones, smoother surface, better beam absorption for metallic materials, more consistent and repeatable. The research results indicate to the feasibility and purposefulness of the practical use of remelting and alloying with the WC particles using the high power diode laser for manufacturing and regeneration of various tools from the HS6-5-3-8 high speed steel.

790. Mechanical milling of aluminum powder using planetary ball milling process

M. Ramezani, T. Neitzert (New Zealand)

799. Effects of pre-process and post-process parameters on formability of magnesium alloys

M.W. Soomro, T.R. Neitzert (New Zealand)

810. A review of contemporary solutions for cold rolling that allow quality improvement

W. Soszyński, A. Studnicka (Poland)

817. The influence of different steering systems on a wheel slip

D. Stajnko, P. Berk, B. Mursec, P. Vindis (Slovenia)

825. Pb(II) leaching from waste CRT funnel glass in nitric acid solutions

A. Strzałkowska, M. Wojtala, J. Siwka (Poland)

829. Performance of cryogenically treated CBN inserts on difficult to cut materials during turning

S. Thamizhmanii, S. Hasan (Malaysia)

835. Manufacturing and characterisation of PMMA-graphene oxide (GO) nanocomposite sandwich films with electrospun nano-fibre core

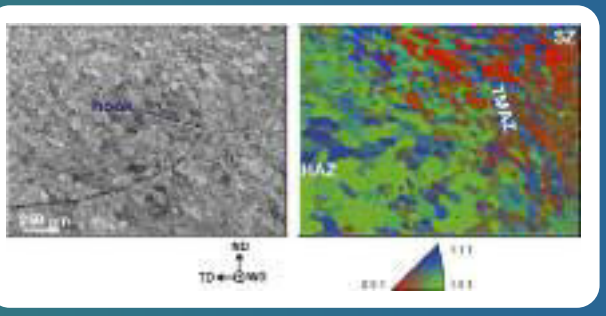
J. Upadhyay, R. Das, S. Rao, D. Liu, D. Bhattacharyya (New Zealand)

841. Evaluating the machinability of AISI 304 Stainless Steel using alumina inserts

M.A. Xavior (India)

848. Oxidation behaviour of palladium modified aluminide coatings deposited by CVD method on nickel-based superalloys under air atmosphere

M. Zagula-Yavorska, K. Kubiak, J. Sieniawski (Poland)

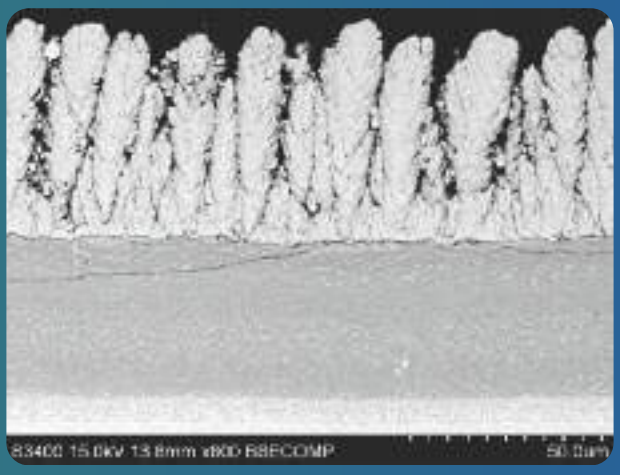


629

The paper written by Z.W. Chen and S. Yazdanian on "Friction Stir Lap Welding: material flow, joint structure and strength" on a **page 629** informs that friction stir welding has been studied intensively in recent years due to its importance in industrial applications. The majority of these studies have been based on butt joint configuration and friction stir lap welding (FSLW) has received considerably less attention. Joining with lap joint configuration is also widely used in automotive and aerospace industries and thus FSLW has increasingly been the focus of FS research effort recently. A number of thermo-mechanical and metallurgical aspects of FSLW have been studied in our laboratory. In this paper, features of hooking formed during FSLW of Al-to-Al and Mg-to-Mg will firstly be quantified. Not only the size measured in the vertical direction but hook continuity and hooking direction have been found highly FS condition dependent. These features will be explained taking into account the effects of the two material flows which are speed dependent and alloy deformation behaviour dependent. Strength values of the welds will be presented and how strength is affected by hook features and by alloy dependent local deformation behaviours will be explained. In the last part of the paper, experimental results of FSLW of Al-to-steel will be presented to briefly explain how joint interface microstructures affect the fracturing process during mechanical testing and thus the strength. From the results, tool positioning as a mean for achieving maximum weld strength can be suggested.

654

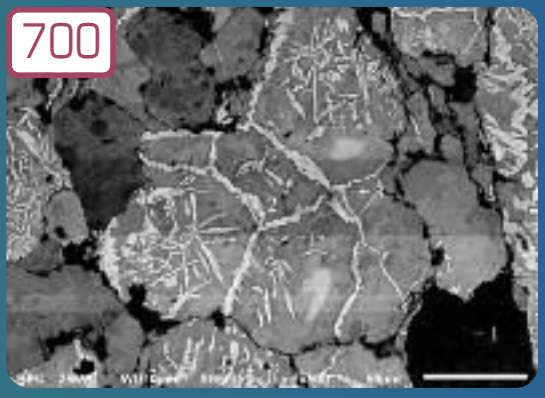
Authors: L.A. Dobrzański, B. Tomiczek, M. Adamiak and K. Gołombek in the paper entitled "Mechanically milled aluminium matrix composites reinforced with halloysite nanotubes" on a **page 654** discuss fabrication of aluminium AlMg1SiCu matrix composite materials reinforced with halloysite nanotubes by powder metallurgy techniques and hot extrusion. The milling process has a huge influence on the properties of powder materials, changing the spherical morphology of as-received powder during milling process to flattened one due to particle deformation followed by welding and fracturing particles of deformed and hardened enough which allows to receive equiaxial particles morphology again. The investigation shows that so called brittle mineral particles yields to plastic deformation as good as ductile aluminium alloy particles. That indicates that the halloysite powder can play a role of the accelerator during mechanical milling. High energy ball milling as a method of mechanical milling improves the distribution of the halloysite reinforcing particles throughout the aluminium matrix, simultaneously reducing the size of particles. The apparent density changes versus milling time can be used to control the composite powders production by mechanical milling and the presence of halloysite reinforcements particles accelerates the mechanical milling process. It has been confirmed that halloysite nanotubes can be applied as an effective reinforcement in the aluminium matrix composites. Deformation, grain size reduction and dispersion conduce to hardening of the composite powders. Mechanical milling causes a high degree of deformation, decrease the grain size even to nanoscale and create an enormously uniform distribution of reinforcing phases or oxides in the structure of the metal. Conducted research shows that applied technology allows obtaining very good microstructural characteristics.



689

In the paper entitled "The technology of Plasma Spray Physical Vapour Deposition" by M. Góral and J. Sieniawski on a **page 689** the new technology of thermal barrier coating deposition – LPPS Thin Film and Plasma Spray – Physical Vapour Deposition is presented. The deposition of thermal barrier coatings is currently the most effective means of protecting the surface of aircraft engine turbine blades from the impact of aggressive environment of combustion gases. The new technologies of TBC depositions are required. The essential properties of the PS-PVD process have been outlined, as well as recent literature references. In addition, the influence of a set process condition on the properties of the deposited coatings has been described. The new plasma-spraying PS-PVD method is a promising technology for the deposition of modern thermal barrier coatings on aircraft engine turbine blades. The constant progress of engine operating temperatures and increasing pollution restrictions determine the intensive development of heat-resistant coatings, which is directed to new deposition technologies and coating materials. The completely new technologies was described in the paper.

700



Authors: P. Hyjek, I. Sulima, P. Malczewski and L. Jaworska in the paper entitled "Application of HP-HT method in the manufacture of NiAl phase" on a **page 700** discuss the effect of variable temperature and constant pressure to consolidate the powder mixture of nickel and aluminum in an amount to provide receipt of NiAl intermetallic phase. In particular, the influence of high pressure – high temperature (HP-HT) method to change the structure of sintered density, porosity, Young's modulus and Vickers hardness. Manufactured by HP-HT phase NiAl is characterized by compact design with relatively low porosity. Microscopic observations and EDS analysis revealed the existence of a complex multi-phase structure, which also resulted from microhardness tests. It was found out that the optimum properties have produced NiAl phase at the sintering temperature of about 1300°C. Sintered NiAl phases can be used as a matrix composites reinforced with ceramic particles. Composite based on intermetallic phase NiAl as a result of strengthening the ceramic particles should have correspondingly high strength properties at elevated temperatures, as well as resistance to oxidation and abrasion. Used for the manufacture of NiAl intermetallic phase sintering technology under high pressures (HP) and the temperatures (HT), which then parameters were well-chosen to get optimum usable properties (mechanical and physico-chemical properties). In addition, the studied process characterized the short time of consolidation of powders as well as the possibility to obtain assumed chemical composition.

Cleaner production and biotechnology

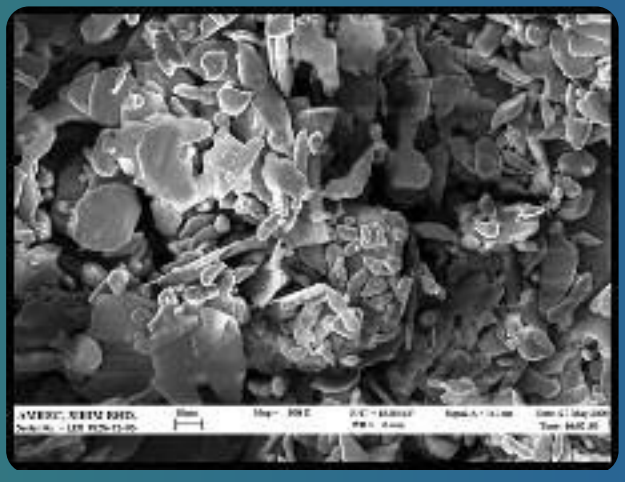
Industrial management and organisation

Technical paper

Technical announcement

734

In the paper entitled "TEM microstructure investigations of aluminium alloys used for laser alloying" by K. Labisz, M. Krupiński and T. Tański on a **page 734** the results of Transmission Electron Microscope investigation concerning the structure of the AlSi7Cu4 cast aluminium alloy using for alloying and remelting with the high power diode laser (HPDL) are presented. There are also presented the results of the thermo-derivative analysis performed using the UMSA (Universal Metallurgical Simulator and Analyser) device, allowing to determine the specific points of the solidifying alloy, what is helpful for phase determination occurred in this alloy. In this work especially the changes of the precipitation type, size and shape were determined. The reason of this work was also to present the laser treatment technology, which will be used for further alloying and remelting with ceramic powders – especially carbides and oxides. Particularly the overview will be directed on the laser power to achieve good layer hardness for protection of this hot work tool steel from losing their work stability and to make the tool surface more resistant to action in external conditions. The structure of the surface laser tray changes in a way that there are very high roughness of the surface zone and the flatness or geometry changes in an important manner, crucial for further investigation. Developing of new technology with appliance of Al alloys, High Power Diode Laser and diverse ceramic powders will be possible to obtain, based in findings from this research project. Some other investigations should be performed in the future, but the knowledge found in this research concerning the proper process parameters for each type of alloy shows an interesting investigation direction. The combination of metallographic investigation for cast aluminium alloys – including electron microscope investigation – and HPDL treatment parameters makes the investigation very attractive for automobile, aviation industry, and others where aluminium alloys play an important role.



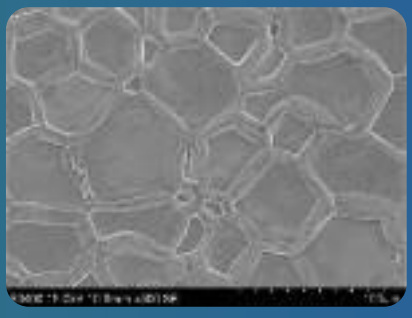
790

Authors: M. Ramezani and T. Neitzert in the paper entitled "Mechanical milling of aluminum powder using planetary ball milling process" on a **page 790** inform that mechanical alloying has recently attracted considerable attention as researchers strive to enhance nanocomposite properties and extend their utility. The process can be performed at room temperature and homogeneous nanocomposite powders can be produced. In this paper, the effect of different ball milling parameters and operating conditions (milling time, ball size, processing control agent (PCA) and speed) in mechanical alloying of aluminum powder to achieve particle size reduction with less contamination were investigated. Two types of PCA, i.e. stearic acid and methanol have been used and microstructure evolutions at different operating conditions were studied. It was shown that the optimized milling parameters for aluminium composite are 100 stainless steel ball (10mm), 200 rpm rotation speed with direction reversal and 1 min pause time after every 15 min running time, under argon gas for 30 hr of milling.

835

The paper from Manufacturing and processing area made by J. Upadhyay, R. Das, S. Rao, D. Liu and D. Bhattacharyya on "Manufacturing and characterisation of PMMA-graphene oxide (GO) nanocomposite sandwich films with electrospun nano-fibre core" on a **page 835** presents information about nanocomposite materials, comprising of polymer matrices and nano-sized reinforcements, exhibit significantly enhanced mechanical and functional properties at extremely low filler loading. In recent years, graphene oxide (GO) has emerged as a new class of low cost nano-filler with high mechanical strength and stiffness, and alterable electrical properties. For nano-fillers with layered structure like GO, complete exfoliation and uniform dispersion of filler in the polymer matrices is essential to enhance the matrix-filler interaction and in turn the mechanical and/or functional property improvement. Conventional nanocomposite manufacturing methods including in-situ polymerisation and solvent processing encounter the problem of agglomeration of GO films. Additionally, its low bulk density presents difficulties in handling, and the energy requirement for mechanical mixing and extrusion processes is very high. In this work, manufacturing of poly(methyl methacrylate)–graphene oxide (PMMA-GO) nano-fibre mat using relatively novel approach of employing electrospinning technique were reported. The manufactured electrospun core was inserted between plain polymer layers to prepare a robust and easy to handle sandwich film. Morphology and structure of the PMMA-GO nano-fibre cores was evaluated with scanning and transmission electron microscopy and X-ray diffractometry. The manufactured nano-fibre mat samples exhibited uniform diameter and dispersion. The functional parameters including thermal stability and gas barrier were evaluated with differential scanning calorimetry and oxygen permeation testing, and these functional properties were observed to be superior to that of monolithic polymer counterparts.

848



The paper entitled "Oxidation behaviour of palladium modified aluminide coatings deposited by CVD method on nickel-based superalloys under air atmosphere" by M. Zagula-Yavorska, K. Kubiak and J. Sieniawski on a **page 848** informs about the oxidation resistance of palladium modified aluminide coatings deposited by CVD method on nickel-based superalloy. Palladium coatings 3 and 7 μm thick were deposited by the electroplating process. The heat treatment of electroplating coatings at the temperature 1050 °C for 2 h under argon atmosphere was performed. Low activity CVD aluminizing process of palladium heat treated coatings (3 and 7 μm thick) at the 1050°C for 8 h using IonBond equipment was performed. Oxidation resistance was evaluated at 1100°C for 1000 h in air atmosphere using furnace of Czylok company. The microstructure investigations of palladium modified aluminide coatings were conducted by the use of optical microscope (Nikon Epiphot 300) and a scanning electron microscope (Hitachi S-3400N) equipped with an Energy Dispersive Spectroscope EDS (VOYAGER of NORAN INSTRUMENTS). The phase composition was identified by X-ray (ARL X'TRAX) diffractometer. The surface roughness parameter – Ra of modified aluminide coatings was evaluated by Perthometer S2 MAHR equipment. The microstructure of palladium modified aluminide coatings (3 and 7 μm thick) consists of (Ni,Pd)Al phase and two zones: outer and internal ones. Low activity CVD aluminizing at 1050°C for 8 h causes the increase of surface roughness parameter of modified coatings. The increase of platinum thickness from 3 to 7 μm causes a greater surface roughness of aluminide coatings. On the ground of the obtained results, it was found out that palladium modification of aluminide coatings to increase the oxidation resistance of CMSX 4 Ni-base superalloy. The palladium modified aluminide coatings are used as an alternative for platinum modified aluminide coatings in turbine blades of aircraft engines.

Photo essay

The Organising Committee of the AMME 2012 Conference