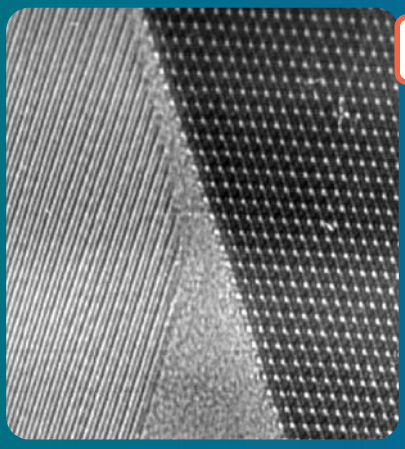
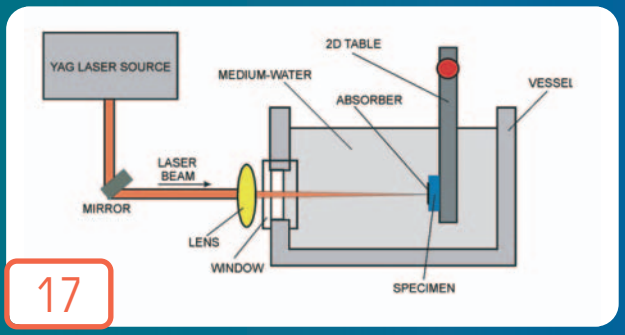
Materials

Selected materialographical photo



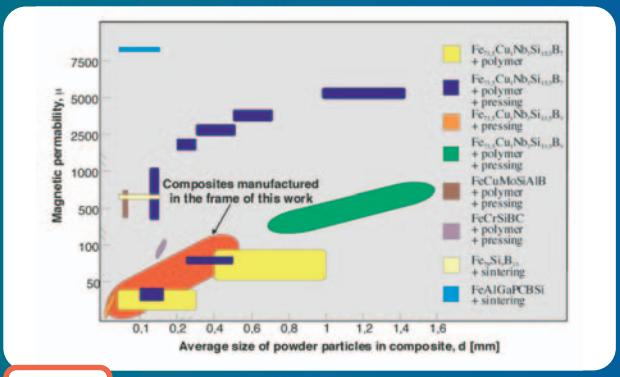
43

The research paper entitled "Silicon nitride ceramics – review of structure, processing and properties" by S. Hampshire on a **page 43** examines the development of silicon nitride and the related sialons and their processing into a range of high-grade structural ceramic materials. Silicon nitride is one of the major structural ceramics that possesses high flexural strength, good fracture resistance, good creep resistance and high hardness. These properties arise because of the processing route which involves liquid phase sintering and the development of microstructures in which high aspect ratio grains and intergranular glass phase lead to excellent fracture toughness and high strength. The development of knowledge of microstructure–property relationships in silicon nitride materials is outlined, particularly recent advances in understanding of the effects of grain boundary chemistry and structure on mechanical properties. This review should be of interest to scientists and engineers concerned with the processing and use of ceramics for engineering applications.



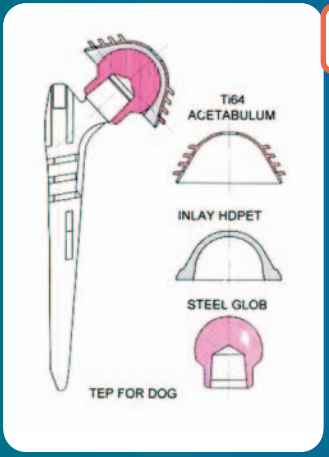
17

An author: J. Grum in the paper entitled "Comparison of different techniques of laser surface hardening" on a **page 17** presents a comparison of various techniques of laser surface hardening for various kinds of structural and tool steels, and special maraging steel and hardening of nodular graphite and gray cast irons. With the present findings constructors and experts in laser technology can essentially improve the quality and operating life of machine parts or tools. Experimental investigations of laser surface transformation hardening, laser remelting and laser shock processing were performed. Trials of laser hardening were carried out under different conditions, with different modes of laser guidance over the specimen surfaces, and with different degrees of path overlapping. Different kinds of absorbents, were tested, the depths of hardened paths or layers were measured, profiles of hardness and residual stresses were measured, the microstructures formed were analysed, and a micro-chemical analysis was made. The research conducted on the influences of different modes of laser-beam guidance in terms of microstructure and variations of microstructure and residual stresses in the thin surface layer are original.



68

In the research paper entitled "Soft magnetic polymer-metal composites consisting of nanostructural Fe-basic powders" by R. Nowosielski on a **page 68** the research results of soft magnetic composites consisting nanocrystalline powders obtained by soaking and high energetic milling of amorphous ribbons of metallic glasses $Fe_{78}Si_9B_{13}$ and $Fe_{73.5}Cu_1Nb_3Si_{13.5}B_9$ is presented. The paper presents influence of chemical composition of selected Fe-based metallic glasses, annealing temperature and parameters of the high-energy ball milling process on structure and magnetic properties of soft magnetic powders materials obtained in this technique. This paper reviews also possibility of magnetic properties forming for metal-polymer nanocrystalline composites. Results and a discussion of the influence of high energy mechanical milling process on particle size and their distribution and annealing temperature of powders as well as structure and magnetic properties of investigated samples is presented. According to achieved results it has been attempted to describe the possibilities of improvement the soft magnetic properties of obtained Fe-based nanocrystalline powder materials and composites from them manufactured. The amorphous and nanocrystalline $Fe_{78}Si_9B_{13}$ and $Fe_{73.5}Cu_1Nb_3Si_{13.5}B_9$ powders obtained by high-energy ball milling of metallic glasses feature an alternative to solid alloys and make it possible to obtain the ferromagnetic nanocomposites, whose shape, dimensions and magnetic properties can be freely formed in the determinate range.

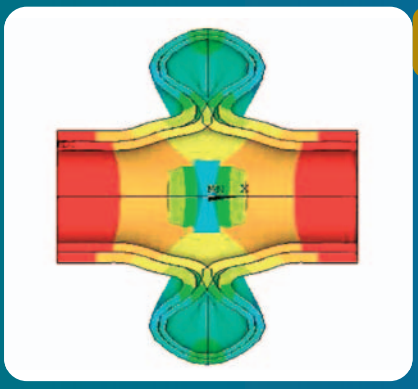


146

The paper from Materials area made by M. Žitňanský, Ľ. Čaplovič, Ľ. Rehák and F. Makai on "Investigation and implantation of total hip replacement in biological experiment on animals" on a **page 146** informs professional public about our research activities and results in the area of development of implants. This paper is the result of partly primary and partly applied research. The achieved results will be used for preparing of the total endoprostheses into the human skeleton. A method used in the present study, was the computer design of 3D virtual model, rapid milling, rapid turning and special testing, to produce a new total hip replacement for dogs. Results of these activities are eight complete total hip replacement – THR for dog implantation and for test preparing in vitro and in vivo and finally, for biological experiments on animals/ dogs. There is development of THR in possibilities of SR, but with marks of European and world quality.

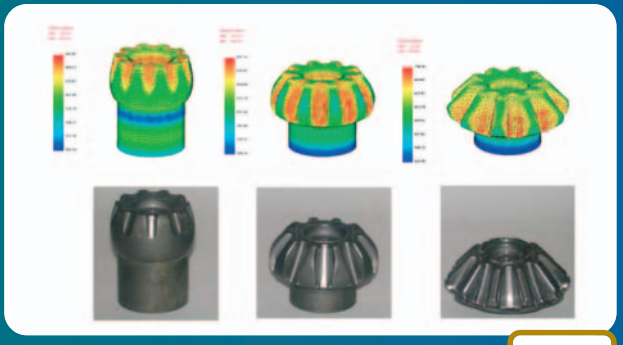
Properties

Analysis and modelling



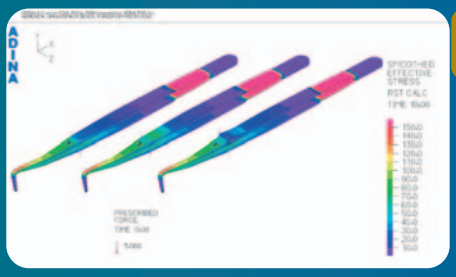
212

Authors: M.S.J. Hashmi, M.D. Islamn and A.G. Olabi in the paper entitled "Experimental and finite element simulation of formability and failures in multilayered tubular components" on a **page 212** inform that optimisation of the operating conditions is one of the most significant studies in the hydroforming process, which affect the forming of successful components. This paper studies the hydroforming process involving combined (axial feed and internal pressure) and multi stage non-linear loading action theoretically and experimentally for a multi layered tubular blank placed in a pre-shaped die block. Finite Element simulations have been carried out using the commercial finite element package ANSYS in order to predict the most efficient and acceptable operating condition for certain material properties of multilayered blank and initial blank geometry. Finite Element simulation of a multi layered tube hydroforming and optimisation of the best forming conditions based on a number of simulations were carried out to avoid wrinkling or bursting of the tubular blanks.

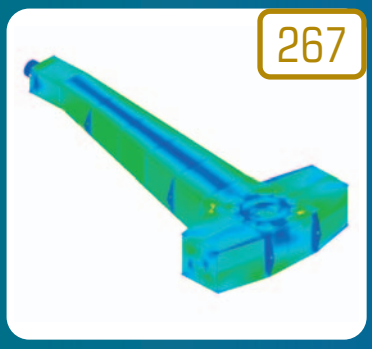


219

In the research paper entitled "Research Activities of Computer-Aided Materials Processing Laboratory" by Y.-T. Im, H.-W. Lee, H.-C. Lee, M. Awais, Y.-G. Jin, K.-H. Jung and K.-H. Jung on a **page 219** the research works carried out at the national research laboratory for computer-aided materials processing at the department of mechanical engineering at KAIST is presented. The research papers published so far from the laboratory were carefully reviewed and highlights for developing simulation tools for mesh generation, 2D or 3D finite element analyses for forging, shape rolling, solidification, semi-solid forging, compression molding of thermoset composites, injection molding without or with short fibres, and expert system for multi-stage axi-symmetric cold forging, extrusion, and multi-pass shape rolling are recaptured. Proper usage of the simulation tools and interface such tools with the automatic design system with the help of artificial intelligence will be very useful at the design stage of new manufacturing products and processes. In addition, proper understanding of deformation mechanics is of importance to properly utilise such numerical tools. Understanding of material behaviour at various processing conditions and characterisation of proper boundary conditions in terms of friction and temperature should be carefully made. Handling of complex geometry and computational efficiency for such geometry should be improved as well. Further development of three dimensional design systems should be necessary.

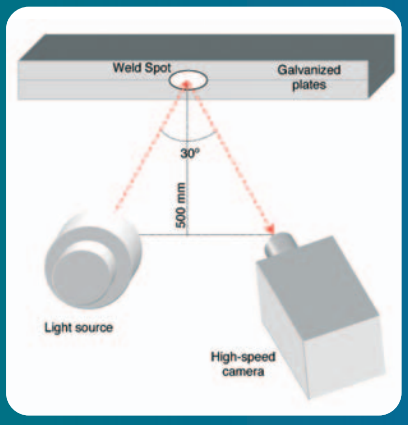


The Analysis and modelling section represented by L. Jeziorski, J. Jasinski, M. Lubas, M. Szota, P. Lacki and B. Stodolnik on "Numerical modelling of structure and mechanical properties for medical tools" on a **page 237** presents conception to obtain new medical tools, after optimising the basic construction parameters by numerical calculations. The prepared model could be helpful for engineering decisions used in the designing and producing forceps and bowl cutter. In order to design forceps and bowl cutter property, it is necessary to optimise many parameters and consider the functions, which these medical tools should fulfil. Of course, some simplifications are necessary in respect of calculation methodology. In the paper a solution procedure concerning this problem has been presented.
The presented solution allows for precise determination of the geometrical dimensions according to the functional requirements that forceps should fulfil. The presented numerical analysis describes a small range of the forceps application but the used algorithm can be applied in any other type of forceps. Also in the paper, the numerical simulation results of the bowl cutter being loaded are presented. Residual stress distribution on the tool surface is presented. A position of the cutting edges and holes carrying away the bone chips is shown as a polar diagram. The numerical simulation makes it possible to obtain the suitable geometry, better material properties and the instructions heat treatment of these tools. These research was carried out in order to improve ergonomics, mechanical properties and work condition of medical tools. For bowl cutter geometrical sharp and distribution of cutting holes was improved.



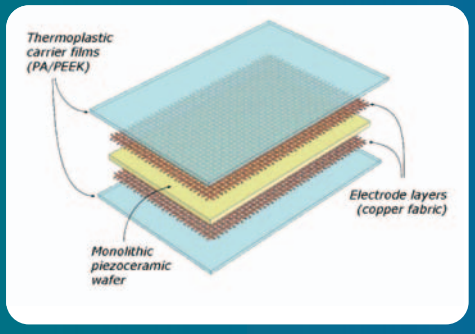
The Analysis and modelling section represented by E. Rusiński, J. Czmochowski and P. Moczko on "Investigations of causes of dumping conveyor breakdown" on a **page 267** presents designing and exploitation problems of machines used in strip mines and investigation of its reasons based on steering frame breakdown of the dumping conveyor. The paper provides information backed by evaluation and test results, stating the nexus of causes of the dumping conveyor failure. The experimental and numerical approaches show a relationship between designing and manufacturing process of machines. This can be helpful for the designers and researchers looking for reasons, methods of investigations or how to prevent failures of similar machines. Numerical (FEM) and experimental approach was used to investigate reasons of the breakdown. Fractographic and microscopic evaluation and chemical analysis, were used to perform material evaluations. The objectives are achieved by analysis of the numerical simulations results and data coming from material evaluations. Additionally, the new design of the steering frame was discussed in order to prevent future similar problems in the half-shafts systems. The study provides practical implication into designing of half-shafts undercarriage systems and their safetyings. Discussed design of the safetying should be redesigned or the half-shaft system should be changed into one shaft design.

Manufacturing and processing



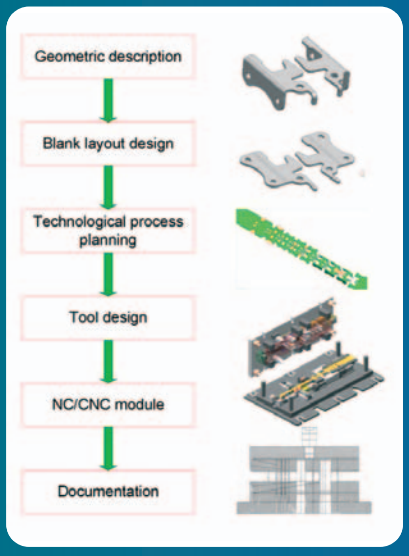
333

The paper from Manufacturing and Processing area made by S.C.A. Alfaro, J.E. Vargas, M.A. Wolff and L.O. Vilarinho on "Comparison between AC and MF-DC resistance spot welding by using high speed filming" on a **page 333** describes an idea to compare resulted for the same process of welding under different conditions (equipment, materials and/or parameters) makes possible the choice of these better conditions used to the optimisation of the process. In this work it will be carried through the filming of the formation and growth of the nugget in resistance spot welding executed in AC and MF. A comparison for same times in both the processes will be carried through to verify which of the used processes offers better conditions, control and results as well as will help for one better understanding of the process aiming at the optimisation. For currents below 2 kA, no nugget was observed. and the formation of same after 10º cycle for bigger current of 3 kA. The MF-DC welding offers the possibility of obtaining nuggets more uniforms within shorter times (depending on the plate configuration). In this work the AC machine is limited by the values of current of welding and pressure of the electrodes: (2-6) kA e (87-261) kgf respectively. Other materials: aluminum, stainless steel or material exactly dissimilar could be used following the line of this research. Bigger currents levels can also be used.



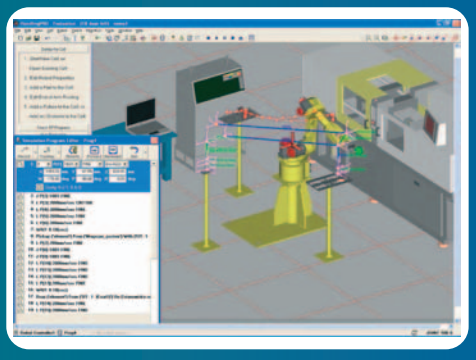
390

The paper entitled "Development of novel piezoceramic actuator modules for the embedding in intelligent lightweight structures" presented by W. Hufenbach, M. Gude, N. Modler and C. Kirvel on a **page 390** shows a specific example of novel morphing structures is introduced, which rely on multistable deformation phenomena of fibre-reinforced composites with an unsymmetrical lay-up. For the large-scale capable utilisation of such active structural parts made of fibre-reinforced thermoplastic composites, novel piezoceramic modules, which are specifically tailored to the structural material, and required manufacturing methods are developed. The piezoceramic modules with the highly regarded compatibility to thermoplastic composites permit their substantially coherent and homogeneous integration in the fibre composite structure without intricate adhesive assembly effort. Furthermore, thermally induced residual compressive stresses during the manufacturing process serve for purposefully prestressing the piezoceramic components to reduce the module's sensitivity to tensile loading. The successful development of the novel TPM offers a significant advancement in the efficiency within the large scale production of novel intelligent lightweight structures.



435

In the research paper entitled "Recent achievements in computer aided process planning and numerical modelling of sheet metal forming processes" by M. Tisza on a **page 435** the specific value both for process planning and die design engineers is presented. During the recent 10-15 years, Computer Aided Process Planning and Die Design evolved as one of the most important engineering tools in sheet metal forming, particularly in the automotive industry. This emerging role is strongly emphasised by the rapid development of Finite Element Modelling, as well. The purpose of this paper is to give a general overview about the recent achievements in this very important field of sheet metal forming and to introduce some special results in this development activity. Applying the above approach a more powerful and efficient process planning and die design solution can be achieved radically reducing the time and cost of product development cycle and improving product quality. The proposed integrated solutions have great practical importance to improve the global competitiveness of sheet metal forming in the very important segment of industry.



466

The paper made by J. Świder on "Research projects and university education in mechatronics and robotics at the Faculty of Mechanical Engineering, Silesian University of Technology" on a **page 466** describes the activities undertaken for the creation of a laboratory infrastructure which are provided, together with research scop formulation and commercial results of cooperation with industrial companies. The paper is focused on presenting the outcome of the task set before its author by Professor Leszek A. Dobrzanski seven years ago, when he was a Dean of the Faculty of Mechanical Engineering, concerning the development and implementation of the Faculty concept of research projects and education in automatic control, mechatronics and robotics. Following several years of activities coordinated by the author, particularly good conditions of educating engineers in mechatronics have been provided, including a unique laboratory infrastructure that is used both for research schemes, commercial projects in mechatronics and robotics conducted for industrial companies. Practical implications include a unique laboratory infrastructure and well developed and implemented projects in the field of mechatronics.

Industrial management and organisation

Education and research trends

Indexes