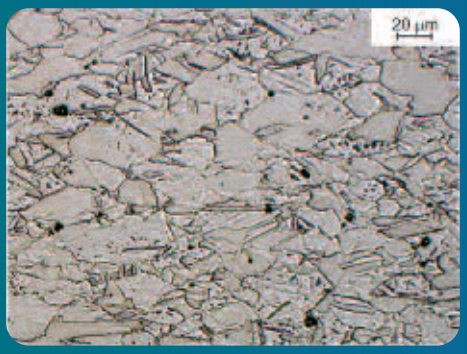
Contents

Research monograph

Materials



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The paper from Materials area made by L.A. Dobrzański, M. Czaja, W. Borek and K. Labisz on "Influence of thermo-plastic deformation on grain size of high-manganese austenitic X11MnSiAl17-3-1 steel" on a **page 169** compare fragmentation of grains after thermo-mechanical treatment using Gleeble 3800 simulator of high-manganese austenitic X11MnSiAl7-1-3 steel. The hot-working behaviour was determined 4- and 8-stage compression tests performed in a temperature range of 850 to 1100°C by the use of the Gleeble 3800 thermo-mechanical simulator. The comparison between two types of thermo-mechanical treatment has been established based on microstructure research and X-ray diffraction analysis. It was found out that X11MnSiAl7-1-3 steel in initial state and after thermo-mechanical treatment on Gleeble simulator has homogeneous austenite structure. Compression tests were realized in the temperature range from 850 to 1050°C with the true strain 4x0.23 for 4-stage process, and 0.4 in the first deformation, and 0.25 and 0.2 in the following deformations for 8-stage process. The multi-stage compression examination gives the possibility to refine the austenite microstructure. Based on microstructures research it was found out that this process perfectly led to the fragmentation of the material structure which may result in the ideal material properties. The obtained microstructure after Gleeble simulations can be useful in determination of power-force parameters of hot-rolling for thin sheets to obtain fine-grained austenitic microstructures.

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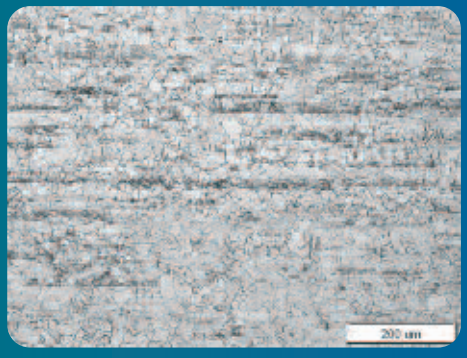
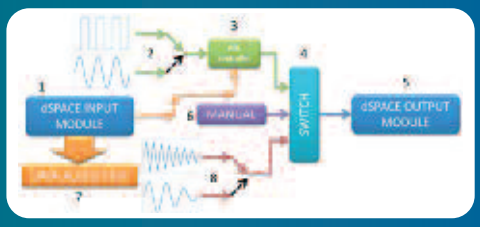


The paper written by A. Kurc-Lisiecka and M. Kciuk on "The influence of chemical composition on structure and mechanical properties of austenitic Cr-Ni steels" on a **page 210** analyzes the influence of the chemical composition on the structure and mechanical properties of austenitic Cr-Ni steels. The special attention was put on the effect of solution heat treatment on mechanical properties of examined steels. The examinations of static tensile tests were conducted on ZWICK 100N5A. Hardness measurements were made by Vickers method. The X-ray analyses were realized with the use of Dron 2.0 diffractometer equipped with the lamp of the cobalt anode. The metallographic observations were carried out on LEICA MEF 4A light microscope. Results shown that after solution heat treatment the values of strength properties (UTS, $YS_{0.2}$) and hardness (HV) of both investigated steels decrease and their elongation (EL) increases. The X5CrNi18-8 steel in delivery state shown austenitic microstructure with twins and numerous non-metallic inclusions, while in X10CrNi18-8 steel revealed austenitic microstructure with numerous slip bands in areas with deformation martensite α'. The examined steels after solution heat treatment followed by water-cooling has the structure of austenite. The relationship between the solution heat treatment, structure and mechanical properties of investigated steels was specified.



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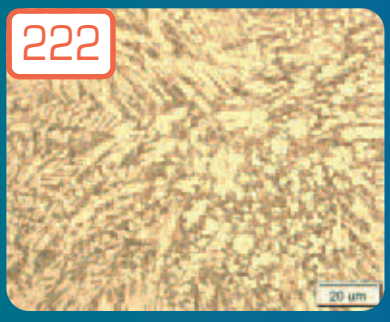
Authors: B. Minorowicz, A. Nowak and F. Stefański in the paper entitled "Position regulation of magnetic shape memory actuator" on a **page 216** discuss the materials with magnetic shape memory. Those materials are a new group of smart materials, which distinguished by large deformations (up to 10%), and relatively high operating frequencies. Authors used design applications in research samples made of Ni_2MnGa alloy in order to find out of their capabilities in transducers and for better understanding their nonlinear behaviour. The design of transducer was for Authors a first attempt of practical application of MSMA. Results help in: modelling process of hysteresis for future open loop regulation, finding out optimal working conditions and scope of available operating parameters. Changes will be applied in next transducers design e.g. shape of magnetic circuit and these transducers will have more compact design. Step responses of material are much worse than values given by manufacturer, because response of controllable power supply is up to 0.1 s. Another problem was stiffness of transducer and repeatability of obtaining results, but since modifications it was successfully eliminated. Implemented in the examined transducer operating mode is identical to the principle of operation of an electromagnetic transducers used in design of electro-hydraulic and electro-pneumatic cartridge valves. In those valves solenoid moves a spool and after a power cut due to the spring tense, it returns to a basic position. A future work will focus on their replacement by transducers designed with the use of MSMA.



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In the paper entitled "The production attempt of Fe-Nb-B-Zr and Fe-Nb-B-Y system alloys by die pressure casting method" by W. Pilarczyk and M. Kucharczyk on a **page 222** the possibility of the production of Fe-Nb-B bulk metallic alloys with additions of yttrium and zirconium elements were determined. Furthermore, the paper tends to present the structure and selected properties of obtained alloys. Moreover, the influence of an argon atmosphere on casting process was observed in it. The production attempts were performed on Fe-Nb-B-Zr and Fe-Nb-B-Y system alloys in form of a plate. Master alloy ingots with compositions of $Fe_{72}B_{22}Y_4Nb_2$ and $Fe_{71}(Nb_{0.8}Zr_{0.2})_6B_{23}$ were prepared by induction melting of pure Fe, Nb, B, Y and Fe, Nb, B, Zr elements in an argon atmosphere. The ingots were crushed and then the investigated material was cast with and without protective atmosphere. The investigated materials were cast in form of a plate with thickness of 1 mm. The structure analysis of the studied materials in as-cast state was carried out using X-ray diffraction (XRD) and microscopic observation. The thermal properties of the alloys were examined by DSC methods. The measurments of hardness were performed with the Vickers method. A Fe-Nb-B-Y and Fe-Nb-B-Zr system alloys in form of a plate were produced by die pressure casting method. The investigation methods revealed that the studied as-cast alloys were crystalline. The structure of the obtained plates is rather fine-grained and there were not found any impurities and undesirable phases inside the materials. The results of calorimetric curves confirm that all tested samples are crystalline. To extend the potential applications of the Fe-based BMGs, amorphous alloys with larger critical sizes and better processability are required. The Fe-Nb-B-Zr and Fe-Nb-B-Y bulk metallic glasses obtained by die pressure casting method can be used for production of telecommunications devices, sensors or low-energy transformers. Those materials exhibit excellent mechanical and soft magnetic properties. An overall presentation of an influence of the yttrium and zirconium additions on the attempt of forming $Fe_{72}B_{22}Y_4Nb_2$ and $Fe_{71}(Nb_{0.8}Zr_{0.2})_6B_{23}$ alloys can be seen.

Properties

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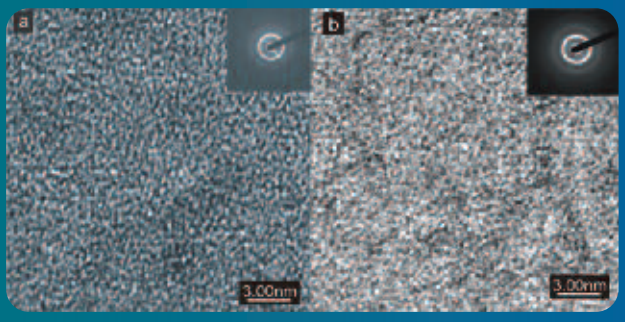

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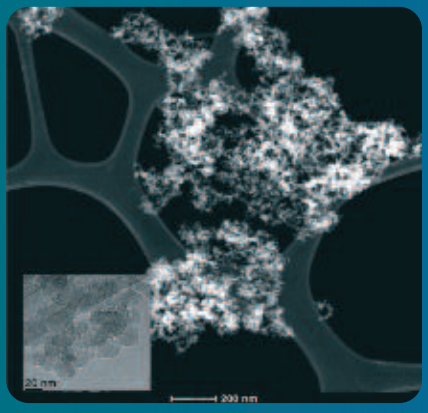
The research paper made by J. Gondro on "The effect of heat treatment on the magnetic properties of $Fe_{82}Zr_7Nb_2Cu_1B_8$ amorphous alloy" on a **page 244** clarifies the results of investigations into the: microstructure, magnetic properties and thermal stability of amorphous $Fe_{82}Zr_7Nb_2Cu_1B_8$ alloy in the state prevailing after solidification and a multi-stage heat treatment process. Samples of the investigated $Fe_{82}Zr_7Nb_2Cu_1B_8$ alloy were found to be amorphous, both in the as-quenched state and after a multistage thermal annealing process. The sample with the lowest value of hyperfine field induction on the 57Fe was found to possess the lowest value of Curie temperature, it is related to the so-called invar effect. The sample of the investigated alloy that had been subjected to the annealing process, at temperatures of 573K and 600 K for 15 minutes exhibits the biggest change in the magnetic entropy. The investigated alloy was obtained in the form of thin ribbons of width 3 mm and thickness approximately 20 μm. The required ingots of alloy were obtained by arc-melting high-purity component elements. The structure and the microstructure were examined using Mössbauer spectroscopy and transmission electron microscopy. The microstructure study confirmed the amorphicity of the investigated alloy. The thermal stability was determined on the basis of DSC (Differential Scanning Calorimetry) plots. Also measurements of the magnetic properties, such as magnetic susceptibility and magnetization as a function of temperature and magnetizing field were taken. The paper presents some researches of the Fe-based amorphous alloys obtained by arc-melting high-purity component elements. The paper presents some researches of the Fe-based amorphous alloys obtained by arc-melting high-purity component elements.



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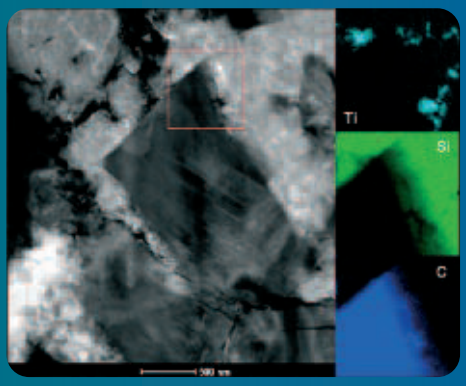
The Properties section is represented by A. Hudecki, M. Pawylta, L.A. Dobrzański and G. Chladek on "Application of feature method to the modeling of composite structural elements" on a **page 257**. The paper describes the surface properties of ceramic nanoparticles applied as fillers in composite materials of polymeric warps. For research there were used three types of ceramic micro and nano fillers: silver sodium hydrogen zirconium phosphate AlphaSan RC2000 (Milliken Chemical) and silica Aerosil DT4 i Aerolisl R 812 (Evonik Corporation). For the purpose of mentioned above materials scanning electron microscope SEM, Transmission Electron Microscope TEM and gas adsorption method for the purpose of qualifying specific surface area BET, Langmuria, porosity BJH and energy adsorption were used. On the basis of undergone research the dependence between size, shape, porosity of particles and specific surface area BET, Langmuira and energy of adsorption were pointed out. Methods of measurements based on gas adsorption belong to the types of measurement methods that are very intensively developing that allows to undergo measurements of various surface properties meaningful both in material engineering as well as in catalectic chemistry.



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The Properties area is shown in the paper on "Sintering of diamond composites with SHS-prepared bonding phases" P. Putyra, L. Jaworska, L. Stobierski, J. Morgiel, M. Bucko, M. Rozmus and P. Wyzga on a **page 268**. The aim of the study was to investigate materials with reduced cobalt content as well as diamond compacts with non-cobalt bounding phase. Phases Ti_3SiC_2 and Cr_3AlC obtained using the self-propagating High-Temperature Synthesis (SHS) technique were used as a PCD (polycrystalline diamond) bonding phases. Diamond composites with 10-20 mass% of SHS bonding phase were prepared by using a Bridgmann-type High Pressure – High Temperature (HP-HT) apparatus. Sintering of the composites were carried out at 1950±50°C and 8±0,2 GPa. Phase compositions of MAX powders and compacts were tested using X-ray diffraction. Microstructure investigations were performed using scanning (JEOL) and transmission (Tecnai FEG 200kV) microscopes and high spation resolution EDS mapping. During the sintering processes, bonding phase decomposition processes occur in the material. Mainly carbides and silicides are formed. Diamond phase materials are characterized by multi-phase composition. Due to the low thermal stability of the cobalt as a bonding phase in PCD there is a need to reduce its volume in the composite. The application of the newest non-cobalt bonding phases (Ti_3SiC_2 and Cr_3AlC) obtained by SHS sythesis.

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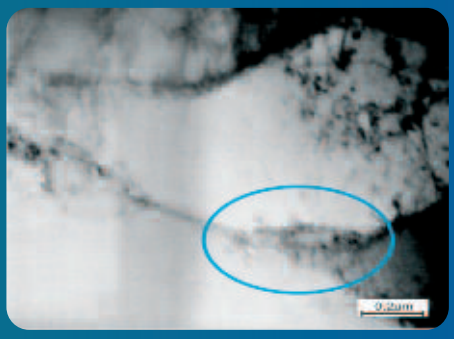

In the research paper entitled "FEM simulation of Ductility Minimum Temperature (DMT) phenomenon in CuNi25 alloy" P. Sakiewicz, R. Nowosielski, R. Babilas, D. Gąsiorek and M. Pawlak on a **page 274** the possibility of existence the non-uniform deformation hypothesis as a cause of Ductility Minimum Temperature phenomenon (DMT) in CuNi25 alloy is checked by three dimensional finite element method simultaions. The necessary information and mechanical properties have been collected during elevated temperature tensile tests and other research and analysis of microstructure changes in material after deformation at the range of DMT existence. Experimental results were compared with three dimensional finite element method (FEM) simulation. During the experimental studies the course of elongation curves has been determined. The stress in material after deformation at elevated temperature was analysed by FEM simulation. It has been confirmed the possibility of existence the inhomogeneous deformation hypothesis as a cause of DMT phenomenon. Understanding of material properties during high temperature deformation leads to the selection of the appropriate production parameters and reductions of cost, helps to avoid destruction of material during production or operating. FEM simulations can help to reduce the costs of multiple destructive tests to determine material properties. FEM simulation and investigations of the CuNi25 alloy complete knowledge about mechanical properties of the material and help to develop correct parameters for more effective technologies for material production and exploitation.

Analysis and modelling

Manufacturing and processing

Industrial management and organisation

Technical paper

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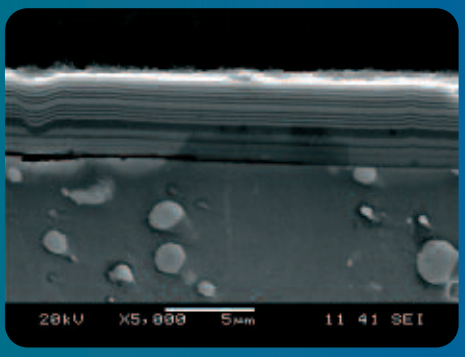
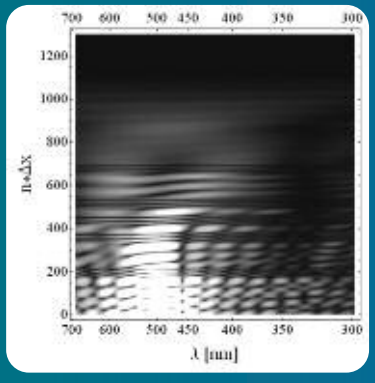


The paper entitled "The effects of the coating stripping process on regenerated tool cutting edges" by D. Toboła, K. Czechowski, I. Wronska, A. Łętocha and T. Miller on a **page 294** informs that the cutting tools of high speed steel or cemented carbide need to be regenerated in many cases. It involves stripping the remnants of the initial coatings. The effects of chemical removal of the PVD TiN, TiAlN, TiN/(TiAlSi)N/TiN and TiZrN/10x(TiN/ZrN)/TiN coatings on some elements of geometry of cutting edges and the adhesion of subsequent coatings deposited on the cutting inserts are considered. The chemical coating stripping process did not cause unfavourable changes in the roughness parameter Ra of the rake and flank faces of cutting inserts, or in the roughness of their cutting edges. Subsequent coatings deposited on the decoated inserts had a marginally lower adhesion, but in the case of TiN coated cemented carbide, the latter coating had better adhesion than the original. Surface analyses showed that the PVD coating stripping methods were effective for TiN and TiAlN coated high speed steel HS6-5-2 inserts, as well as for TiN coated and commercially TiN/(TiAlSi)N/TiN coated cemented carbide inserts. The paper is concerned with geometry of cutting edge and adhesive properties of subsequent coatings. To verify fully the effectiveness of the described methods further research on different coating removal from tools made of various tool materials should be carried out. The effects of chemical removal of mono and multilayer PVD coatings from cemented carbide and high speed steel inserts on the regenerated cutting edges quality were determined.



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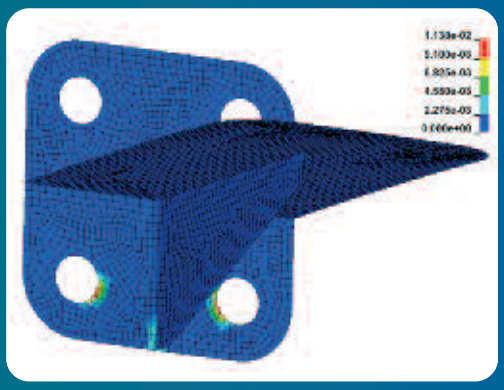
The paper written by S. Garus, J. Garus, M. Szota, M. Nabiałek, K. Gruszka and K. Błoch on "The implementation of the electromagnetic wave propagation algorithm in superlattices" on a **page 327** discusses the implementation of FDTD algorithm for studing the electromagnetic wave propagation and appointing the wavelength distribution of the electromagnetic waves leaving the structure for monochromatic incident wave in the case of a wavelength range of the band gap and in the case of full transmission. The FDTD simulation comparison of the results with those obtained using the matrix method demonstrate good correlation between two methods. The use of the FDTD method and Fourier transforms (FFT) allows for a more complete picture of the observed phenomena, along with the distribution of time in which it takes place. The material structures consisted of quasi one-dimensional lossless and non-dispersive isotropic material were analysed in the paper. The analysis of the lossy materials with dispersion would be important. The analysis of two-dimensional space would allow to study the propagation of the incident wave different angles. The simulation allows to understand the temporal distribution of the electromagnetic wave propagation in the superlattice structure for the full transmission rate, and in the case of the occurrence of photonic band gap. The novelty is to use FDTD algorithm with FFT to study the behaviour of the electromagnetic wave in the electromagnetic wave wavelength of band gap range.



The paper entitled "Mean field homogenization in multi-scale modelling of composite materials" by W. Ogierman and G. Kokot on a **page 343** shows the testing of the capabilities of the mean field homogenization scheme in numerical analysis of composite materials. Another goal of the research is an attempt of coupling of mean field homogenization procedure with finite element computations to carry out a multi-scale analysis. The application of mean field homogenization allows to obtain the effective properties of heterogeneous material very efficiently. The process of assigning material parameters to each composite's phase on the micro level is operative and fast. Coupling homogenization procedure with finite element solver leads to full multi-scale analysis where material nonlinearities can be taken into account. Methodology presented in the paper shows efficient approach to find effective composite properties and in addition allow to carry out nonlinear multi-scale analysis. The paper presents new methodology which is intensively developed in the field of numerical simulation of structures and materials. The material parameters are not treated as the constant input data, but are obtained as results of the material parameters modelling process on the micro-scale level.

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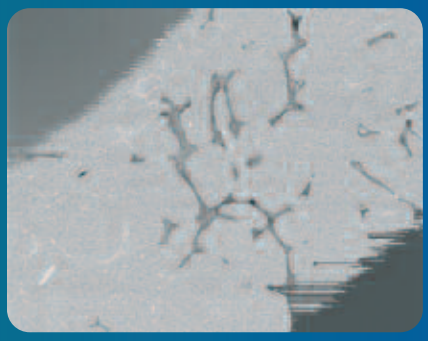

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The paper from Manufacturing and processing area made by A. Januszka, R. Nowosielski and A. Pusz on "Investigations of temperature distribution in metallic glasses fabrication process" on a **page 360** describes the preparation, structure and mechanical properties of magnesium based alloys with chemical composition of Mg-1 (wt%) Ca prepared in the form of ingot. The studied samples were prepared by the tubular resistance furnace melting in silicon crucible. The structure of the alloy was examined by X-ray diffractometry (phase analysis) and scanning electron microscope (chemical analysis of the micro-regions). Microhardness was measured using Vickers hardness testing machine with automatic track measurement. Microstructure was examined by optical light microscopy. The X-ray diffraction investigations have revealed that the studied cast ingot the two-phase alloy structure. Chemical analysis confirmed the expected chemical composition. Values of the microhardness tests of materials were compared before and after remelting. Magnesium alloys are new class of biodegradable materials other bioresorbable biomaterials for orthopedic applications. The potential benefits of ownership of Mg alloys are the closer modulus of elasticity to the bone than stainless steel or titanium, biocompatibility and bone- active properties and the elimination of necessity of a second operation to remove the implant body. Two-component Mg-Ca alloy is characterised in that a solid solution limit, and creates a stable intermetallic phase Mg_2Ca.