1. M. Zuk, J. Gorka, A. Czuprynski, M. Adamiak

Properties and structure of the weld joints of quench and tempered 4330V steel. This work outlines the research on welding of heat treated 4330V steel using the flux core arc welding process. The research describes the effect of preheat temperature, interpass temperature, heat input, and post weld heat treatment on strength, hardness, toughness, and changes of microstructure in the weld joint. Welding with the lower heat input and without post weld heat treatment results in optimal mechanical properties in the weld metal. Austempering at 400 °C results in optimal mechanical properties in the heat affected zone (HAZ). Increasing preheats and interpass temperature from 340 to 420 °C did not improve Charpy V-notch values or ultimate tensile strength in the weld metal or heat affected zones.

2. K. Skotnicová, G. S. Burkhanov, Y. S. Koshkid'ko, D. Růžička, T. Čegan, J. Cwik, N. B. Kolchugina, A. A. Lukin, O. Životský, K. Hrabovská

Influence of heat treatment on the structural and magnetic characteristics of $(Nd_xPr_{1-x})_2Fe_{14}B$-based magnetic material for low-temperature application. Sintered Pr-Nd-Fe-B-based permanent magnets with 10 and 13 wt. % of Pr were prepared by traditional technology and then subjected to various heat treatments. Stoichiometric composition of the matrix grains corresponds to $(Pr_{0.3}Nd_{0.7})_2Fe_{14}B$ and $(Pr_{0.4}Nd_{0.6})_2Fe_{14}B$ compounds, respectively. Conducted thermomagnetic analysis to samples of these magnets showed the presence of spin-reorientation transition in temperature 95 and 75 K, respectively. This makes the magnet potentially applicable for low temperatures. For these compounds, we have determined the optimum heat-treatment conditions. The magnetic domain structure of the magnet subjected to an optimum heat treatment has been studied. The effect of different low-temperature heat treatments on the magnetic properties of magnets has been demonstrated.

3. S. Sawicki, H. Dyja, A. Kawałek, M. Knapiński, M. Kwapisz, K. Laber

High-temperature characteristics of 20MnB4 and 30MnB4 micro-addition cold upsetting steels and C45 and C70 high-carbon-steels. the paper analyzes the high-temperature plasticity characteristics of 20MnB4 and 30MnB4 with micro-additives, intended for cold upsetting and high-carbon steels C45 and C70 in the "solid phase-liquid" during heating and cooling. The investigation was conducted to determine the plastic formability of the examined alloy under hot plastic working conditions. Experiments were carried out on the simulator Gleeble 3800 with the aim of determining the susceptibility of 20MnB4, 30MnB4, C45 and C70 steels to cracking at high temperature. The nil strength (NST), nil ductility (NDT) and ductility recovery temperatures (DRT), and the fracture toughness factor and the BRT (brittleness temperature range) have been determined.

4. R. Kruzel, M. Suliga

The impact of the heat treatment parameters on patenting line on mechanical-technological properties of steel cord wires. In the paper the influence of modification of patenting process on steel cord properties has been assessed. It was found that the wires of pearlite structure, in comparison to the wires of pearlite-bainite structure, characterized much better properties which is confirmed by higher tensile strength by more than 12 %, higher by 1,6 % the number of twists and higher by 3,6 % the number of bends. It was found that weaving steel wire cord causes a decline in its exploitation properties, which should be associated with an additional deformation of the wire in the cords manufacturing and the size of the decline depends on the type of wire structure.

5. M. Suliga, R. Kruzel

The influence of lubricant carrier and lubrication conditions on mechanical-technological properties of high carbon steel wires. In this paper the effect of the type of soap powder and lubricant carriers on lubrication conditions in multipass drawing process of high carbon steel wires has been determined. The wire drawing process was conducted in industrial conditions by means of a modern multi-die Koch drawing machine. For wires drawn on borax and phosphate lubricant carriers the mechanical-technological properties have been carried out, in which yield stress, tensile strength, uniform elongation, number of twists and number of bends were assessed. It has been proved that the application of phosphate lubricant carrier and also the rotary die in the first draft in an essential way improve the lubrication condition in high speed multipass drawing process and makes it possible to refine the mechanical properties of wires.

6. K. Gawdzińska, L. Chybowski, J. A.Bejger, S. Krile

Determination of technological parameters of saturated composites based on SiC by means of a model liquid. The paper describes a method for determining technological parameters of the formation process of saturated composites based on SiC by applying the theory of dynamic similarity. Empirical relations have been presented in terms of hydraulic analysis of the saturated liquid flow (liquid metal) and determination of the saturated composite density depending on the technological parameters of its formation process: saturation time and pressure. Adopting the method for determining the density of silumin composites reinforced with silicon carbide by means of Wood's metal as a model liquid has been described. Microscope images of the composite structure have been shown after filling it with the model liquid. Remarks have been made on the application of the method.

7. M. Losertová, M. Štamborská, J. Lapin, V. Mareš

Comparison of deformation behavior of 316L stainless steel and Ti6Al4V alloy applied in traumatology. The comparative analysis of mechanical properties was performed for AISI 316L stainless steel and Ti6Al4V alloy using the digital image correlation (DIC) method. Both types of materials are commonly used for implants in traumatology. Tensile tests of the cylindrical tensile specimens were performed at room temperature and at an initial strain rate of 0,0025 s^{-1}. The strain analysis during tensile tests was carried out by means of Vic 2D image correlation software. Ti6Al4V alloy showed higher yield strength and tensile strength. The differences in the strain localization zones were observed.

8. A. Milinović, V. Marušić, I. Samardžić

Research INTO boride layers growth kinetics on C45 carbon steel. This study focuses on evaluation of borides formed on C45 steel. Pack boronizing is carried out at a temperature range of 870 – 970 °C in durations of 4 to 8 h. Values of frequency factor ($4{,}51 \cdot 10^{-4}$ $m^2 \cdot s^{-1}$) and activation energy (199,63 $kJ \cdot mol^{-1}$) are determined by means of Arrhenius equation. Analysis is also performed to assess the change in volume share of boride phase and the surface microhardness in the layer cross section. Results indicated that cross sectional changes of volume share of boride phase depends on boronizing temperature and duration. In addition, empirical expression showing functional relationship between them has been obtained.

9. V. Brozek, P. Pokorny, P. Bouska, J. Stoulil, L. Mastny

Corrosion properties of chromia based eco - friendly coatings on mild steel. Ceramic nanocrystalline coatings of chromium oxide (III) on steel S235JRH-1.0038 (EN 10025-1) were prepared using the liquid precursor plasma spraying (LPPS) method from ammonia dichromate (VI). Their structure and anti - corrosion properties were compared to the standard chromium oxide (III) coating prepared by thermal spraying. The newly prepared coatings had very high adhesion and minimal porosity. Anticorrosion properties were characterized by the means of the electrochemical impedance spectroscopy (EIS), measuring the charge transfer resistance R_{ct} and capacitance of electrical double layer CPE_{dl} in the 0,5 mol/l NaCl. Coatings of Cr_2O_3 prepared by the LPPS method showed unambiguously improved anti - corrosion properties.

10. M. Madej, D. Ozimina, R. Gałuszka, G. Gałuszka

Corrosion, friction and wear performance of diamond – like carbon (DLC) coatings. The a - C:H:W, TiN/a - C:H:W and the CrN/a - C:H:W coatings were deposited on steel surface by physical vapour deposition methods and studied for corrosion and tribological properties, after elemental and structural analysis. In friction pairs the elements coated with diamond-like carbon showed better tribological properties than the elements without coatings. The presence of interlayers in coatings contributed to an improvement in the tribological properties but decreased corrosion resistance.

11. V. Pepel, A. Žerovnik, R. Kunc, I. Prebil
Crack growth through low-cycle fatigue loading of material ARMOX 500T. This paper presents microstructure analysis of the creation and growth of cracks in uniaxial load. Analyse were done for steel Armox 500T (armour sheet). Results show that cracks are present quit early in steel lifetime. First micro cracks occur before the 200th cycles, whereby crack growth is progressive during further loading. Also it can be seen that after a certain number of cycles there are more longer cracks then shorter ones.

12. I. Bartenev, A. Issagulov, A. Baysanov, V. Roshchin, E. Makhambetov, G. Sirgetayeva, D. Issagulova
Studying microstructure and phase composition of a new complex calcium containing alloy. in the given article there are presented the results of studying the microstructure and phase structure of a complex alloy of alumosilicon with calcium. It is established that in the studied CAMS alloy active elements are present at a type of difficult intermetallid that positively influences quality of both ordinary, and qualitative brands of steel.

13. V. Marušić, I. Samardžić, I. Opačak, L. Marušić
Influence of induction hardening parameters on the GS30Mn5 weld properties. This study examines parameters of post-weld heat treatment on the test specimens made of cast steel GS30Mn5. The welding is performed with shielded metal arc welding (SMAW) process. The aim is to obtain the surface without illicit cracks, with hardness ranging from 320 up to 400 HB. After induction heating, the specimens are cooled alternately with air and water. Decreased speed of quenching results in avoiding the occurrence of illicit splashes, while the hardness is maintained within the prescribed limits.

14. J. Kulhánek, P. Tomčík, R. Trojan, M. Juránek, P. Klaus
Experimental modeling of weld thermal cycle of the heat affected zone (HAZ). Contribution deals with experimental modeling of quick thermal cycles of metal specimens. In the introduction of contribution will be presented measured graphs of thermal cycle of heat affected zone (HAZ) of weld. Next will be presented experimental simulation of measured thermal cycle on the standard specimens, useable for material testing. This approach makes possible to create material structures of heat affected zone of weld, big enough for standard material testing.

15. B. Kalandyk, R. Zapała, J. Kasińska, B. Radoń
Impact strength of GX8CrNi12, GX5CrNi18-9 and GX5CrNiMo19-11-2 cast steel at - 30 °C. The results of impact tests carried out at - 30 °C on cast alloyed GX8CrNi12, GX5CrNi18-9 and GX5CrNiMo19-11-2 steel grades are reported. It has been shown that at - 30 °C, the addition of 1 % Ni to cast GX8CrNi12 steel does not provide the required impact strength of 35 J/cm^2. In contrast, other tested materials containing 8 ÷ 9 % Ni can easily reach exceeding 50 J/cm^2. Numerous non-metallic inclusions present in the microstructure of cast GX5CrNiMo19-11-2 steel resulting from, among others, the miscalculated refining process were found to be one of the main causes of reduced impact strength as compared to the cast GX5CrNi18-9 steel.

16. J. Kasińska
Modification influence of mischmetal on fractography fracture of G17CrMo5-5 cast steel samples after the three-point bending test. The article presents the analysis of fracture surfaces after the three-point bending test at a temperature range from + 20 °C to - 80 °C. The author shows a beneficial effect of mischmetal on the cracking mechanism and on the character of fractures. It has been shown that the width of the ductile fracture zone under the bottom of the notch and the nature of the cracking mechanism change with decreasing test temperature.

17. M. Mihaliková, A. Lišková
dynamic characteristics of automotive steel sheets. The aim of this experimental research was to perform an analysis of deformation characteristics on two different types of steel: IF steel, and micro-alloyed steel were used automotive industry. For that purpose changes of properties of these materials were carried out by static $10^{-3} \cdot s^{-1}$ and dynamic $10^{3} \cdot s^{-1}$ strain rate assess its plastic properties. Vickers micro hardness test was carried out by the static and dynamic loading condition and describes different hardness distribution. The higher strain hardening of materials was obtained too that was confirmed by distribution of dislocations.

18. J. Drápala, S. Brožová, I. Szurman, K. Konečná, G. Kostiuková, J. Vontorová, P. Jonšta, K. Sobotková
Influence of selected rare earth metals on structural characteristics of 42CrMo4 steel. The influence of rare earth metals (REM) addition on solidification structure of the low-carbon 42CrMo4 steel was investigated. Alloys were prepared by means of a centrifugal casting. The addition of cerium, praseodymium or mischmetal in the steel produced greatly improved solidification structure with a suppressed columnar grain zone, finer grain size in the equiaxed grain zone. The additions occurred in the steel bath in the form of REM oxide and/or oxide-sulphide inclusions and as dissolved REM segregated along with other elements at prior grain boundaries and interdendritic spaces. Microstructure (light microscope), SEM/EDX chemical microanalysis, and TOF-SIMS analysis – mapping of elements in the structure of alloys were obtained.

19. I. Matin, M. Hadžistević, Đ. Vukelić, B. Trifković, M. Potran, T. Brajlih, I. Drstvenšek
Advanced procedure for fabrication of substructure in dentistry. The paper presents some aspects of the novel integrated system, procedure for fabrication of metal substructure of metal-ceramic crowns. The results been shown that the CAD/CAE/RP technology integration presented in this paper can be fully applied to casting metal substructures. The substructure fabricated in this way, confirm the reduction of the total manufacturing time, with an increase in the percentage of high quality castings that use integrated system.

20. T. Karkoszka
Factors influencing the requirements fulfilment in the zinc coating processes. The aim of the analysis was the assessment of the zinc coating process with application of the authorial methodology which allows in the highest degree to reflect the threats occurring in this process. Findings of the analysis are as follows: factors influencing the requirements fulfilment in the zinc coating process are not only the significance and the probability of occurrence of the incompatibilities and the possibility of process supervision, but also the influence of the technological parameters realization on ensuring the specific requirements and technical difficulty of parameters realization.

21. A. C. Murariu, S. Crâsteți, I. Samardzic
Detection of adherence imperfections at the inteface of substrate-coating layer by using infrared thermography. The paper presents Infrared Thermography (IRT) for non-destructive examination of the imperfections in the coatings layers deposited by Electric Arc Spraying (EASP), designed to assess the dimension and position of the lack of adhesion, as a typical imperfection placed at the interface between the coating layer and the base material. Metallographic analyses were used to confirm the absence or presence of imperfections, enabling establishment of the etalon for non-destructive examination and detection of adherence imperfections at the coating–substrate interface layer, together with optimum process parameters, obtained by experiments.

22. F. Tošenovský, D. Vykydal, P. Klaput, P. Halfarová
Stochastic optimization of laboratory test workflow at metallurgical testing centers. The objective of the paper is to present a way to shorten the time required to perform laboratory tests of materials in metallurgy. The paper finds a relation between the time to perform a test of materials and the number of technicians carrying out the test. The relation can be used to optimize the number of technicians. The approach is based on probability theory, as the amount of material to be tested is unknown in advance, and uses powerful modelling techniques involving the generalized estimating equations.

23. A. D. Mekhtiyev, Zh. D. Zholdubayeva, B. D. Issin, E. G. Ogoltsova, A. V. Yurchenko, D. K. Issin
Method of silicon filter refining from harmful impurities. In the article there are considered the types of filters used for silicon refinement, the possibilities of mechanical separation of inclusions when the melt is through the filter, the efficiency of silicon refinement from impurities. There are also considered the advantages of bulk granular filters which consist of the lumpy or granulated elements. There are described the methods of obtaining filtering elements, the functions executed by the filters depending on their type. There are presented the analysis results obtained in filter refinement of silicon which show the impact of different filters materials on the content of impurities.

24. V. Pečínková, Z. Lenčéš, Z. Jonšta

Gass presure sintered Si_3N_4 – $MgSiN_2$ composites. Si_3N_4 and $MgSiN_2$-based ceramic composites have excellent thermo-physical and mechanical properties, however with limited industrial applications. In this paper the preparation of $Si_3N_4/MgSiN_2$ composite by gas pressure sintering (GPS) is described and some of the mechanical properties like Vickers hardness and indentation fracture are characterised and compared with hot pressed (HP) samples. The 15,3 GPa hardness and 7,6 MPa·$m^{1/2}$ fracture toughness of GPS composites was slightly lower compared to HP samples (16,5 GPa, 8 MPa·$m^{1/2}$).

25. E. Tillová, L. Kuchariková, M. Chalupová, J. Belan, A. Vaško, I. Švecová

Influence of laser surface hardening on corrosion properties of Al-Zn-Si cast alloy. This work is focused on the effect of the laser surface treatment (laser power 50 and 80 W) on microstructure and corrosion properties of self-hardened AlZn10Si8Mg cast alloy used for engine and vehicle constructions. The electrochemical impedance spectroscopy (EIS) technique and Nyquist plots in a 1M NaCl test solution at 20 °C were carried out. A detailed corrosion study showed that corrosion resistance samples with laser layer were marginally less; probably the presence of chloride ions significantly damaged the Al_2O_3 film and caused the formation of $NaAlO_2$.

26. K. Milewski, J. Kudliński, M. Madej, D. Ozimina

The interaction between diamond like carbon (DLC) coatings and ionic liquids under boundary lubrication conditions. The aim of the study was to analyse antiwear DLC coatings produced by physical vapour deposition. The a-C:H coatings were deposited on steel elements designed to operate under friction conditions. The coating structure was studied by observing the surface topography with a scanning electron microscope (SEM) and a profilometer. The friction and wear properties of the coatings were examined using a ball-on-disc tribotester. The lubricants tested were two types of ionic liquids (1-butyl-3-methylimidazolium tetrafluoroborate and trihexyltetradecylphosphonium bis(trifluoromethy-lsulphonyl) amide). The experimental data was used to select ionic liquids with the best tribological properties to operate under lubricated friction conditions and interact with DLC coatings.

27. R. Bęczkowski

Effect of cladding parameters on the hardness of bimetal plates. Hardness is one of the components responsible for the resistance to wear. The development of new materials with hardness surface more than 65 HRC is possible with use welding technologies. High chromium cored wires belong to welding materials that are often used to cladding to protect surface. This article show the problem of determining the important parameters of cladding FCAW to obtain the most hard surface. The use of high chromium cast iron to cladding on to structural steel S235JR showed us how important is knowledge about influence the technological parameters by made this plate and how have a significant impact on the final characteristics surface. For experiment Plackett-Burman design is used.

28. F. Tehovnik, J. Burja, B. Arh, F. Vode

Precipitation of σ phase in superaustenitic stainless steel UHB 904L. Superaustenitic stainless steel UHB 904L with high Mo concentrations is widely used in applications that require high toughness and corrosion resistance. Given certain thermal histories, UHB 904L may be susceptible to the formation of potentially detrimental intermetallic phases, such as the σ (sigma) phase. The formation of the σ phase is promoted by high concentrations of Cr and Mo, while elements such as carbon, nickel and nitrogen retard its formation. Samples of UHB 904L were isothermally annealed within the temperature range between 850 – 1 000 °C, for 8 h each, followed by water quenching. Microstructural analyses using light and electron microscopy showed that the σ phase forms at temperatures up to 1 000 °C. The tensile specimens were solution treated at 1 000 °C, 1 060 °C, 1 100 °C and 1 140 °C for 0,5 h, followed by water quenching. The tensile tests were performed at room temperature.

29. R. Jasionowski, W. Polkowski, D. Zasada

Relationship between crystallographic texture and cavitation resistance of AS-CAST X8CrNi25-21 and X6CrAl13 steels. In this paper, results of the cavitation resistance evaluation of as-cast X8CrNi25-21 austenitic steel and X6CrAl13 ferritic steel having a various grain orientations, are shown. It was found that the austenitic steel with a preferred < 110 >// ND orientation (where ND is a normal direction to the surface that was exposed to the cavitation process) exhibits a superior cavitation resistance over other examinated materials.

30. M. Torres-López, L. Guerra-Fuentes, L.Y. Gomez-Zamorano, M.A.L. Hernandez-Rodriguez, E. Garcia-Sanchez

Thermal and phase transformations analysis in a PREMOMET® steel. Thermal analysis in a PREMOMET® steel has been performed by differential scanning calorimetry (DSC) and high-resolution dilatometry. The phase transformation temperatures (Ac_1, Ac_3, M_s and M_f) of this steel were obtained by the two methods at different heating rates showing good agreement between both techniques. The enthalpy of α-γ transformation for this steel was measured using the thermograms acquired by DSC and microstructure was analyzed by scanning electron microscope (SEM). The results showed that this steel retained a martensitic structure for all conditions.

31. J. Jaworski, T. Trzepieciński

Properties of low-alloy high-speed steel at elevated temperature. This paper presents the results of research on the determination of the coefficient of thermal conductivity and hot hardness of cutters made of selected grades of low-alloy high-speed steels, HS6-5-2 and HS3-1-2. The investigations of hot hardness and yield stress values of HS6-5-2 steel at elevated temperatures have shown that the hot hardness value decreased to 650 – 700 HV (59 – 60 HRC) in the temperature range of 500 – 550 °C. However, the hardness of the samples preheated to the temperature of 500 – 550 °C and measured at room temperature does not change. A decrease of the hot hardness of the steel is correlated with decreasing yield stress at elevated temperature.

32. V. Brozek, M. Vokac, J. Kolisko, P. Pokorny, T. F. Kubatik

Incorporation of tungsten metal fibers in a metal and ceramic matrix. Tungsten fibers have high tensile strength but a poor oxidation resistance at elevated temperatures. Using this first characteristic and to prevent oxidation of tungsten coated composite materials in which the primary requirement: reinforcement against destruction or deformation, was studied on tungsten fibers and tungsten wires which were coated by applying the metal and ceramic powders via plasma spraying device in plasma generator WSP®. Deposition took place in an atmosphere of Ar + 7 % H_2, sufficient to reduce the oxidized trace amounts of tungsten.

33. J. Borowiecka-Jamrozek, J. Lachowski

The effect of the properties of the metal matrix on the retention of a diamond particle. This paper deals with the modelling of the mechanical properties of materials used as the matrix in diamond tools. Saw blade segments were fabricated by combining various metal powders with diamond crystals and then hot pressing them. After consolidation, the specimens were tested to analyse their density, hardness and tensile strength. The stress/strain fields around a diamond particle embedded in the metal matrix were determined by computer simulation. The effective use of diamond tools is strongly dependent on the mechanical properties of the matrix, which has to hold the diamond grits firmly. The retention capacity results from the interactions between the diamond crystals and the matrix during the segment fabrication process. The stress and strain fields generated in the matrix were calculated using the Abaqus software.

34. M. Sedlaček, B. Podgornik, D. Česnik

Influence of heat treatment and K_{Ic}/HRc ratio on the dynamic wear properties of coated high speed steel. The aim of this work was to determine the impact of various heat treatments on the K_{Ic}/HRc ratio and subsequently on the wear properties of coated high-speed steel under dynamic impact loading. The results showed that hardness and improvement in the fracture toughness have significant influence on the adhesion and impact wear properties of the coated high-speed steel.

35. M. Vaško, M. Blatnický, P. Kopas, M. Sága

Research of weld joint fatigue life of the AlMgSi07.F25 aluminium alloy under bending-torsion cyclic loading. The contribution deals with a research into the fatigue life of weld joints of AlMgSi07.F25 aluminium alloy. The paper will present unique biaxial testing equipment, process of preparation of specimen rods for fatigue tests, and the results of fatigue life assessment for the aluminium alloy during cyclic bending-torsion loading. Fatigue

tests under constant amplitude loading were performed on a special electromechanical machine with a suitable clamping system. The obtained fatigue curves were compared with the most widely-known fatigue criteria such as LIU, F-S and B-M.

36. P. Kopas, M. Blatnický, M. Sága, M. Vaško
Identification of mechanical properties of weld joints of AlMgSi07.F25 aluminium alloy. The aim of this paper is to present the analysis of selected mechanical properties of weld joints of AlMgSi07.F25 aluminium alloy. We will focus on the influence of the test bar neck shape on the tensile strength characteristics and the course of hardness in the weld joint cross-section. For the welding process using TIG (Tungsten Inert Gas) technology we considered AlSi5 as the additive material. This paper also includes a short study of numerical modelling of the test bar welding.

37. T. Dembiczak, M. Knapinski, B. Garbarz
Mathematical modeling of phenomena of dynamic recrystallization during hot plastic deformation in high-carbon bainitic steel. Based on the research results, coefficients were determined in constitutive equations, describing the kinetics of dynamic recrystallization in high-carbon bainitic steel during hot deformation. The developed mathematical model takes into account the dependence of changing kinetics in the size evolution of the initial austenite grains, the value of strain, strain rate, temperature and time. Physical simulations were carried out on rectangular specimens measuring 10 × 15 × 20 mm. Compression tests with a plane state of deformation were carried out using a Gleeble 3800.

38. R. Ulewicz, F. Novy
Fatigue life of high strength steel for cold forming. The article presents the results of fatigue tests carried out on STRENX-type high-strength cold forming steel. For high-cycle fatigue tests carried out using low cycle loading frequencies of around 30 Hz, a ROTOFLEX machine was used. For ultra high-cycle tests, a KAUP-ZU testing machine was employed, which enables fatigue tests to be performed with symetric specimen loading (R = -1) and at a frequency of f ≈ 20 kHz. The relationships $\sigma_a = f(N)$ were determined experimentally in the high and ultra high-cycle region for STRENX high-strength steel. To determine the fatigue crack initiation mechanism, the fractographic analysis of fatigue fractures was made.

39. A. Mashekova, A. Turdaliev, A. Kawalek, S. Mashekov, U. Murzakhmetova, L. Kurmangaliyeva, N. Smagulova
Ultrafinegrained structure of D16 aluminium alloy after rolling in the corrugated rolls and on the longitudinal-wedge mill. The article explains the influence of number of passes on the parameters of the microstructure of D16 aluminium alloy during rolling in the corrugated rolls, and the impact of the drafts while rolling of the strips on the longitudinal wedge mill. A comparative evaluation of the grain size of the ultrafine grained structure was conducted after rolling strips in the corrugated rolls by various passes, and after rolling on the longitudinal wedge mill at deformation temperature of 320 °C. It is shown that the sheet material of D16 aluminium alloy ensures uniform formation of an ultrafine grain structure with the size of about 220 - 240 *nm*, which leads to increased strength properties of the alloy and preserve good ductility.

40. S. Savićević, H. Avdušinović, A. Gigović-Gekić, Z. Jurković, M. Vukčević, M. Janjić
Influece of the austempering temperature on the tensile strength of the austempered ductile iron (ADI) samples. Austempered Ductile Iron (ADI) is a class of ductile iron subjected to a two-step heat treatment process – austenitization and austempering. The heat treatment gives to ADI a high value of tensile strength and an especially good strength-to-weight ratio. However, designers in most cases are unfamiliar with this material that can compete favorably with steel and aluminum castings, weldments and forgings. The high tensile strength of ADI is the result of its unique ausferrite microstructure. In this paper, an investigation of the influence of the austempering temperature on the tensile strength of the ADI samples is presented.

41. J. Belan, L. Kuchariková, E. Tillová, A. Vaško
The influence of applied heat-treatment on in 718 fatigue life at three point flexural bending. The Inconel alloy 718 is an iron-nickel based super-alloy with a working temperature up to 650 °C. Presented phases such as γ″ (Ni_3Nb), γ′ (Ni_3Al), and δ (delta – Ni_3Nb) are responsible for the alloy′s unique properties. The δ – delta phase is profitable when situated at grain boundaries in small quantities due to increasing fatigue life. However, at temperatures close to 650 °C the γ″ transforms to δ – delta and causes a decrease in fatigue life. Heat-treatment (800 °C/ for 72 hours) and its influence on fatigue life are discussed in this paper. Fatigue tests were carried out at room temperature. After the tests we plotted the S-N curves for both stages. SEM (Scanning Electron Microscopy) fractography was carried out as well.

42. M. Basiaga, W. Walke, D. Nakonieczny, A Hyla
Physiochemical properties of TiO_2 nanoparticle thin films deposited on stainless steel. The purpose of this study was to evaluate the usefulness of TiO_2 layer to improve hemocompatibility of 316LVM stainless steel. The TiO_2 layers studied in this work were deposited from $TiCl_4$ and H_2O in a low-pressure Atomic Layer Deposition (ALD) reactor taking into account number of cycles and process temperature. As a part of the research electrochemical studies of the layer after 28 days exposure to artificial plasma were carried out. In particular, potentiostatic, potentiodynamic and impedance studies were conducted. The obtained results were the basis for selection of surface treatment method dedicated to blood-contacting stainless steel implants.

43. M. I. Neacșu, E. R. Chiriac, A. Chiriac, O. Pandia, I. Saracin
Technological parameters optimization of the AlZn5Mg3Cu alloy thermomechanical treatment process. The paper presents the results of experimental research with a view to optimizing the thermo mechanical treatment process that has been applied to AlZn5Mg3Cu alloy used in the aviation industry. The research led to the conclusion that, for the alloy studied, the highest mechanical strength values were obtained for an artificial aging time of 16 hours at a temperature of 120 °C, while the lowest resistance values were obtained for an artificial aging time of 8 hours at 160 °C.

44. G. Gałuszka, M. Madej, D. Ozimina, J. Kasińska, R. Gałuszka
The characterisation of pure titanium for biomedical applications. The paper presents results of research on the use of pure titanium medical implants, dental and orthopedics - as pins hip replacements. The properties of metal biomaterials, including their hardness, determine the usefulness of the material and are one of the criteria for its use. They depend on their chemical composition and structure. Studies included the observation of the microstructure and mechanical properties of pure titanium. The observations surface were carried out using a scanning electron microscope SEM. The optical profiler was used to depict the geometric structure of the surface, and to carry out the nanoindentation tests a nano hardness tester was used.

45. R. Gałuszka, M. Madej, D. Ozimina, A. Krzyszkowski, G. Gałuszka
The characterisation of the microstructure and mechanical properties of diamond - like carbon (DLC) for endoprosthesis. The paper presents the results of research of DLC coating of a - C:H type obtained by using a technique of physical vapor deposition (PVD) on the surface of CoCrMo alloy, commonly used for the elements of the endoprosthesis. The surface has been observed using a scanning electron microscope (SEM). Analysis of the chemical composition and distribution of the different elements were performed using glow discharge optical emission spectrometry analysis (GDOES). It has been shown that the DLC elements are characterized by high hardness and good adhesion to the substrate.

46. A. B. Naizabekov, S. N. Lezhnev, H. Dyja, T. Bajor, K.Tsay, A. Arbuz, N. Gusseynov, R. Nemkaeva
The effect of cross rolling on the microstructure of ferrous and non-ferrous metals and alloys. The cross rolling is the one of most perspective method of refinement microstructure metals by severe plastic deformation method. This method gives ability to get the long length billets. However, deformation and trajectories of the metal is very heterogeneous across the section of the rolled piece. This paper presents the finite element method (FEM) simulation of hot cross rolling and experimental study of the effect of the cross rolling on a different three-roll mills on the microstructure of ordinary structural alloy steel, stainless steel and technical copper in different zones of the bar. Analysis showed significant structure refinement in all cases. The best result was achieved on the stainless steel, and shown the formation of equal-axis ultra-fine-grain structure on the bar periphery.

47. M. Sapieta, A. Sapietova, V. Dekys
Comparison of the thermoelastic phenomenon expressions in stainless steels during cyclic loading. The main purpose of this paper is to compare the thermoelastic stress in specimens of stainless steel. As material specimens we chose stainless steel of AISI 304, AISI 316Ti and AISI 316L types. The specimens were cyclically loaded with three-point bending. The whole process was recorded using an infrared camera. The thermal differences that

occurred during the test were evaluated based on the thermoelastic stress equations. Subsequently, stress distributions in the specimens were compared for different types of stainless steel.

48. I. Samardžić, M. Dunđer, M. Katinić, N. Krnić
Weldability investigation on real welded plates of fine-grained high-strength steel S960QL. The paper presents results of impact energy effects on real welded specimens of fine-grained high-strength S960QL steel, and elaborates the dependence of real welded specimen hardness on heat input. Results are obtained through measuring of hardness HV 10 and by experimental Charpy V-notch test. V-notch on test tubes was moved for 0,5 mm from the fusion line in the heat affected zone.

49. M. I. Neacșu, R. E. Chiriac, A. Chiriac, O. Pandia, I. Saracin
Experimental research on the influence of soaking aging type on some mechanical properties of the alloy AlZn5,7MgCu . The paper presents results of experimental laboratory-scale research on the influence of the AlZn5,7MgCu alloy thermal processing mode. Two types of aging heat treatment were studied, namely: a natural aging and an artificial aging treatment. For each of the two types of technological heat treatment, the change of the mechanical properties was monitored according to the parameters of the aging procedure. The experimental research of this paper highlights the advantage of artificial aging as compared to natural aging, but this advantage must also be seen in terms of the costs implied by the two types of treatment.

50. A. Śliwa, M. Bonek
Application of finite element method (FEM) for definition of the relationship between properties of laser alloyed steel surface layer. Investigations include FEM simulation model of alloying the PMHSS6-5-3 steel surface layer with the carbides and ceramic powders, especially WC, VC, TiC, SiC, Si_3N_4 and Al_2O_3 particles using the high power diode laser (HPDL). The FEM computations were performed using ANSYS software. The scope of FEM simulation was determination of temperature distribution during laser alloying process at various process configurations regarding laser beam power and method of powder deposition, as pre coated past or surface with machined grooves. The FEM simulation allows specifying the heat affected zone and the temperature distribution in the sample as a function of time and thus allows the estimation of the structural changes taking place during laser alloying process.

51. K. Kostúr
Process check of annealing process of coiled sheets by indirect measurement. The contribution deals with a possibility of increasing quality production and decreasing costs in annealing furnaces by process check of annealing temperatures. The lowest temperature of annealed coiled sheets is very important. The information about this inner temperature is unknown during annealing. It is possible to obtain this information by indirect measurement. The indirect measurement uses two types of mathematical models. In this paper, the structure of both models and its verification is described.

52. A. W. Orłowicz, M. Tupaj, M. Mróz, G. Wnuk, T. Kij, L. Kozak
Abrasive wear resistance of a quenched and sub-zero treated high-chromium white cast iron. The study reported in this paper concerned development of such microstructure of high-chromium (24 % Cr) cast iron which could secure high abrasive wear resistance of die inserts used to fabricate stampings from refractory materials. It was found that by increasing the cast iron cooling rate as a result of thermal interaction with the chill, it is possible to obtain fine carbide precipitates with diversified morphology, rich in Cr and Fe, containing Mo and Si. The matrix in the regions of thermal interaction with the chill was enriched in Cr and Mo, but depleted of Fe and Si. The sub-zero treatment process was developed to secure presence of hardening products in the matrix. The obtained structure of high-chromium cast iron has made the inserts more resistant to abrasive wear compared to tool steels after hear treatment used earlier.

53. S. Malej, J. Medved, B. Š. Batič, F. Tehovnik, M. Godec
Microstructural Evolution Of Inconel 625 During Thermal Aging. Inconel 625 is due to alloying elements prone to precipitation of different intermetallic phases and secondary carbides during thermal aging. The base of investigation is nickel superalloy Inconel 625 in hot rolled state. Thermal aging was conducted at temperature 650 °C with different duration of treatment for each sample. Microstructural analysis was performed by light microscope and scanning electron microscope. The results of microstructure observation showed the precipitation of intermetallic γ››- Ni_3Nb phase in the γ matrix and δ-Ni_3Nb phase with $M_{23}C_6$ secondary carbides at the grain boundaries.

54. B. Žužek, F. Kafexhiu, B. Podgornik, F. Vodopivec
Effect Of Carbides Size And Distribution On Creep Rate. One of the most influential microstructure constituents in creep resistant steels are carbide particles. Carbide particles act as obstacles to dislocations movement, therefore the creep rate strongly depends on their size and distribution. At elevated temperatures to which creep resistant steels are exposed, carbide morphology is altered by the coarsening mechanism, consequently deteriorating the creep resistance of these steels. The aim of this work is to study the role of size and distribution of carbide particles on creep rate. Different distributions and size of carbides were obtained by different heat treatment conditions. The effect of different carbide morphology on the creep resistance was evaluated by uniaxial constant load creep tests.

55. C. Zitelli, S. Mengaroni, A. Di Schino
Vanadium Micro-Alloyed High Strength Steels For Forgings. To fulfill the industrial demand of forged steels with high tensile properties and microstructural requirements coupled with reduced cost, the possibility to increase the properties of C-Mn steels by means of precipitation strengthening as achieved by micro-alloying (and without the addition of expensive elements such as Mo and Cr) has been evaluated. In order to do that, the effect of V addition has been exploited by means of metallurgical modelling followed by a laboratory ingot manufacturing. Heat treatment has been designed aimed to achieve the desired target tensile properties. Results show that ASTM A694 F70 grade requirements can bel fulfilled by 0,15% V addition and a proper heat treatment in a ferrite-pearlite microstructure, representative of a forged component.

56. P. Snopiński, T. Tański, M. Sroka, M. Kremzer
The effect of heat treatment conditions on the structure evolution and mechanical properties of two binary Al-Mg aluminium alloys. The presented investigation results were carried out on two binary aluminium-magnesium alloys. The article focuses on the influence of heat treatment conditions on the precipitation response of AlMg3 and AlMg5 aluminium alloy, microstructure evolution and strength of the alloys. The microstructure variation was analysed using a scanning electron microscope and an optical microscope in order to characterise the microstructure in a heat treated condition. Tensile tests and hardness measurements were carried out to investigate the effect of heat treatment on the mechanical properties.

57. M. Sroka, A. Zieliński, A. Hernas, Z. Kania, R. Rozmus, T. Tański, A. Śliwa
The effect of long-term impact of elevated temperature on changes in the microstructure of inconel 740H alloy. This paper presents the results of investigations on microstructure changes after the long-term impact of temperature. The microstructure investigations were carried out by light microscopy and scanning electron microscopy. The qualitative and quantitative identification of the existing precipitates was carried out using X-ray phase composition analysis. The effect of elevated temperature on precipitation processes of test material were described. The obtained results of investigations form part of the material characteristics of new-generation alloys, which can be indirectly associated with the stability of functional properties under the simultaneous effect of high temperature and stress.

58. G. Napoli, S. Mengaroni, M. Rallini, L. Torre, A. Di Schino
Interrupted quenching in high carbon steels for forgings. The present study is focused on analyzing the effect of the interrupted quenching followed by a partitioning process in a high carbon steel 0,50 % C, 1,50 % Mn, 0,40 % Si, 2,00 % Cr without significant contribution of Al. Thermal treatments were performed at laboratory scale in a quenching dilatometer Linseis R.I.T.A RL78. The fractions of retained austenite were evaluated by scanning electron microscope. The temperature for the interrupted quenching phase was evaluated based on the Koistenen and Marburger equation (adapted to the 0,50 % C steel) and the result highlights a correlation between the chosen different temperature of quenching and the fraction of retained austenite formed during the quenching step of the process.

59. P. Skubisz

Controlled austempering of hammer forgings aimed at pseudo normalized microstructure directly after deformation. The study concerns cost-effective realization of controlled thermomechanical processing (CTMP) of medium-carbon and HSLA steel aimed at producing microstructure and properties equivalent to normalized condition directly after forging. The results of theoretical and physical modeling of hot forging with subsequent heat treating adopted for industrial realization in continuous manner were verified in semi-industrial conditions of a forge plant.

60. P. E. Di Nunzio, A. Di Schino

Contact fatigue phenomena in back-up rolls of alloyed steels. The improvement of back-up rolls properties in terms of wear resistance is driven by the need of longer and longer rolling sessions aimed to increase productivity and reduce costs. Chemical composition effect on contact fatigue phenomena, bringing to the occurrence of macroscopic damages named spalling, have been studied and tested in laboratory. Moreover, the removal by grinding operations of damaged portion of rolls surface should be not sufficient to restore the initial performances of material. Experimental tests showed that a portion of material below the damaged one keeps memory of the last fatigue cycle, and has to be removed.

61. A. Di Schino

Analysis of phase transformation in high strength low alloyed steels. The effect of low-alloy additions on phase transformation of high strength low alloyed steels is reported. Various as-quenched materials with microstructures consisting of low carbon (granular) bainitic, mixed bainitic/martensitic and fully martensitic microstructures were reproduced in laboratory. Results show that for a given cooling rate, an increase of austenite grain size (AGS) and of Mo and Cr contents decreases the transformation temperatures and promotes martensite formation.

62. F. Kafexhiu, F. Vodopivec, B. Podgornik

Analysis of primary creep in simulated heat affected zone (HAZ) of two 9 - 12 % Cr steel grades. The primary creep of the parent metal (α), intercritical (α+γ), and coarse-grained (γ) microstructures of simulated weld heat-affected zone (HAZ) for the steels X20CrMoV121 and X10CrMoVNb91, aged for 4 320 hours (6 months) at 750 °C and 17 520 hours (2 years) at 650 °C was analyzed. The time and creep strain at the transition point from primary to secondary creep were found to vary strongly between the parent metal and two simulated HAZ microstructures, especially after ageing at 750 °C.

63. T. Šolić, D. Marić, Ž. Jagodić, I. Samardžić

Testing of the shopprimer's influence on the quality of welded joint. This paper presents the process of preparing the surface of construction material and applying the temporary protection that refers to the two-component epoxy workshop primer (shopprimer) in order to perform testing of its influence on mechanical properties of the weld. Testing of mechanical properties of welds after welding proved that there were no negative influences of the protective coating on the quality of welded joint.

64. T. Milek

The effect of upsetting ratio on mechanical properties for hydromechanically bulged axisymmetric components made from copper tubes. The paper presents experimental results of investigations of hydromechanical bulge forming of copper axisymmetric components whose relative wall thickness was $s_0/D = 0{,}045$. The deformation ratio of material in the paper was defined as relative upsetting ratio Dl/l_0 (where Dl – the punch displacement, l_0 – initial length of tube). The investigations produced a liquid pressure and a force profile in hydromechanical bulge forming of copper axisymmetric components with different relative ratios $Dl/l_0 = 0{,}054 \div 0{,}109$. The research aimed to determine the impact of upsetting ratio on mechanical properties for hydromechanically bulged axisymmetric components. The tensile strength R_m increased and the percentage reduction of area Z decreased as the upsetting ratio Dl/l_0 increased.

65. W. Depczyński, L. Nowakowski, P. Hepner, E. Miko

The influence of porosity on machinability of sintered Fe foam elements. The aim of the experiment was to study the machinability of porous metal foams formed by reduction of metal oxides during sintering. The analysis focused on the machining process of metal foams with respect to their porosity and mechanical properties. The factors investigated included the geometry of the specimens, the surface condition depending on the machining parameters (milling) and the porosity of the metal foam. The metallic porous structure was obtained as a result of sintering the mixture of iron based powders ASC 100.29 and DISTALOY SE (DIST SE) with porosity from 67,9 % (SE 1) to 77,8 % (SE 2) for ASC base powder and 75,7 % to 80.3 % for DISTALOY SE were used.

66. A. Z. Issagulov, Sv. S. Kvon, V. Yu. Kulikov, T. Kovalyova

Studying intermetallic phase of Ni-Cr superalloy after thermal processing. The superalloys on basis of Ni-Cr is meant for manufacturing rotor blades, disks and fastening details, which are used under 850 ^{0}C. These alloys additionally doped with Mo, Mo, W, Al and etc. for giving them a high-temperature properties. The main strengthening phase in these alloys is intermetallic phase, its nature, distribution pattern and dispersity [1].

67. Sv. Kvon, A. Issagulov, V. Kulikov, I. Medvedeva, S. Arinova

Studying heat treatment impact on heat resisting properties of Cr-Ni – A. E. system alloy. The article presents the results the impact of heat treatment on iron-nickel alloys with adding Mo, Nb, Ti and Al, at this the content of chrome was increased in comparison with the classical structure to 40 - 45 %.

68. K. Gryc, M. Strouhalová, B. Smetana, M. Kawuloková, S. Zlá, L. Socha, K. Michalek, M. Tkadlečková, A. Kalup, P. Jonsta, M. Sušovský

Determination of solidus and liquidus temperatures for bearing steel by thermal analysis methods. The first part of presented paper is devoted to comparison of solidus and liquidus temperatures determined by two methods of thermal analysis for one real steel grade 100CrMo7. Two modern devices for high-temperature analysis were used. The direct thermal analysis method was used during an experiments realised on large samples (22 g) at NETZSCH JUPITER device. Small bearing steel samples (up to 210 mg) were studied by differential thermal analysis method at Setaram SETSYS 18_{TM}.The robustness of both used thermo-analytical methods was documented. Measured results were compared with liquidus and solidus temperatures used in industry and calculated by specialized IDS and ThermoCalc software. Measured temperatures differ from the theoretically calculated by tens for liquidus to more than 100 °C for solidus.

69. M. Spilka, A. Kania, R. Nowosielski, A. Maciej

Fabrication and selected properties of multilayer Fe/Cu systems. The paper presents investigation results of the structure and selected physical properties of multilayer systems obtained by the electrolysis method. The obtained samples compose of 20 alternate layers of Fe/Cu with the following single layer thicknesses: 50 nm and 100 nm. The multilayer Fe/Cu systems for electromagnetic field shielding are characterized by relatively good quality. On the basis of topographical tests, no major defects have been found. As a result of magnetic studies, it has been found that the samples are magnetically soft materials.

70. P. V. Kovalev, S. D. Popova, A. Z. Issagulov, V. Yu. Kulikov, Sv. S. Kvon

Investigation of the effect of high strength strips steel modification with rare-earth metal (REM). The present work describes the study on influence of modifying steel with rare-earth metals on metallurgical quality of ingots and finished steel. To achieve the assigned task, the laboratory melting of 08G2NMDFBT (X100) pipe steel was carried as in open (UIP 100 – 2,4), so in vacuum induction furnace (ISV-0,01 - PI) with use of conditioning agents, which contain rare-earth metals. Next materials were used as conditioning agents: mischmetal (MM), which contain total amount of rare-earth metal (REM) up to 93 %, AlPCIr and RENTN which contain total amount of from 31 to 32,6 %.

71. A. Z. Issagulov, Sv. S. Kvon, V. Yu. Kulikov, D. R. Aubakirov, D. A. Issagulova

Deoxidation impact on the impurity index of heat resistant steel 40H15N7G7F2MS. Analyzing failure causes of the parts made of heat resistant steel shows that one of the defining factors impacting the properties is concentration of harmful impurities both dissolved in steel and being in the form of nonmetallic inclusions. The latter, in turn, is considerably defined by the process of steel deoxidation.

72. V. Yu. Kulikov, A. Z. Issagulov, Sv. S. Kvon, Ye. A. Sidorina
Studying the effect of boron on heat-resistance properties of Ni-Cr alloys. Heat-resistant alloys based on Ni-Cr system are widely used as alloys for the manufacture of rings, fasteners, turbine disks and other parts operating at temperatures up to 750 °C. To improve the properties of these alloys, these are additionally doped by Al, Ti, Mo and other elements.

73. A.W. Orłowicz, M. Mróz, M. Tupaj, B. Kupiec, L. Kozak, T. Kij
Application of ceramic coating to improve abrasive wear resistance of die inserts used to press-mould stampings of refractories. The paper presents results of a study on abrasive wear resistance of die inserts for composite moulds used to press-mould stampings from refractory materials, determined based on susceptibility to scratching with a diamond indenter. For the study, two inserts of high-chromium cast iron were prepared, of which one was provided with a ceramic coating (60 % Al_2O_3 + 40 % TiO_2) with a metallic interlayer (NiAlCrSi). Both layers were deposited by means of the Atmospheric Plasma Spraying (APS) method. The obtained scratch test results indicate that with the use of the same load force (20 N), die inserts with ceramic coating are characterized with less indenter penetration depth which should translate to higher resistance to abrasive wear.

74. J. Mikuła, W. Grzegorzek, K. Gołombek, D. Łukowiec, M. Sroka
Functional properties of coated by chemical vapour deposition sintered tool materials investigated with use of tribological tests. The purpose of the work is to present the results of investigations into the structure and properties of sintered carbides with deposited wear resistant coatings after a tribological test carried out with the method of combined examination of abrasion wear resistance and edge fracture resistance.

75. Z. Y. Xu, J. H. Liu, Z. J. He, Q. H. Pang
Study on clogging mechanism of submerged entry nozzle of steel 38CrMoAl. By phase analysis of the clog of nozzle and type analysis of inclusion in 38CrMoAl steel, the effects of calcium treatment on nozzle scabbiness were analyzed and the mechanisms of clogging were discussed. The results indicated that the clogs of nozzle consist of Al_2O_3, $MgO{\cdot}Al_2O_3$, CaS and calcium aluminate mixture, Because the inclusion in molten steel with high melting point aggregating in nozzle inner wall. Clogging has been caused by high sulfur content of steel liquid, irrelevant refining slag system and excessive calcium treatment. The nozzle clogging was analyzed and some measures were put forward.

76. T. Pornpibunsompop, P. Thanakijkasem
High temperature and stress corrosion cracking of 310S austenitic stainless steel in wet chloride corrosive environment. High temperature corrosion and stress corrosion cracking of 310S austenitic stainless steel in wet chloride environment at a high temperature was investigated. The result showed that high temperature corrosion products mostly consisted of ferrous oxides and chromium oxides. Chloride ions attacked a chromium passive film and strongly reacted with iron and chromium. As a result of metal chlorides being volatized, tunnel of pores inside corrosion layer existed. Intergranular stress corrosion cracking was observed. The oxide originated on surface could act as a crack initiator and a crack propagation would progress along grain boundaries and particularly along tunnel of pores.

77. A. Tomaszewska, B. Oleksiak
Microstructural characteristics of new type γ-γ` Co-9Al-9W cobalt-based superalloys in as-cast state. The paper presented deals primary with the structure characteristics of a new type of cobalt-based superalloys Co-9Al-9W type, casted via induction melting process with partially dosing of Common problems described in literature are focused on difficulties in obtaining uniform distribution of tungsten, particularly in interdendritic areas. That was the reason for the modified casting process to be applied. The method of tungsten dosing into liquid melts of Co and Al allows to obtain microstructure characterized by considerably decreased microsegregation. The material obtained was analyzed by standard methods such as light and scanning microscopy with analysis of chemical composition in micro-areas. Additionally, the detailed analysis of the sub-grain level was made by S/TEM on thin foils collected from equiaxed grains zone of the ingot.

78. J. Svetlík, J. Buša, T. Brestovič, M. Pituk, A. Pešková, P. Dudová
Research into oil film coating of a steel pipe interior by oil mist blowing. Corrosion protection is one of the most frequently addressed issues in metallurgic and engineering applications. Oil film coating of inaccessible areas such as interior of a steel pipe is technically complicated. Because of that, the choice of the interior pipe film coating via oil mist is a viable solution. However, it is necessary to establish what will be the composition of the oil layer and what distance the required oil thickness will span. These are the aspects dealt with in the present paper.

79. J. Cumin, I. Samardžić, M. Dunđer
Mechanical clinching process stress and strain in the clinching of EN-AW5754 ($AlMg_3$), and EN AW-5019 ($AlMg_5$) metal plates. This paper presents the results of Finite Element Method numerical simulation performed onEN-AW5754($AlMg_3$), EN AW-5019 ($AlMg_5$) plates subjected to mechanical clinching. The goal was to observe differences between aluminum plates in the same tool; and to determine the possibility of using the constructed tool for the clinching of Al-Al material combinations. This tool construction is to be produced and tested in laboratory conditions, to elaborate prospective results, and reach additional conclusions.

80. A. Z. Issagulov, I. Yu. Zykov, A. G. Melnikov, O. V. Lobankova, I. S. Makogon, S. A. Bojok, S. K. Arinova
Investigation the impact of a laser on the Chernov-Luders lines in the 40X9C2 steel. The study presents investigation results of the hardening points impact, created on the model surface by means of a laser complex. The authors investigated the change in the steel microhardness in the area which is treated with laser processing and presented the model of stress-strain diagram. The article reveals a change in the yield point and the plasticity of the models as a result. The authors made a number of speckle photos showing the Chernov-Luders lines behavior.

81. M. K. Ibatov, A. Z. Issagulov, Sv. S. Kvon, V. Yu. Kulikov, S. K. Arinova
Boron microadditives effect on heat resisting properties of Cr-Ni-Fe based alloy. The introducing of boron in very small amounts (0,001 – 0,02 %) improves considerably wear resistance and hardness, raises hardenability and thermal stability, it promotes grain crushing [1-3]. A preliminary analysis of the natural phases identified certain phases such as $(Nb, Mo)_2B$. It is also possible to assume the formation of boron-containing iron-based eutectics and complex carbon-boride phases based on chromium.

82. D. Romanov, V. Kormyshev, V. Gromov
Regularities in the formation of the structure and properties of electric explosive coatings of metals and alloys. By the methods of modern materials science and analysis of physical models, regularities and the nature of the formation of wear and electroerosion resistant coatings in the case of electro-explosive coating and subsequent electron beam treatment are revealed. Methods for the electric-explosive deposited of wear and electroerosion-resistant coatings of various systems for copper, aluminum and low-carbon steel with subsequent electron-beam treatment were developed. The developed methods of electro-explosive coating of wear and electroerosion resistant coatings using electron-beam processing, protected by patents for inventions, are applied for machining parts used in the engineering, electrical and mining industries. The reported study was funded by RFBR, according to the research project No. 16-32-60032 mol_a_dk and Grant of the President of the Russian Federation MK-1118.2017.2.

83. A. Al-Shahrani, H. Aljabr
Influence of processing parameters on recrystallization behavior for API-X70 steel. Softening mechanisms including dynamic recrystallization on thermo-mechanical processing of API have crucial effect on resultant microstructure, and consequently the mechanical properties. The influence of deformation temperature and strain rate on dynamic recrystallization (DRX) behavior and mechanical properties of API-X70 were studied using Thermo-mechanical simulator (Gleeble). DRX parameters including critical and peak strains for the deformation temperatures of 950 C, 1025 C and 1100 C with strain rate of 0,1 and 5 s^{-1} were determined. Peak stresses and strains relationship with the Zener–Hollomon parameter was determined. Moreover, the volume fraction of dynamically recrystallized fraction was computed and the DRX map for the selected steel was developed. The DRX was found to be starting earlier with higher strain rate and lowering deformation temperatures.

84. A. Nagode, K. Jerina, M. Bizjak

The influence of sol-gel alumina coating on corrosion and decarburization of hypo-eutectoid carbon steel. During the heat treatment of steel components in air a decarburization may occur at higher temperatures. Carbon from the steel surface reacts with the gasses from the atmosphere and thus,the carbon content in the steel surface is reduced. Decarburization may be a serious problem, since it deteriorates the mechanical properties of steel surface, namely it lowers the hardness and strength, which leads to less wear and fatigue resistance. Another problem related to the reaction on steel surface is a corrosion. The costof corrosion is estimated to 3,4 % of global GDP and thus, corrosion processes rates need to be minimized.Therefore, a simple and environmental friendly alumina coating was produced by sol-gel technique to effect the corrosion and decarburization of C45 steel. The steel surface was coated by dip coating and dried at different temperatures. The corrosion tests were performed on the polished surfaces of the C45 steel using a salt-spray test in a chamber. For the decarburization measurement the steel samples were annealed in air at temperatures at which typical heat treatment are performed ($T< A_{C1}$, $A_{C1}< T < A_{C3}$ and $T> Ac_3$). The influence of sol-gel alumina coating on decarburization was estimated by a metallographic analysis and hardness measurements.

85. M. Dunder, I. Samardžić, A. Ćorić, G. Salopek

Effects of real welding parameters of high-strength S1100QL steel on hardness and impact energy properties. The research objective was to test the parameters of real welding of the high-strength micro-alloyed S1100QL steel against the hardness and impact energy. The samples were welded at different welding parameters. Results of measuring the HV10 hardness and of experimental Charpy V-notch test performed at different temperatures are presented in tables and diagrams. This paper presents also the welding parameters, which provides a high quality welded joint without cold cracks.

86. B. Karpe, S. Novak, A. Nagode, S. Kožuh, A. Pavlič, S. Rečnik, B. Kosec

Industrial control measurements of high chromium steel rolls heat treatment. In this paper, industrial control measurements of the heat treatment of high chromium steel (HCS) rolls is presented. Measurements of the gas fired car bottom chamber furnace Bosio PP-KP 70/1150 were carried out in the company Valji d. o. o., Štore, Slovenia. Temperature in the individual heating zones of the furnace, temperatures of the roll surface, furnace external walls, and gas consumption was monitored throughout the whole process of heat treatment. The temperature profile of the rolls cross-section was calculated using computer simulation. Periodical measurements of CO and NO_x emissions were also carried out with the aim of combustion evaluation and ecological integrity. The successfulness of heat treatment was examined through microstructure observation, hardness measurement, and the amount of retained austenite in the heat treated rolls.

87. V. Marušić, A. Milinović, I. Opačak, I. Putnik

Research into possibilities of reducing the X155CrVMo12-1 tool steel fragility. This research varies the parameters of austenitization and quenching of the tool steel X155CrVMo12-1. It also focuses on investigation of the structure, hardness and impact energy. It was determined that the cracks were generally intercrystalline, with carbide deposition. It was observed that quenching at the temperature interval from ≈ 700 °C to ≈ 600 °C, at a speed greater than 15 °C/s, achieved higher impact energy with about the same hardness. It was concluded that prevention of carbide coalescence had influence on the reduction of steel fragility.

88. D. A. Romanov, E. A. Martusevich, M. A. Stepikov, E. A. Gayevoy, V. E. Gromov

Structural-phase state of the system "CdO-Ag coating / copper substrate" formed by electroexplosive method. The study on phase and elemental composition of the surface layer of copper electrical contact of contactor KPV-604, subjected to the electroexplosive deposition of the composite coating of the CdO-Ag system, was carried out by the method of Transmission electron microscopy (TEM). The scale of the elements of coating surface structure after electroexplosive deposition varies in a very wide range – from hundreds of micrometers to tens and hundreds of nanometers. According to the morphological characteristic two layers can be distinguished in the volume of coating: the coating itself and the heat affected layer smoothly transiting into the main volume of the sample.

89. S. A. A. Sajadi, A. Nazari Alavi, M. Mirzai

Investigation of thermal behavior of α-PbO and β-PbO in O_2 atmosphere. The compounds α-lead oxide (α-PbO) and β-lead oxide (β-PbO) were purchased from Merck co. and used for thermal investigations in laboratory. The compound was heated in a thermogravimeter at different temperature, from 25 to 400 °C. The used gas atmosphere was O_2. The received products were investigated by X-ray diffraction (XRD) technique. The received product Pb_3O_4 was confirmed by XRD. The textures of two different morphologies of α-PbO, β-PbO and the product Pb_3O_4 is investigated by scanning electron microscope (SEM) and transmission electron microscope (TEM) techniques.

90. T. Šolić, D. Marić, M. Duspara, I. Samardžić

Analysis of plated layer's effects on the structure resistance to corrosion. This paper presents the laboratory testing of protective effects that the plated layer had on the structure resistance to corrosion by using the weighing method, i.e. the method of mass loss. The described procedure refers to preparation of samples, their exposure to aggressive atmosphere of the salt chamber and analysis of obtained results. According to the properties of the base material and its reduced stability in the experimental conditions, it is confirmed that the use of plated layer was required to improve the structure resistance to corrosion and to protect the base material.

91. A. Wańkowicz-Lis, B. Oleksiak, G. Siwiec, J. Wieczorek, A. Tomaszewska

Decorative metallic coatings applied with galvanic method. In the presented paper the authors aimed at describing the effects of basic parameters of galvanizing process upon the quality of the obtained silver decorative coatings.

92. T. A. Ayupova, A. M. Dolzhanskiy, N. Stojčević

Determination of the limit degree of metals technological deformability at wedge-shaped samplesrolling. Experimental rolling of the hypoeutectic cast aluminum alloy AK7ch - both of the initial composition and of the strontium-scandium complex optimally microalloyedone in the cast state and after hydrogen treatment, has been carried out. A strip of thickness 2.4 mm was obtained from the workpiece with a maximum thickness of 11 mm by a rolling method from a cast aluminum alloy containing the Sr-Sc complex.It allows to extend possibilities of the use of casting alloy of AK7ch for manufacturing of wares as by the method of casting also by the pressure processing. The true deformation of the AK7ch alloy containing the Sr-Sc complex after optimal hydrogen treatment was 1.19.

93. T. A. Ayupova, D. Čurčija

The mechanical properties of heat treated AK7ch alloy optimally modificated by the complex Sr-Sc. The quantitative analysis of the response function data of mechanical properties(H_μ, HB, σ_B, φ) is carried out. Quantitative dependences of the specified functions of the response from independent variable (T_q, t_q, T_a, t_a)) are received. It allows to calculate concrete andpredictvalues of mechanical propertiesof alloy AK7ч at fixed values of independent variables.The mode of heat treatment is optimized: the heat treatment of the investigated alloy, carried out in accordance with the optimal regime, provides an increase of σ_B on 70 MPa, hardness on 10 HB, with preservation of high level of plasticity.

94. V. Z. Kutsova, T. A. Ayupova, I. Mamuzić

Atomic interaction and choice of modificators for Ak7ch alloy. The atomic interaction in the AK7ch alloy under individual and complex modification by Sr and Sc by the physicochemical modeling method was studied. Analysis of the corresponding pair interactions allows to predict the element modifying efficiency of an alloy with a particular composition. The maximum modifying effect have elements with minimal directionality of the Si-X and O-X bonds. The criterion $\Delta\bar{e}_C$ should be used for qualitative determination the metallized state of the system as a whole. It allowsto predict the alloying and microalloying impurities efficiency on the mechanical properties of the alloy.By the analysis of the structure parameters and the mechanical properties correlations of the alloy, obtained experimentally and the atomic interaction parametres the optimum concentration of the modifier elements for AK7ch alloy was determined.

95. P. Klaver, M. Sluiter
Predicting single phase bcc-based high entrony alloys using thermodynamic databases. We present results of a thermodynamic search scheme for finding single-phase high-entropy alloys without a large presence of brittle intermetallic phases, like Laves and Heusler phases. The search is geared towards finding transition metal alloys with good high temperature mechanical and oxidation properties. Rather than using a brute force approach of calculating all possible compositions, we limit the search by following the phase equilibrium of single phase to the lowest temperature at which diffusion might play a role. A simple analysis evaluates a sum (c*log (c)) entropy term to eliminate phases that have elemental concentrations far removed from being equiatomic.

96. V. Kutzova, M. Kovzel, P. Shvets, A. Grebeneva
The features of structure formation, phase composition, properties and isothermal decomposition kinetics of supercooled austenite in chromium-manganese cast iron. The kinetics of supercooled austenite decomposition in cast iron with a content about 2,7% C, 15,9% Cr, 10,5% Mn, in the temperature range 550-25 ° C was studied. It is determined that the decomposition of austenite occurs both in diffusion and in shear-diffusion mechanisms. The temperature intervals for the decomposition of austenite in pearlitic (550-400 ° C) and bainitic (350-200 ° C) regions was established. The lines for the release of excess carbides and the onset of the martensitic transformation (MH) are not plotted on the diagram. The phase composition of the cast iron after the isothermal soaking was determined. The maximum hardness of the cast iron is formed during the isothermal soaking in the pearlite region at a temperature about 500 ° C and in the bainite region at 250 ° C.

97. V. Kutzova, M. Kovzel, P. Shvets, A. Grebeneva
The nanostructural matrix formation of economically allowed wear-resistant high-chrome alloys by treatment on bainite. The bainite morphology in economically alloyed wear-resistant high-chromium alloys was studied. In the intermediate temperature range, bainitic structures formation with a α-phase of various shapes and residual austenite or carbide (Me_7C_3) was revealed. It is shown that in the process of bainitic reaction in high-chromium iron, two types of austenite are formed in the structure of the metal matrix, which differs in lattice parameter, in carbon content, and in alloying elements. The first high-carbon austenite is formed due to the transformation, the second is metastable, the decomposition of which provides surface hardening of the products during operation. This confirms existing ideas about the presence of an "upper" carbide-free bainite, which provides high levels of toughness and wear resistance.

98. V. Kutzova, T. Kotova, A. Stecenko
Structure and properties formation of hot-rolled ultra low-carbon sheet steel. Quantitative parameters of structure, mechanical properties, elements distribution on section of samples ultra low-carbon sheet steel after deformation with hot rolling on austenitic and ferritic temperature ranges and cooling conditions were researched. As demonstrated, the zonal variation in grain size in structure of the sheet steel after deformation in two passes is a consequence of incomplete recrystallization process in the central zone of sheet. The research of the mechanical properties of sheet steel showed that with increasing of degree of deformation increase of values of strength properties and decrease of plastic characteristics.

99. V. Kutzova, I. Ratnicova Z. Blažeković
Influense of the complex physical and chemical processing in liquid and solid states on the structure and properties formation of semiconductor silicon. The newest comprehensive technology for production of semiconductor silicon (Cz-Si), which includes doping with transition metals and rare earth metals (REM), heat-treatment at the temperatures of phase transformations or processing in a magnetic field at the room temperature and provides an enhanced complex of mechanical and electro physical properties Cz-Si for instrumentation products are developed and investigated. Due to the use of doped Cz-Si after machining in a magnetic field for instrumentation products in the machine-building, rocket and space industries and for the manufacture of solar cells, it provides savings by eliminating from the process of obtaining the allowed Cz-Si heat-treatment and replacing it with processing in a magnetic field at normal temperature. The Cz-Si alloying and magnetic processing leads to the durability and thermal stability of appliances and solar cells.

100. N. Pogrebnaya, V. Kutzova, M. Kovzel, A. Stecenko
Features of structure formation during thermo mechanical treatment of constructional building steels. The comparative analysis of the different methods influence on the hardening of the structure and properties of ferrite-pearlite and bainite classes steels was shown at present work. The austenite grain is crushed by influence of thermo mechanical processing (TMP) and like result substructure developed is created that contributes to the increase in the nucleation sites of martensitic crystals, which favorably affects the whole complex of mechanical properties. The strengthening process, as a result of the TMP is a consequence of the realization of the following factors: the increasing in the dislocation density; separation of carbides; presence of a developed structure of martensite crystals; small sizes of martensitic crystals. The feasibility of the using TMP is due to the savings energy resources, due to the study of the heat of the rolling heating of rolled metal.

101. T. Myronova, I. Semenova, G. Šimunović
Effect of Alloying on White Cast Iron Plasticity Increasing. In the course of studying the behavior of white cast iron during deformation it appeared that carbide transformations facilitate decrease of yield stress and increase of alloy plasticity. By causing occurrence of phase transformations in alloyed ferrous carbide the continuity of eutectic network can be damaged, which would cause cast iron to become a ductile alloy. In this case the needed chrome and vanadium content in cast iron is significantly lower than in case of total replacement of ledeburite with eutectics based on Cr_7C_3 or VC carbides.

102. S. YU. Makeiev, V. YA. Osinniy, N. V. Osinnja, O. V. Holyavik
About heating of superhard materials by heat flow of arc plasma. In the mining and metallurgical complex for the destruction of strong ore is used cone crusher. The taper surfaces of the crushing bowl are subjected to impact-abrasive wear. Therefore, they are made of Hadfield steel, which is treated by the plasma mechanically. Occur during processing, the stress concentrators in the form of microcracks are appeared, which affect the service life of the crusher. Study of parameters of plasma - mechanical treatment is done. The dependences of the temperature on the surface of the cutter and in the area of the chip formation from the plasma heating modes are obtained. It was found that for this technology as a heat source, you must apply the plasmatrons with an indirect arc, in which there is no tight binding of the arc to the workpiece.

103. Y. Projdak, S. Gubenko, I. Nikulchenko
Influence of non-metallic inclusions on structure formation and strengthening of surface layer with increased mechanical properties under Laser Treatment. The peculiarities of the formation of zones of contact interaction in the steel matrix and in the surface layers of nonmetallic inclusions under laser treatment were studied. It was established the peculiarities of transformation of the inclusion-matrix boundaries is associated with heterogenization of their structure. New factors that determine the influence of nonmetallic inclusions on the strengthening of steels under laser action are established. It was shown that laser treatment allows to reduce their average size and contamination of steel. The effect of deformation modes and laser treatment on the initiation of cracks near inclusions during deformation was established. The effect of the structure of the microcomposite zones of saturation of the steel matrix on the spreading of cracks from inclusions, related to their inhibition, was investigated.

104. Y. Projdak, S. Gubenko, I. Nikulchenko
Possibility of Local Strengthening of the Railway Wheels Scrap Zone. The principal possibility of laser strengthening of the railway wheels scrap zone in the regime of continuous radiation was shown, when it is possible to obtain the bainite structure of the laser-strengthened layer under the regime: laser beam power 600 W, speed of its displacement of 5 ... 15 mm / s, especially in the combination with traditional thermal treatment, which will not only increase the wear resistance of the tread of railway wheels, but also reduce the risk of cutting the crests during operation. The results obtained in the work are proposed for use in the manufacture of railway wheels in the conditions of LLC "Interpipe Management".

105. S. Gubenko
Non-Metallic Inclusions and Strength of Steels. The results of the study of deformation and destruction of non-metallic inclusions in steel treatment pressure in various conditions were listed. The influence of high-energy treatments and active media on the formation of microcracks in steels along the

inclusion-matrix boundaries is shown. Special attention for development of fracture along interphase inclusion-matrix boundaries was given. The transformation of nonmetallic inclusions under various thermal and deformation effects and its influence on the properties of steels is studied. Possibilities of rise of steels with non-metallic inclusions cracking resistance by thermal and deformational actions are discussed.

106. A. Movchan, S. Gubenko, C. Chernoivanenko

The Formation of Four-phase Composites Based on the Fe-W-Cr-C System. The mechanisms of structure formation during carburization of alloys of the Fe-W-Cr system are studied. It is shown that formation both two-phase ($\gamma + M_6C$) and three-phase ($\gamma + M_6C + M_{23}C_6$) colonies are possible in this system. The regularities of structure formation are described using the four-component Fe-W-Cr-C state diagram. The temperature-concentration conditions for the growth of triple austenite-carbide colonies in the investigated alloys have been established. The Fe-W-Cr-C alloys with a four-phase composite structure of a carburized layer can be recommended as tool material for fabricating a semi-heat-resistant cutting tool with low alloy doping.

107. E. Parusov, S. Gubenko, M. Kostelec

Cement Carbide Fragmentation and Forming of Sub-microcrystalline Structure During the Cold Flow Processing of the Perlite Grade Steels. At the total percentage reduction (drawing) of coiled bars of ca. 70% with the structure of sorbitic perlite, cementite plates are being transformed into separate fragments (or blocks) when passing the monolithic wire drawing die system. Since these fragments have a compact form, the observed phenomenon can be called a cold dynamic coalescence of cementite. It is hereby shown that during the fragmentation stage related with forming of meso-banded structures, the fragmentation of curved banded structures of localized cold metal flow takes place; at that, the junction is being formed between the fragments of the non-oriented boundaries which brings about the forming of sub-microcrystalline structure. The deformation of cementite plates by way of their fragmentation is distinctive mainly for the metal structure areas with coerce-plated perlite, in the zones of its fragmentation the increased concentration of dislocations is observed; this results in the drastic deterioration of the processing ductility of wire mill rod.

108. V. Soare, D. Mitrica, M. Burada, M. T. Olaru, I. Constantin, B. A. Carlan, V.I. Soare, V. Badilita, M. Ghita

Study of the oxidation resistance of novel high-entropy alloys from the Al-Cr-Fe-Ni-Ti-Si-Nb system. The paper studies a new type of high entropy alloy (HEA) with superior properties for jet engine applications. AlCrFeNiTiSiNb HEAs were obtained by induction melting and were characterized. The chemical analysis revealed that the alloy presented uniform elemental distribution. The X-ray diffractometry identified two Laves-type hexagonal solid solutions with slightly different lattice parameters and crystallite sizes. Microscopy analyses revealed a fine dendritic microstructure with equiaxed grains. The oxidation resistance was determined at 1100˚C for maintaining times of up to 50 hours. Remarkable results were obtained, with a mass gain of just 7.04 mg/cm^2. The oxidation resistance was higher than that of currently used alloys. Also, the microhardness measurements for the AlCrFeNiTiSiNb alloy resulted in a maximum value of 1400 HV.

109. D. Volšak, J. Arbeiter, M. Vončina, T. Smolar, M. Lažeta, J. Medved

Effects of homogenization conditions on the microstructure evolution of aluminum alloy AlFe1Si. Non-equilibrium solid solution slabs from aluminium alloy AlFe1Si, casting by Direct Chill process need to be suitably homogenized. Before further hot rolling process need to be archive proper distribution of microstructure phases, corresponding to the finishing properties of the aluminium foils. The degree of homogenization strongly depends of the conditions as time and temperature, which the slab is exposed. In our study, it was investigated the effect of temperature and time on the success of homogenization for alloy AlFe1Si. Homogenization was carried out at two different temperatures (580 and 600°C) and five different times (4, 6, 8, 10 and 12h). Microstructures of different samples were observe by optical and electron microscopy. From the results of metallographic investigation has been found that homogenization is sufficient when the fine microstructure phases Al_6Fe are not observed, which are usually observed in the microstructure of the casting temper alloy AlFe1Si. After the appropriate homogenization in the microstructure, only the eutectic phase $Al_{13}Fe_4$ of the rounded morphology can been observed.

110. S.A. Nikulin, A.B. Rozhnov, T.A. Nechaykina, V.I. Anikeenko, O.I. Zabolotnikova

Evaluation of crack resistance of low-carbon cast steel using the acoustic emission measurement. Crack resistance of low-carbon cast steel (Russian standard – 20GL) strengthened by "volume-surface" hardening was determined. Hardening has led to a gradient of structure and hardness along the sample thickness. The acoustic emission method is used for evaluation of crack resistance and for analysis of crack development kinetics in material having variable ductility. This work was funded from a grant from the President of the Russian Federation for state support of young Russian scientists and candidates of science (№ МК-6650.2018.8).

111. F. Tehovnik, J. Burja, S. Malej, F. Vode, B. Podgornik, B. Arh

Evolution of microstructure during hot deformation of inconel 625 alloy with different strain rates. Hot compressions tests of Inconel 625 superalloy were conducted using a deformation al dilatometer to the strain level of 0.7 at 1050 °C, with a different strain rate. Optical microscope and electron backscatter diffraction technique were used to investigate the microstructure evolution and nucleation mechanisms of dynamic recrystallization. Microstructural evolution of Inconel 625, deformed to the strain level of 0.7 at 1050 °C, reveals that the size of the DRX grains and the fraction of DRX increase with the decrease in strain rate. At the strain rate 10 s^{-1}, the grain sizes are mainly located in the size below 20 μm, indicating that nucleation of DRX was dominant due to the combined effects of high stored energy and short deformation time for grain growth at high strain rate.

112. Nikulin S., Nechaykina T., Rozhnov A., Rogachev S.

Proving the viability of manufacturing of multi-layer steel/vanadium alloy/steel composite materials by numerical simulations and experiment. Vanadium alloys are promising structural materials for fuel cladding tubes for fast-neutron reactors, but high solubility of oxygen and nitrogen in vanadium alloys at temperatures more 400 ºC limits their application. We present a novel composite three-layered material consisting of alloy V-4Ti-4Cr (provides high long-term strength) and stainless steel Fe-0.08C-17Cr (as corrosion resistant protective layer) produced by co-extrusion. Finite element simulations were utilised to explore the various co-extrusion parameters influence on manufacturability of multi-layered material. Experimental verification of the simulation was performed using co-extrusion with the process parameters suggested by the numerical simulations. Investigation revealed a defect-free diffusion layer at the interfaces between both materials indicating a good quality bonding for these co-extrusion conditions. The work was supported by the Ministry of Education and Science of Russia (unique identifier No. RFMEFI57517X0124).

113. T. Oršulová, M. Roszak, W. Pakiela, P. Palček

Laser nitriding of austenitic stainless steels. Nitriding is one of the thermochemical treatment types which belongs to the group of the fastest developing surface engineering methods. Nitriding of austenitic stainless steels is one of the methods of surface curing of materials. The primary purpose of nitriding is to achieve a hard surface while retaining the tough core of the component. During laser nitriding, metal surfaces are irradiated by short laser pulses in a nitrogen-containing atmosphere. Of all types of steels, nitriding of austenitic steels is the most complex. During nitriding, the components must be annealed in order to prevent flaking or blistering of the nitrided state. Stabilized grades of steels or low carbon steels are recommended for nitriding. The aim is to obtain increased resistance to abrasion and resistance to surface oxidation of steel. The resulting thickness of the nitrided layer that can be achieved in the austenitic steel is very thin- above 0,125 mm.

114. T. Balaško, M. Vončina, J. Burja, J. Medved

High temperature resistance of hot work tool steels with increased thermal conductivity. Investigated hot work tool steels are mainly used as moulds at high pressure die casting of light alloys and extrusion of polymers. Since all those processes are operating at high temperatures, the main focus of this research was to investigate high temperature resistance of tool steels. In this paper the main focus is on hot work tool steels with increased thermal conductivity. Two different steels were analyzed namely W600 and HTCS-130. Tests were made in air atmosphere at two different temperatures – 500 °C and 700 °C. Samples were held at the determined temperatures for 72 hours. Optical microscopy was used to determine the thickness of oxide layer and XRD (X-ray diffraction) to determine the constitution of oxide layer and the oxide type. Results showed that at 500 °C W600 steel has better high temperature resistance than HTCS-130 steel. On the other hand at 700 °C HTCS-130 has better high temperature resistance than W600.

115. G. Popescu, B. Ghiban, R. Trusca, V. Soare, D. V. Dumitrescu, D. Mitrica, M. Burada, M. T. Olaru, I. Constantin, B. A. Carlan
Microstructural characterization of a biocompatible TiZrNbCrFe high entropy alloy obtained by mechanical alloying. In this paper, Ti, Zr, Nb, Cr and Fe powders were mechanically alloyed in a high energy planetary ball mill and afterwards pressed and sintered at high temperatures (900-1100 °C). The resulted samples were characterized using X-ray diffractometry (XRD), scanning electron microscopy (SEM), energy dispersive spectrometry (EDS) and inductively-coupled plasma spectrometry (ICP-OES) analysis. The analyses revealed that the phase formation processes and homogeneity of the elemental distribution in the alloy are strongly influenced by the milling time.

116. V. Soare, D. V. Dumitrescu, D. Mitrica, M. T. Olaru, I. Constantin, V.I. Soare, V. Badilita, M. Ghita, G. Popescu, B. Ghiban
Novel TiZrNbTaFe high entropy alloys for biomedical applications. The paper studies a new type of biocompatible high entropy alloy (HEA). TiZrNbTaFe HEAs were obtained by induction melting and characterized. The chemical analysis revealed that the cast alloy maintained the established stoichiometry and presented uniform elemental distribution. X-ray diffractometry identified a hexagonal solid solution with a lattice parameter of 5.032 Å and crystallite size of 13 nm. Microscopy analyses revealed a dendritic microstructure with almost no phase segregation (<1%). The corrosion resistance was determined in simulated body fluids (0.9% NaCl intravenous and Ringer lactate solutions). Remarkable results were obtained for the corrosion rate (0.00067 mm/year for NaCl and 0.00075 mm/year for the Ringer solution). The overall corrosion resistance was higher than that of 316L steel and Ti–6Al–4V.

117. I. Petryshynets, F. Kováč, V. Puchý, M. Podobová
Selective growth of grains with enhanced rotation texture in temper rolled Fe-Si steels. The present work investigates the microstructure and texture evolution stages in Fe-Si electrical steels. The main idea behind the improvement of soft magnetic properties relies on strain–induced grain growth and heat transport phenomena promoting the preferable formation of coarsened grains with so called cube crystallographic orientation {100}<0vw>. In order to achieve the desired orientation with appropriate microstructure state, we have used an adjusted temper rolling process and subsequent dynamical annealing conditions. The experimental material was taken from industrial line after final cold rolling and then was subjected to the thermo mechanical treatment in laboratory conditions. The obtained microstructure leads to a significant decrease of coercivity measured in DC magnetic field from 70 A/m to 16 A/m.

118. M. V. Koteneva, S. A. Nikulin, A. B. Rozhnov
Structure and mechanical properties of oxide films of zirconium alloys formed under different oxidation conditions. One of the most important characteristics of zirconium alloys is their high corrosion stability which provides safe performance of the elements during long-term exploitation in a reactor. Depending on chemical composition, surface state and oxidation conditions of the alloy, its corrosion results in the formation of the oxide films of various structure and defectiveness, which should affect significantly protective properties and eventually corrosion stability of the alloy. The paper presents the results of studying of the structure and mechanical properties of oxide films of zirconium alloys E110, E125 and E635 oxidized in water, steam and water with the addition of lithium.

119. N. Martynenko, E. Lukyanova, E. Li, M. Gorshenkov, M. Morozov, V. Yusupov, N. Birbilis, S. Dobatkin, Yu. Estrin
Ultrafine-Grained High Strength Biodegradable Mg-Y-Nd-Zr Alloy After Rotary Swaging. Rotary swaging of the Mg-3,56%Y-2,20%Nd-0,47%Zr(wt.%) alloy was carried out with a stepwise decrease of temperature from 400°C to 325°C with an increase of the extrusion ratio to 2,56–2,78. Rotary swaging leads to the formation of the ultrafine-grained structure with the average grain size ~0,7 μm. With reduction of the grain size the strength increases up to YS = 285 MPa, and UTS = 415 MPa compared with the initial values of YS = 161 MPa, UTS = 234 MPa. The deformation by rotary swaging does not affect the corrosion rate of the alloy, as measured by the methods of potentiodynamic polarization, weight loss, and hydrogen evolution. This research was supported by the Russian Science Foundation (grant #17-13-01488).

120. V.V. Roschupkin, M.M. Lyahovitskii, M.A. Pokrasin, N.A. Minina
Experimental study of acoustic properties and microhardness of steel 45. The paper presents the results of investigation of the ultrasonic velocity, the relative temperature expansion and microhardness of steel 45. The measurements were carried out both on annealed and quenched samples. An experimental study of the acoustic properties and thermal expansion of steel 45 was carried out in the temperature range from room temperature to 1100 °C and microhardness up to 500 °C. The temperature boundaries of the phase transformations in the investigated steel are determined. Investigation of the microhardness was carried out by the method of continuous indentation using the Berkovich indenter in accordance with the international standard ISO 14577-1.215, 2.215, 3.215 and 4.207 on the automatic installation of NanoTest. Based on the results of the experimental and calculated data, approximating equations are constructed for the temperature dependences of the thermophysical and mechanical properties of the investigated steel.

121. A. A. Tokar, O. V. Rybalchenko, M. M. Morozov, A. N. Belyakov, V. I. Torganchuk, V. S. Yusupov, S. V. Dobatkin
Structure and properties of Cr-Ni- Ti austenitic steel after rotary swaging. The structure and properties of 17.3%Cr-9,2%Ni-0,7%Ti austenitic steel after rotary swaging at temperatures 500°C and step-by-step decreasing of processing temperature 500-200°C and 500-20 °C were studied. Rotary swaging produces UFG structure with average grain size 135 nm with a high fraction of deformation twins in the austenite. Due to obtained microstructure ultimate strength of steel after rotary swaging significantly increases. Application step-by-step mode with decreasing of processing temperature from 500 to 20°C allows to achieve the maximal UTS (1300 MPa) in metastable austenitic steel. Fatigue strength is enhanced owing to the refinement of the structure and twinning of the austenite during rotary swaging, as well as due to partial martensitic transformation in austenitic steel. The work was supported by the RFBR (grant 16-08-00365-a).

122. N. Yurchenko, N. Martynenko, E. Lukyanova, A. Tokar, V. Serebryany, N. Birbilis, G. Salishchev, S. Dobatkin, Yu. Estrin
Effect of multiaxial deformation on structure, texture, mechanical and corrosion properties of Mg-0.8%Ca alloy. The Mg-0,8%Ca alloy was processed by multiaxial deformation with a decrease in the processing temperature from 450 °C to 250 °C. The structure with an average grain size of 2,1-2,8 μm are formed in the alloy after deformation. The grain refinement results in an increase in the strength up to YS = 193 MPa, and UTS = 308 MPa compared with the initial values of YS = 51 MPa, UTS = 97 MPa. The structural features caused by deformation leads to a slight increase in resistance to electrochemical corrosion (the corrosion potential increases while the current density drops). However, the chemical corrosion resistance stays at the same level. This research was supported by the Russian Science Foundation (grant #17-13-01488).

123. Volchenkova V. A., Kazenas E. K., Ovchinnikova O. A., Penkina T. N, Smirnova V. B., Fomina A. A.
Development of express methods for determination of contents of rare earth elements in magnesium alloys. Using atomic emission spectrometry with the inductively coupled plasma(AES–ICP) and X-Ray fluorescence analysis (XRF) the new methods have been developed for simultaneous quantifying the contents of rare earth elements (REE) in the wide range of concentrations from10^{-3} to n•10% in magnesium- based alloys. Optimal analytical parameters were chosen for determining: Ce, Dy, Gd, Y, Er, Sc, Sm, and Zr. The influence of matrix element magnesium and methods of it elimination was studied. This made it possible to determine the elements without preliminary separation of the matrix with good metrological characteristics. It is shown that the method of the AES –ICP is the dominant for determining the content of REE from10^{-3} to n%. The method of XRF is preferable at the determination of high concentrations from n % and above.

124. A. I. Ogarkov, S. V. Shevtsov, I. A. Kovalev, A. N. Nechaev, S. V. Kannykin, A. V. Shokodko, A. A. Konovalov, D. V. Prosvirnin, A. S. Chernyavskii, V. M. Ievlev, K. A. Solntsev
Irradiation of titanium, zirconium, and hafnium nitrides with high-energy xenon ions. Ion-beam irradiation of titanium and hafnium nitrides leads to the formation of nano- and micropores in the surface layer of the samples. The surface layer of zirconium nitride samples contains nanopores both before and after irradiation. The presence of pores in the unirradiated ZrN_x samples probably ensures the possibility of structural relaxation without further pore formation under irradiation. The pore size characteristic of irradiated ZrN_x is greater than that of the unirradiated material. High-resolution TEM of the irradiated ZrN_x samples revealed local crystal structure distortions unrelated to dislocations and attributable to the impact of high-energy xenon ions.

125. I. A. Kovalev, V. Yu. Zufman, A. I. Ogarkov, S. V. Shevtsov, S. V. Kannykin, A. V. Shokodko, A. A. Konovalov, D. V. Prosvirnin, A. S. Chernyavskii, V. M. Ievlev, K. A. Solntsev

Kinetics of zirconium saturation with nitrogen during high-temperature nitridation. At all of the temperatures studied (1500, 1800, 1965, and 2400°C), the saturation of Zr ribbons with nitrogen involves two stages: the first stage (in which the metallic phase disappears) can be represented by an exponential rate law, and the second stage (corresponding to an increase in nitrogen content up to the stoichiometric composition of ZrN) has a linear rate law. The lowest synthesis temperature above which zirconium saturation with nitrogen can be described by an exponential rate law is 900°C.

126. S. V. Shevtsov, A. I. Ogarkov, I. A. Kovalev, S. V. Kannykin, A. V. Shokodko, A. A. Konovalov, D. V. Prosvirnin, A. S. Chernyavskii, V. M. Ievlev, K. A. Solntsev

The nature of structural inhomogeneity in ceramics produced by zirconium nitridation. Nitridation of one-dimensional zirconium samples produces compact zirconium nitride-based ceramics in which the inner and surface nitride layers differ drastically in grain structure. The observed texture of the nitride layer correlates well with the texture of the starting zirconium samples and is caused by ZrN endotaxy with respect to the nitrogen solid solution in α-Zr.

127. A. Z. Issagulov, T. S. Makaev, M. K. Ibatov, Sv. S. Kvon, V. Yu. Kulikov, A. M. Dostayeva

Effect of reducing agent's nature on the microstructure and certain properties of 30CrNi2Mo high-quality steel. The experiment results allow us to state that killing with the new FS45A15 aluminum ferrosilicon reducing agent has a beneficial effect on the formation of a fine-grained structure. After several processing methods 30CrNi2Mo high-quality steel can be considered as an analogue of Hardox 500 steel as a wear-resistant material.

128. I. Samardžić

Structure and service properties of welded joints of corrosion – resistant steel. The structure of welds of steel 08Kh18N10T and titanium alloy VT-6 formed by diffusion welding is studied by methods of metallographic and x-ray spectrum microanalysis. Images of microstructure obtained in the mode of reflected electrons and maps of distribution of main elements over a cross section of a weld are analyzed.

129. R. Križanić

Evoluation of cyelic strenght of welded joints. New original methodology of evaluation of cyclic strength of welded joints with technological defects is worked out. A calculation-experimental analysis of conditions for their evolution is performed. Criteria of presence of defects in welds on fixed ice-proof driling rigs, differentiated with respect to categories of importance of structural elements and safe from the point of view of fracture mechanics and fatigue strength, are established.

130. M. Z. Chukhleb

Peculiarities of structures compositions and hardness of wear-proof coatings. Influence of grading structure of powder wire from alloy VK9 on structure and conposition of wear-proof coverings is investigated at argon-arc cladding by gas-flame methods are examined. Adjusting power wire with granularity up to 80 : 150-280; 280-850 microns was used.

131. R. Križanić

Corrosion behaviour of the fusion zone welds of Al-Cu alloy. The corrosion behaviour of the fusion zone of gas tungsten are welds of AMg6 Al-Cu alloy was studied. Dynamic polarisation and impedance testing were used to determine the pitting and general corrosion resistance of the fusion zone respectively. Optical and scanning electron microscpoy studies were carried out to find the mechanism of corrosion.

132. I. Mamuzić

Effect of heat input an residual stress. The Article present bulk residual stress distributions, as measured by neutron diffraction, for the configuration of a single pass gas tungsten are weld bead desposited on to a 10 mm thick X18N9T steel substrase. The resulting microstructures and residual stress distributions are discussed in terms of the differing thermal excursions across each weld. In regions that are austenitised during welding the transformation strain on cooling is shown to compensate in part for thermal contraction strains.

133. L. L. Rokhlin, T.V. Dobatkina, I.E. Tarytina, I.G. Korolkova, D.R. Temralieva

Effect of cerium on structure and properties of the Mg-Y-Gd-Zr system alloys. Using optical microscopy, electrical resistance and hardness measurements at room and elevated temperatures methods and also the tensile tests effect of the cerium addition up to 1,0 mas.% on structure and kinetics of the Mg supersaturated solid solution decomposition in the Mg-Y-Gd-Zr alloys, containing ~5 mas.%Y, ~5 mas.%Gd, ~0,5 mas.%Zr was studied. The results of the experiments indicate, that cerium enable to decrease incubatory stage and to shorten the achievement time of the maximal strengthening during ageing of the alloys, but their strength properties remain at the properties level of the initial Mg-Y-Gd-Zr alloys.

134. T. Karkoszka

Conditions of the supervised risk in the zinc coating processes. Both chemical pretreatment of the steel surface and immersing the steel element in the molten zinc make the hot-dip galvanization process highly risky. Those risk conditions can have the influence on performing the expectations of stakeholders in the process in sustainability term. Therefore, the proposed methodologyof analysis of the traditional hot dip zinc coating has covered the identification and the assessment of failures, environmental impacts and effects of occupational healthy threats. Basing on the calculation of their integrated risk, the key-aspects have been pointed what is required by the supervision. One has proposed the conditions of the supervised risk.

135. H. Jin, L. J. Chen, X. Y. Zhou, Y. Y. Wang

Effect of ultrasonic power on corrosion resistance and hardness of Ni-Co-Al_2O_3 nanocomposite coatings. The Ni - Co - Al_2O_3 composite coatings were prepared by electroplating under ultrasound condition. The influence of ultrasonic power on micro hardness and corrosion resistance was investigated. Studied by SEM, EDAX and XRD, under the cavitation effect of ultrasound condition, the nano Al_2O_3 was dispersed in the coating, and the composite coatings had refiner grains. The surface morphology of coating was uniform and compact. With the increasing of ultrasonic power, the micro hardness of Ni - Co - Al_2O_3 composite coatings increased first and then decreased. When ultrasonic power was 240W, the composite coatings has the highest hardness and the best the corrosion resistance.

136. A. Di Schino, R. Rufini

Thermo-mechanical process parameters effect on a 9% Cr-2 % W steel. In this paper the effect of thermo-mechanical parameters on the mechanical behavior of a 9% Cr-2% W steel is investigated by hot rolling and heat treatment on pilot scale. Results show a strong effect of reheating temperature before rolling on the material hardness, due to an increase of hardenability following the austenite grain growth. A poor effect of the hot reduction and of the following tempering temperature is detected in the total investigated deformation range. A loss of impact energy is found coupled with the hardness increase. The tensile properties values are strongly depending upon the tempering temperature and an increase of tensile yield stress (YS) and ultimate stress (UTS) have been recorded in tensile test carried on at T=550°C and T=650°C.

137. F. Gapsari, Andoko, H. Wijaya

Corrosion behavior of brass in nitric acid. This research is a preliminary study of which purpose is to find some information about corrosion behavior of brass casted product in nitric acid. The corrosion rate test was conducted by polarization and Electrochemical Impedance Spectroscopy (EIS). This study was run with the variation of nitric acid of 0.5; 1; 1.5; 2 M. Optical Microscope (OM) were used to explain and to confirm polarization and EIS result. A mechanism for the reactions taking place at the electrode/electrolyte interface was explained.

138. A. K. Serikbayeva, F. A. Berdikulova, K. K. Mamyrbayeva, Sh. K. Akilbekova

Processing of rare metals containing waste of copper production. The article presents the research results processing rare metal-containing waste to produce osmium, rhenium concentrate using technical sulfur. Installed, the optimum leaching conditions sulfided waste. Presented results of microstructural analysis of electron-rhenium-osmium concentrate.