

## 15. SIMPOZIJ „ MATERIJALI I METALURGIJA “ – dopuna „Zbornik sažetaka“

## 15th SYMPOSIUM „ MATERIALS AND METALLURGY “ – supplement „ Book of Abstracts “

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*Ključne riječi* : metalurgija, simpozij, sažetak, zbornik, časopisi

In Metalurgija 62 (2022) 2, 547-576 published „ Book of Abstracts “ (323 Abstracts). Deadline for received of Abstracts was October, 31, 2021 y. Many authors have request new deadline by December, 31, 2021 y. Organizing committee have accept new deadline. Now it published supplements of 73 Abstracts.

*Key words* : metallurgy, symposium, abstract, book, journal

### 1. V.A.Leibenson, A.M.Golovachov, I.Mamuzić, G.P.Stovpchenko

**Technology of Manufacture of Multilayer Composite Rapid Steel.** The chemical compound and structure of multilayer rolled bar in diameter of 12 mm by the method of macro- and microstructural investigation as well as microroentgenspectral analysis was under study. Dense connection of layers with smooth charge of chemical compound in transitive area is received. The tool from multilayered rapid steel has cost on 10 to 15 % below monolithic and is characterized by a high complex of properties.

### 2. A.Gigović, H.Avdušinić

**The Morphology and Distribution of MnS in Low Carbon Steel.** Non-metallic inclusions are very important (harmful) in steelmaking practice. After oxygen, sulphur is the most important non-metallic element in field of steel metallurgy and sulphides therefore from a second important group of inclusions. If a molten steel containing as little as 1 ppm of oxygen and sulphur then steel contains  $10^9$  to  $10^{10}$  non-metallic inclusions per tone in solid state. In this paper are presented results of the investigation of the shape and distribution of MnS inclusions in low carbon steel.

### 3. V.Petrychka, F.Kovac, Y.Sidor, M.Dzubinsky

**Effect of Rapid Heating on Columnar Grain Growth in Non-Oriented Electrical steels.** The microstructure creation of electrical steels depends on heat treatment conditions. It was experimentally shown that temper-rolling process produces a concentrated deformation on the surface. This type of deformation together with strong temperature gradient, as a consequence of rapid heating, present a high driving force for directly abnormal grain growth in semi-processed non-oriented electrical steels.

### 4. G.E.Kodjaspurov, P.A.Drakatos, C.G.Park

**Preliminary Thermomechanical Processing of Middle Carbon Low Alloyed Steels.** It has been studied the effect of PTMP applying to low alloyed steels with 0,4 to 0,6 % carbon on its micro- and fine structure (using light and TEM microscopy) and mechanical properties. It is shown that PTMP with the use cold rolling in the idle rolls is effective method to improve cylindrical stepped (type axles and shafts) stocks for machine parts. It is found that optimal PTMP parameters realization results in the growth of resistance of the steels to plastic deformation and to brittle fracture simultaneously.

### 5. A.A.Vnukov, I.Mamuzić

**Research of Iron-Based Powder Functionally Graded Material (FGM).** The subject of this research is FGM on the basis of Fe-Cr-Ni-Mn-C system, obtained by powder metallurgy method. The basic layer is constructional powder steel with hard-strength properties. The purpose of this investigation is to research the mechanical properties as well as corrosion resistant of the material. Author also proposes ways of solving problems arising from incompatibility of thermal expansion coefficient of the different FGM layers.

### 6. A.Topčić, DŽ.Tufekčić, M.Jurković, N.Zaimović-Uzunović

**Influence of Process Parameters on Axial Breaking Force of parts Produced by Selective Laser Sintering Process.** Influence on process parameters is analysed in this paper (laser power and scan velocity), as well as post processing influence on value of axial breaking force of the parts produced by SLS process using material DM50 – V2, on machine EOSIMT M250, producer EOS Munich, Germany.

### 7. A.F.Sanin, P.A.Mironenko, I.Mamuzić

**Obtaining new Dispersion-Strengthened Materials using Powder Metallurgy Technologies.** The possibility to manage the processes of materials structure and properties forming using time-temperature parameters of sintering is proved. The analysis of obtained results allowed to ground the mechanisms of elements re-distribution and grain structure evolution during liquid-phase sintering.

**8. S.Gubenko, V.Bespalko, E.Zhilenkova**

**Evolution Dislocations Structure at Deformation and her Influence on Properties Steel with the Various Matrix.** The analysis of interrelation of structure and properties chromium-nickel steel has shown steel, that development of process dynamic recrystallization facilitates destruction of steel at hot deformation. Formation of a substructure with fewangular borders, relaxations of peak pressure and raise plasticity of chromium-nickel steel.

**9. L.L.Rokhlin, N.R.Bochvar, I.Mamuzić, E.V.Lysova**

**Kinetics of the Solid Solution Decomposition in Al-Mg Alloys with Ce and Y at Temperatures 150 to 200°C.** Hardness change and electrical resistivity change during ageing of the Al-Mg alloys containing small contents of Ce and Y were studied. The alloys contained 7 to 16 mass % Mg and up to 0.6 % Ce or Y. Investigation showed, that strengthening effect due of the solid solution decomposition was revealed after long ageing time and depended on Mg contents in the alloys. Cerium and yttrium delayed solution decomposition in AL-Mg alloys. This fast should effect favorably on resistance against intercrystalline corrosion of the alloys.

**10. D.Taloi, L.Vladutiu, I.Constantin**

**Computerized Calculation of the Thermodynamic Functions for Li-Mg Binary Alloy System.** The aim of this paper is to realize a computerized thermodynamic analyse of Li-Mg binary alloy system, based on an interaction model-subregular solution partially ordered (SSSRPO) which take into consideration the probability of ordered elements apparition in alloy melt due to their non additively of the differed nature atomic bond.

**11. R.Križanić, I.Mamuzić**

**Statistical Processing of Mechanical Properties of N80 Quality Casing Tubes.** The paper presents statistical processing of the test results of mechanical properties of Casing tubes according to the API 5 CT standard and N80 quality degree. Statistical processing was made by means of Gauss' curves and controlling boundaries. Through the processing of the results the stability of the manufacturing process, i.e. high tubes quality intended or oil industry, was acknowledged.

**12. A.V.Kudrya, E.A.Sokolovskaya, V.G.Sukhova**

**Multi-Size-Scale Structures and Toughness of Structural Steel.** The fracture analysis is preferentially qualitative and estimation of structure heterogeneity is subjective too. Estimation methods of plasticity and toughness reserve based on measuring of structural heterogeneity and fracture surfaces at different scale levels are offered in this work.

**13. G.Galchenko, I.Mamuzić, O.Chygyrynets', G.Stovpchenko**

**Preserving Composition for Anticorrosive Protection of Reinforce Bar.** Authors worked out the preserving composition for temporarily protection of reinforce bar from corrosion. This one is water soluble and is manufactured from vegetable wastes. The investigation of mechanism of anticorrosive action of preserving compound and its effect of surface layer of metal quality of reinforce bar due to improvement of rolled products' outward and properties.

**14. Z.Kolumbić, D.Krumes, I.Vitez**

**Electrochemical Measurements on Pilot Plant for the Investigations of Hot-dip Galvanized Pipe Corrosions.** After a short introduction, the first part of the paper describes the pilot plant with pipe specimen assembly series. The second part of the paper presents the performed electrochemical measurements without computer aids and displays an example of the obtained final results. The third part of the paper is devoted to the development of the system for the computer aided monitoring of the mixed electrode potentials and electric currents between short circuited specimens.

**15. S.A.Nikulin, V.G.Khanzhin, I.Mamuzić**

**Corrosion Fracture Mechanisms of Zirconium Alloys in Iodine Containing Environment.** Tests of thin-walled tubes made of industrial zirconium alloys E110 and E635 (including a new modifications of these alloys) for stress corrosion cracking (SCS) in an aggressive corrosion environment of iodine-methanol have been carried out. Time to failure of alloys is determined and corrosion damageability is assessed. Corrosion fracture mechanisms observed in zirconium alloys are analyzed on micro and macro levels.

**16. J.Ševčíková, A.Ševčík**

**Metallographic analysis of low-carbon steel corroded in the atmospheric exposure.** The paper deals with the metallographic analysis of low-carbon steel STN 41 1523, 1 after 1,3,5,10 years exposition in the town environment. The results of corrosion and interface of phases steel-corrosion product are given. The shallow corrosion pits deepen during corrosion exposition. Corrosion effect is connected with thickness decrease and change of surface steel morphology. Ability of a steel STN 41 1523 to maintain serviceability in a given corrosion system is therefore terminable.

**17. M.Hagarová, J.Ševčíková, S.Tuleja**

**The structure and properties of PVD coatings.** The main application of TiN films deposited on metal materials by Arc – PVD method lies in increasing of wear resistance. The paper presents results of measurement of mechanical properties of 4 mm thick TiN coating deposited on high-speed steel. The hardness was measured by nanoindenter and the adhesion by scratch test. The structure of TiN film was evaluated by SEM microscopy.

**18. D.Jakubeczyová, M.Fáberová**

**Microstructural Properties of Surface Coated P/M Tool Steel.** The microstructure of surface regions, the hardness increase, the nitriding case depth, three point bending strength and other important characteristics were investigated. It found out that the manufacture quality and the surface hardness of the specimens processed via the techniques were increased to 25-30 %.

**19. G.A.Filipov, M.V.Hlichev**

**Plasma Technologies for the Surface Treatment of Metal Product.** Plasma hardening and nitriding of railway wheels is the most successful of these technologies. The plasma treatment of the critical area of the wheel flange doubles wheel life, so the procedure is widely used by Russian railway now. Very promising is the recovery of worn railwa frogs made of manganese steel using plasma spray coating. Another application of the plasma technology is the coating of copper molds of continuous casting plants with wear resistant refractory layer of Cr-Ni alloy.

**20. A.I.Derevjanko, A.I.Mikhayov, I.Mamuzić**

**Computer Modeling of Grain's Growth at Sintering Nano-Materials.** The computer model of grains structure evolution during nanomaterials reception by sintering is developed. The influence of temperature factors of sintering and dispersion of powder for the growth rate of grains is investigated. The computer modeling has shown, that intensification of grains growth is a consequence of fractal properties of structure building processes in the enviroment of nanoparticles making chaotic fluctuation.

**21. E.K.Beza, O.O. Kochubey, I.Mamuzić, D.V.Yevdokymov**

**Mathematical Modelling of Initial Stage of Phase Creation.** The main idea of the present work is to use asymptotic (small parameter) approach to the problem, according to which the temperature field in the new phase is searched as a series by orders of small parameter proportional to its thickness. In particular, zero approximation coincides with well-known thin body approximation (tangential to new phase thermal flux is neglected, and linear temperature distribution in normal direction takes place).

**22. Y.Sidor, F.Kovac**

**Modelling of Microstructure Creation in Non-Oriented Electrical Steels.** The kinetics of the primary and secondary recrystallisation in different types of non-oriented electrical steels is discussed. As a first approximation, the ferrite grain growth behaviour was analysed by applying the general equation for grain growth. The activation energy for grain boundary motion in both semi-processed and fully processed steels was calculated. The idea of anisotropic grain boundary mobility is applied to the columnar growth description. It is shown that the value of activation energy for columnar grain development along progress normal direction is higher than one for rolling direction.

23. N.Grechanyuk, V.Osokin, I.Grechanyuk, I.Mamuzić, V.V.Bukhanovskii  
**The effect of Thermal Treatment on Structure and Mechanical Properties of Composite, Condensing from a Steam Phase, Material of the System Cu-Zr-Y-Mo.** The paper presents the results of influence of thermal treatment on structure, hardness, short-term strength, plasticity, and fracture behavior of laminar composite material of the system Cu-Zr-Y-Mo, obtained by the method of electron bombardment evaporation and layer-by-layer condensation from a vapor phase in the temperature range from 290 to 1070 K.
24. V.K.Zhukovskyy, I.Mamuzić, O.R.Gokhman  
**X-Ray and Optic Method to Determine the Residual Strees in Textured Materials.** Residual stress are determined on generalization of Hook`s law for textured materials. Suggested method is tested on a alloys of titanium with hexagonal symmetry of crystals and on brass alloys with cubic symmetry of crystals. It is formed the qualitative agreement method and between the results on suggested method to determine the residual macrostress on changing of the interplane distance.
25. A.V.Puchov, M.A.Shtremel  
**Diffraction Method of estimating Plastic Anisotropy of Cold-Rolled IF Steels.** Development of the production technology of deep-drawing IF-steels at JSC "Severstal" has needed a fast and reliable method of X-ray definition of plastic anisotropy (Lankord parameter  $r$ ). The suggested method allows defining  $r$ -value from  $C_{\mu\nu}$  – coefficients of texture distribution function of orientations (ODF) :  $C_{400}$ ,  $C_{420}$  and  $C_{440}$  by Bunge method using of optimum measuring values  $C_{\mu\nu}$  from reflection intensities of only one crystalline plane {hkl}.
26. V.I.Slavov, O.M.Naoumova, I.Mamuzić  
**Determination of phase Composition in the Steel Rolling Surfacing Defects by X-Ray Analysis.** The measurements of the numerous surface defects in hot-and-cold rolled steels and different sources of metallurgical production were done using X-ray Phase Analysis technique. The X-ray Classifier for surface defects in rolled steel was carried out. Identification of the defects origin promotes an improvement steel-making and rolling technology.
27. L.L.Rokhlin, T.V.Dobatkina, N.I.Nikitina  
**Investigation of Ageing and Properties of the Mg-rich Mg-Ce-Y alloys.** The system Mg-Ce-Y is another example of this kind alloys. Investigations showed, that addition of Ce to Mg alloys containing Y results in shortening of Mg supersaturated solid solution decomposition and enhancement of the strengthening effect during ageing. As a result, the strength properties of the Mg-Ce-Y alloys surpass those of Mg alloys with these rare-earth metals added separately.
28. N.A.Volchok, N.M.Shkatulak, I.Mamuzić  
**Influence of Plastic Processing on Elasticity and Dislocation Non-Elasticity of Technical Titanium.** The research of the elastic and non-elastic characteristics at quasi-static of the loading-unloading in elastic area of technical titanium is carried out. The drawn loop of a mechanical hysteresis caused by convertible movement dislocations is observed. In annealed titanium as well as in rolled up to 20 and 40 % of deformation titanium the observable loop of a hysteresis can be described by the generalized Granato-Lukke model of breaking off.
29. F.Lofaj, F.Dorčáková  
**Viscosity of La-Si-Mg-O-N Glasses with Different Nitrogen Content.** Viscosity dependencies of six La-Si-Mg-O-N glasses with nitrogen contents from 0 to 28 e/o prepared by gas-pressure-sintering were investigated in the temperature range from 750° C up to 910°C in order to reveal the effect of nitrogen on viscous behavior of glasses. Viscosity was increased by  $>10^5$  times and glass transition temperature ( $T_g$ ) increased by 110°C and linearly with nitrogen content.
30. R.Budzik  
**Metallurgical Properties of Iron Ore Sinters Produced on the Sinters with the use of Air Overpressure.** Using of excess pressure of air given on the surface of sinter blend has caused the increase of productivity of sintering strips. The sinter produced using this technology is characterized by better strength properties, it was ascertained, that the mineralogical composition of sinter is affected by overpressure of air, as well.
31. V.I.Shatokha, O.A.Gogenko, I.Mamuzić, V.D.Ashikhmin  
**Sinter and Pellets Production Using Metallurgical Wastes.** The cost-effective technology of preparation various kinds of wastes (ferric sludge of different metallurgical processes, and oiled rolling scale) for sintering, providing their mixing with effective humid-absorbing adding – activated peat-is presented. The processes of mass transfer under conditions of peat and various wastes interaction as well as influence of wastes preparation parameters on processes operation and quality of a ready product are investigated. Results of industrial application to utilizing of wastes for iron ore sinter and pellets production are presented.
32. E.K.Isakaev, P.P.Ivanov, I.Mamuzić  
**Thermodynamics Analysis of the Plasma – Based Smelting-Reduction of the Iron Ore.** The major reasons for the lack of progress in the commercialisation of this are associated with the expensive electric energy and the technical hurdles on the way to develop high-power long-lived plasmatrons. Assuming lately some progress in the plasmatrons development the energy-effectiveness of the reduction process is considered in detail using thermodynamics of a sample set of reactants including FeO, CH<sub>4</sub>, and O<sub>2</sub>. The mathematical model is developed for the reduction process in a two-phase flow under intensive radiation from plasma core.
33. H.M.Yu, J.Bilik  
**Kinetic Model of Iron Ores Reduction and its Application to Burden Optimisation in Ironmaking Process.** This paper deals with the kinetic mathematic model of iron ores reduction in blast furnace. In this study the ore reducibility and coke reactivity have been taken into consideration. Application of this model to optimisation of burden composition in ironmaking process was investigated as inverse problems.
34. O.V.Sotsenko, I.Mamuzić  
**Structure of Abnormal Graphite in the Modified Pig-Iron.** In work investigated morphological anomalies of structure of compact inclusions of graphite in cylindrical having cast from modified Mg of pig-iron. It is established, that in Fe-C alloys modified Mg at various speeds of cooling the "abnormal" inclusions of graphite are observed, which morphology essentially differ from "ideal" spherical inclusions. As a hypothesis explaining variety of "abnormal" inclusions of graphite in Fe-C alloys, modified Mg, the concept of the aggregate mechanism of their formation from smallest pyramidal blocks is offered.
35. L'.Mihok  
**Beginnings of Iron Production in the Carpathians Basin.** Metallographic analysis of two iron blooms, dated to 6<sup>th</sup> century B.C. is presented in the contribution. Macrostructure and microstructure of blooms is discussed. On the basis of metallographic analysis results the conclusion were formulated, that concerned course of reduction processes in primitive reduction furnace and formation of the iron bloom. An information about bowl furnace, typical for beginnings of iron smelting in hall stat time in the central Europe, is also included.
36. A.I.Michaliov, V.A.Gladkih, V.F.Lisenko, N.V.Lisaja, T.E. Vlasova  
**The Optimum Selection of Components for Multicomponents Mixture in Processes of Ferro-Manganese Smelting in the Conditions of Fuzzy Data.** The computation algorithms and software of mixture receipt (FeMn, SiMn) of set chemical composition in the conditions of unclear maintenance of chemical elements in the mixture components are worked up with calculation of chemical elements maintenance in initial concentrate, manganese distribution coefficient in mixture baking. A program product is competent on recommendations delivery on optimum selection (on measure of value) of initial components and their parts for receipt of alloys of set composition.

37. A.I.Derevjanko, A.I.Mikhalyov, Ń.Ĺ.Vlasova  
**Wavelet-Fractal Analysis Information Characteristics of Ferroalloy Production.** Questions of the application of *WaveLet* – fractal analysis for the exposure of features of informative descriptions of the ferroalloy process, in particular, - on the example of such major description as specific capacity of the furnace are considered in work. Fractal invariance is a features sign of dependencies at their scaling. In its turn *WaveLet* transformation is spectral presentation of fractal temporal rows.
38. V.Sheremet, S.Troschij, I.Mamuzić, A.Kekuh  
**Control and Optimization of Oxygen Activity in Converter Steels.** The researches of oxygen activity in converter steel were carried out in purpose to definition dependent factor of metal quality. The measuring with sensors has shown the undoubted dependencies between oxygen activity in melts and losses of ferroalloys and, to some extent, a quantity of inner and surface defects. The possibilities of oxygen content optimisation for different kinds of steel were investigated and techniques for oxygen activity stabilisation were proposed and tested that allow to increase the efficiency of deoxidation and quality of rolled metal.
39. M.Warzecha, J.Jowsa, S.Garnearek, T.Merder  
**Numerical Modelling of Fluid Flow into Ladle During Bottom Gas Injection.** The fluid flow phenomena and mixing characteristics in the ladle furnace during bottom gas injection was investigated. Mesh was generated in GAMBIT and commercial computer program FLUENT was used for calculations. Different bubble diameter were determined for different gas flow rate. The Ar gas was injected through eccentric bottom porous material. Investigations show that mixing time is strongly depend on gas flow rate and weakly on place of injection on the ladle bottom.
40. J.Bažan, L.Martinek  
**Effect of the Manufacturing Techniques on the Spurious Elements Reduction in the Steel.** In the paper is evaluated possibility of steel cleanness and quality increasing from view of gas content, harmful elements (phosphorus, sulphur) and carbon reducing on as little as possible contents. In harmony with trend of contents of mentioned elements was analysis aimed on steel making technologies making possible their reducing on contents:  $[H] < 1$  ppm,  $[N] < 15$  ppm,  $[O] < 5$  ppm,  $[P] < 50$  ppm,  $[S] < 10$  ppm,  $[C] < 10$  ppm. For evaluation were used dana about heats and these were then statistically processed.
41. J.Pelichovský, J.Mráček, Z.Adolf  
**Utilization of Metallic Waste Raw Materials with Metallurgical Origin at Steel Production.** Presented paper is engaged in results of monitoring of particular dump, that arose in middle 20<sup>th</sup> century. Monitoring was aimed on finding of steel scrap share including its location on the dump, on quality of non-ferrous metals and further materials of metallurgical, energetic, building and communal origin. Monitoring consisted in determination of shares of component obtained from deep-hole drills top level to bottom layer of dump, their chemical composition and phase analysis.
42. D.Stavrev, D.Rusev, I.Mamuzić  
**Temperature Field of Plasmatic Pattern in Thermal Cycling.** Paper deals with the temperature field analysing of a prismatic pattern made of die steel 4Ch5MFS (H11) during the processes of heating in melted aluminium alloy and cooling water. It's aimed to study the kinetics of the temperature distribution in parts and conditions closed to the exploitation – die casting pins. Analytical decision of simplified version of the formulated task and numerical decision using the software ANSYS 5.5 were done. In both of the cases the boundary conditions are specified by deciding the opposite task of the heat conductivity using the experimental time-temperature curves.
43. A.V.Kekuh, Y.S.Proydak, L.V.Kamkina, R.V.Ankudinov  
**Utilization of Iron-Containing Wastes by Reduction Processing Method.** One of the most hardly utilized kind of iron-content wastes is a alx of rolling process. The technology of calx and dust from electrofilters utilization was worked out using organic carbon-content materials as a reducing agent. High reaction ability of the suggested reducing agent was determined and their positive influence for palletising of wet and oiled iron-containing materials, using for getting sputtered semi-finished products. The semi-finished products may be used as iron addition in steel making process.
44. D.Gubinskaya, K.Kovalchuk, M.Gubinskiy, I.Mamuzić  
**The Efficiency of Emissions Reduction in Metallurgy.** In the present work the efficiency of measures on energy-saving is considered and the conclusion is made that the expensive measures on energy-saving can become profitable for the metallurgical enterprise after the realization in the world carbon market of reduced emissions units (ERU). The given approach was tested at the replacement of coke by natural gas by manufacture of pig-iron at the enterprise "A", which profit has made \$ 6,3 million.
45. P.Aulich, A.W.Bydalek  
**The Mass Transfer on the Slag-Liquid Metal Interphases.** Influence of liquid metal and slag in approximate way can be described by double electric layers. Using this, the influence going on during metals melting has been worked out and shortly introduced on the example of refined liquid metal with carbon-cyanamid slag solution. Influence on liquid metal's structure and chemical composition, have been taken under account. Processes occurring during chemical refining activating by means of slag have been introduced too.
46. O.O.Kochubey, I.Mamuzić  
**Matematical Modelling of Metallurgical Processes in Micro Gravity.** As a result, there are possible only diffusion thermal conduction processes and slow fluid flows, what leads to using of Onsager's equation system and Stokes flow as mathematical models of heat and mass transfer and hydrodynamics in micro gravity. Of course, so unusual mathematical models require development of special calculation method. A family of numerical methods, based on potential theory and asymptotic methods, is proposed. The considered problem is illustrated by several examples of numerical calculations.
47. E.K.Bevza, O.O.Kochubey, I.Mamuzić, D.V.Yevdokymov  
**Matematical Modelling of Slow Phase Transitions.** Several analytical solutions are obtained for one-dimensional (in space) one –phase and two – phase problems. Boundary element method together with Euler scheme for time integration is used for two-and three-dimensional problems. The effectiveness of the approach is confirmed by test problem solutions. Applications of proposed approach to metallurgical problems are discussed.
48. A.V.Syasev, I.Mamuzić, V.A.Syasev, A.A.Kochubey  
**Building up the Hollow Cylinder Having Inner Surface of Crystallization Stage.** The model of building up viscoelastic two phase heated body is developed. The analytical solution of the problem of building up hollow viscoelastic cylinder, having the inner liquid phase, modelling the process of centrifugal casting of pipes, is solved. It is shown that taking into account the creep, disclose the essential stresses dependence, including residual ones, of building up velocity.
49. V.B.Veselovskiy, I.Mamuzić, R.B.Berlov, V.Y.Klim  
**Calculation Methods of Temperature Fields Under Influence of Fields of Different Physical Nature.** For the solving of formulated non-linear problems approximate analytical method (based on the method of successive intervals), numerical and analytical method (that amounts to the system of differential equations) and numerical method are offered. The comparison of solution methods for different kinds of the problems of metallurgical heat engineering such as thermal protection, thermal isolation, warm-up and restoration of iron-ore stuffs is carried out.
50. V.B.Veselovskiy, V.Ř.Syasev, I.Mamuzić, V.V.Veselovskiy  
**Thermal Regimes Control in Metallurgical Processes.** The results of experimental data working and generalization on contact heat exchange with taking into account thermal, mechanical and manufacturing factors are quoted. The application boundaries of obtained calculated relations and the results of comparison with criteria relations known from the literature are shown. Methods and ways of thermal regimes control with the use of parameters of imperfect thermal contact in the process of casting are presented.

- 51. V.B.Veselovskiy, V.V.Nikul'nykova, I.Mamuzić**  
**Identification of Thermal Parameters on the Basis of Thermal Experiments Data.** The problems of identification of thermal parameters on the basis of thermal experiments data are interpreted. With the use of burning device as an example BC are obtained on the flame wall (surface temperature, heat flow and heat transfer coefficients) and the TC of wall material while the device is in use are determined.
- 52. M.Jurković, I.Karabegović, H.Rošić**  
**The Theoretical Fundamentals and Experimental Analyse of Flow Forming Process.** The rotating pressing out has wide application at the cylindrical part producing. In the paper is made the theoretical analyse of stress strain at the forming at the forming zone as well as the forces ( $F_A, F_r, F_R$ ) component analyse. At the experimental process analyse is shown three component sensor tool for measuring of pressing out force components and special origin tools with building sensors for measuring of contact normally stress ( $p_n$ ) and tangent stresses ( $T_x, T_y$ ).
- 53. M.V.Markushev, I.Mamuzić**  
**Mechanical Properties of Submicrocrystalline Commercial-Aluminium Alloys Processed by Severe Plastic Deformation via Angular Extrusion.** Data on ambient temperature mechanical properties of submicrocrystalline commercial aluminium alloys are reviewed. The combination of strength, ductility and crack resistance characteristics achievable is comparable to, or even better than, that found in many high-strength conventionally treated precipitation-hardened alloys. For most of heat treatable alloys, the use of treatment involving severe plastic deformation for improving mechanical properties due to submicron structure processing is less effective. The nature of the effects of severe straining on aluminium alloys structure and properties is discussed.
- 54. A.M.Dolgansky, D.U.Klyuev, N.N.Ocheretnaya, I.Mamuzić**  
**The Influence of the Microrelief Preparation Anisotropy on the Efficiency of Rotating Die Using.** The rod microrelief formation was investigated at various modes of metal preparation to drawing. It was shown theoretically and experimentally that the simultaneous increasing of the cross direction roughness and the die frequency of rotation raise the efficiency of process. The especial expediency of the rotating die using for the rod deformation after scale breaker was proved.
- 55. A.M.Dolzhanskiy, I.I.Lomov, O.S.Yermakova, I.Mamuzić**  
**Rational Parameters of Roller Scale Breaker for Steel Rod.** Power conditions of a rod drawing were explored experimentally and theoretically in roller scale breaker before drawing taking into account friction on rollers surface. Computation exactness was increased twice. A new parameter of work efficiency was offered for roller scale breaker. Rational geometrical correlations were definite for scale breaker. The scale breaker for thick (12 mm) rod with providing minimum energy-expenditure and high quality of cleaning was created and mastered.
- 56. I.N.Lomov, A.Ā.Dolzhanskiy, O.B.Lomova**  
**Extraction Affecting on Polymeric Double Component Lubricating Tape Durability While of Drawing.** Experimentally a process of drawing steel rod with the use of polymeric protective double component lubricant is explored. It was definitude that integrity of remaining on wire tape was satisfactory in case of extraction 1.1 ... 1.3.
- 57. D.Ćurčija, I.Mamuzić**  
**Forces Affect on the Process of Material Drawing.** In the paper, it has been shown that rheologic features of lubricates at boundary lubrication space follow the general form of regressive analysis in this mathematical record ;  $Y=a(X)^{-b}$ . The regression coefficients in operating cases have the values;  $a \approx 10^{-7}$ ,  $b \approx 1/2$ . The result shown above may be useful for modelling of die inlet clearance.
- 58. I.Mamuzić**  
**The Process of Improving Corrosion Stability of Phosphate Coating with Higher Layer Weight on the Surface of Iron Steel.** The goal of the paper is to ensure, by adding some specific organic matters into the basic phosphate bath, which is used for tube preparation before the cold deformation of metal, change of its features as for creating an increased-weight coating. As the matter of fact, an essential improvement of corrosion stability of coating is achieved by providing a phosphate coating of increased weight. For example, the required weight for hydraulic tubes is  $> 15 \text{ g/m}^2$ . An essential increase of mass is registred in coating prepared in phosphate bath with additional of organic acid.
- 59. V.G.Trifonov, I.Mamuzić**  
**Superplastic Die Forging – Problems and Ways o their Solution.** The problems of increasing the efficiency of isothermal die forging of aluminium alloys by using the effect o structural superplasticity and determining most advisable fields of its application are discussed. Methods for processing of homogeneous microcrystalline structure in bulk billets are described and ways for increasing the procedure effectiveness are proposed. The influence of superplastic deformation on grain structure, aging kinetics, mechanical and corrosion properties of aluminum alloys is shown.
- 60. M.Jurković, I.Karabegović, M.Mahmić**  
**An Analyse and Modelling of Spinning Process without Thickness Reduction.** It is gotten through spinning process the different axial-symmetric parts by acting spinning roller on blank of sheet metal, which is shaped through a chuck. In the paper is shown an analyse of stressed and strained state, forming force of spinning modelling process. On the ground of experimental results it is made mathematics modelling of spinning forming force. The obtained mathematical model describes enough accurate and reliable ( $P = 0,98$ ) the spinning forming forces.
- 61. S.Majkuthová, E.Weiss**  
**Discounted Cash Flow (DCF) Assessment Method and its Use in Assessment of a Producer Company.** Characteristic for the DCF methods is that the value of an enterprise is determined by discounting of future Cash Flows. The DCF methods are based on determining the discount rate from the models of theory of capital market, in general from the Capital Asset Pricing Model (CAPM). The market value of overall capital, or the market value of the own capital called „ Shareholder Value“ is considered to be the result of an enterprise assessment.
- 62. R.Križanić**  
**Standard ISO 9001.** To have a certificate ISO 9001 means to have an acknowledgment that the firm is able to realize manufacturing conditions, for a particular product in accordance with requirements of the purchaser. A third party, i.e. an authorized institution, issues the certificate. The quality is the most important item involved in the standard. Being a wide concept, the idea of quality is described through some significant characteristics able to explain it successfully.
- 63. O.Ya.Miroshnichenko, V.V.Mombelli**  
**Formation and Structure of Alkali-Vanadium-Phosphate Glass.** Glasses in  $\text{Me}_2\text{O}-\text{V}_2\text{O}_5-\text{P}_2\text{O}_5$  (Me-Li, Na, K, Rb Cs) systems are of interest as new materials having electronic-ionic conductivity. Anionic lattice consists of chains formed by  $\text{POO O}_{2/2}$ ,  $\text{VOO O}_{2/2}$  and  $\text{VOO O}_{4/2}$  polyhedrals, which relations and degree of polymerisation are determined by the glass formula. Submicroheterogeneous glass structure is ascertained. Degree of glass lattice disordering descends in series  $\text{Li} \ll \text{Na} \ll \text{K} \ll \text{Rb} \ll \text{Cs}$ .
- 64. O.Ya.Miroshnichenko, I.Mamuzić**  
**Structure and Physical-Chemical Properties of Semiconductor Glasses in  $\text{V}_2\text{O}_5-\text{P}_2\text{O}_5$  System.** As the concentration of  $\text{V}_2\text{O}_5$  rises, the number of vanadate chains increases, and in glasses containing over 60 mole % of  $\text{V}_2\text{O}_5$  the three-dimensional vanadate lattice is formed. In this connection, binding energy of structural elements of anionic lattice, which value has been calculated for these glasses, descends. As vanadate groups have a lot of micropores, higher  $\text{V}_2\text{O}_5$  content results in increasing molar volume, thermal longitudinal expansi coefficient and brittleness of glass.

**65. S. Baisanov, V. Tolokonnikova, G. Yerekeyeva, G. Narikbayeva, I. Korsukova**

**Thermodynamic-diagram analysis of the Fe-Si-Al-Mn system with the construction of diagrams of phase relations.** In the practice of complex theoretical studies of multicomponent systems, the so-called thermodynamic-diagram analysis method is known, which greatly simplifies the study of the features of phase transformations in multicomponent systems by dividing them into thermodynamically stable elementary partial subsystems of the same dimension as the main one. Thermodynamic-diagram analysis combines a thermodynamic assessment of the chemical interaction of components in the system under study with a geometric diagram. Such a combination, as studies of the physico-chemical bases of the production of refractories and ferroalloys have shown, turns out to be productive when interpreting chemical interactions in complex systems.

**66. Ye. Zhumagaliev, G. Yerekeyeva, A. Nurumgaliev, O. Mongolkhan, A. Davletova, G. Sagynbekova**

**Thermodynamic-diagram analysis of the Fe-Si-Al-Cr system with the construction of diagrams of phase relations.** The Fe-Cr-Si and Fe-Cr-Al systems are the basic ones in the development of the technology for smelting a new complex alloy - aluminosilicochrome. Aluminosilicochromium can be used as a reducing agent for metallothermic production of low- and medium-carbon ferrochromium grades with subsequent use in the smelting of stainless steel grades. Construction of a diagram of the phase composition of a four-component system Fe-Si-Al-Cr, consisting of 4 three-component systems Fe-Si-Al, Fe-Cr-Si, Fe-Cr-Al, Si-Cr-Al. Three-component Fe-Si-Al system, which will be the base of the Fe-Si-Al-Cr tetrahedron. It is necessary to analyze the thermodynamic properties of compounds for binary and ternary systems.

**67. F. Yang, Zh. Tong, Sh. W. Zou, Zh. Y. Li, Z. J. Shen**

**Pelletizing Analysis of Cylinder Pelletizer on MgO-fluxed Pellets by.** Abstract : Discrete Element Method (DEM) was used to analyze palletization process of MgO-fluxed pellets in cylinder pelletizer. The effects of the charge ratio and rotational speed of the cylinder pelletizer on the behavior of MgO-fluxed pellets were investigated by using the simulation. The simulation results show that under the condition of a certain gradient angle of the cylinder pelletizer (The gradient angle is  $3^\circ$ ), the suitable parameters of the cylinder pelletizer are that the charge ratio is 3 % and the rotational speed  $N_c$  / critical rotation speed  $N_c$  is 0,3.

**68. A. Nitsenko, V. Volodin, X. Linnik, N. Burabaeva, F. Tuleutay**

**Behavior of copper chalcogenides during vacuum-thermal processing.** The obtained results indicate a very low probability of separation of compounds into copper and chalcocogen by dissociation under vacuum-thermal processing conditions. Liquid-vapor phase transitions in binary systems  $Cu_2S - Cu_2Se - Cu_2S - Cu_2Te$ , and  $Cu_2Se - Cu_2Te$  at low pressures of 15 and 0,7 kPa are constructed, based on the vapor pressure of copper chalcogenides. It is shown that the separation of chalcogens is one stage by thermo-vacuum treatment of mattes at a technological pressure of 0,7 – 15 Kpa is not possible.

**69. S. Zh. Oralbayev, Y. Shambulov, G. A. Smailova, O. K. Abdirashev, A. Bukayeva, D. Yergaliyev, A. Tulegulov, A. Zhauyt**

**Theoretical background of the restoring of the crankshaft necks by ferromagnetic materials welding.** It examined the heat release from the pad weld and its cooling rate. The temperature of a part of the pad weld located in each sector is constant throughout the whole volume, so its heat is emitted into the environment in three ways : convection heat transfer; radiant heat transfer; heat transfer in the base metal of the shaft neck. Based on the above mentioned procedure, a numerical method was used to predict the temperature of the pad weld and its cooling rate. For its implementation, the necessary calculations were made according to a compiled program in the QBASIC language. On the basis of these provisions, the theoretic background is proposed for the possibility of the wide-ringed welding of crankshaft necks, which ensures a minimal change in the structure and geometry of the crankshafts.

**70. Z. B. Karshyga, A. A. Ultarakova, N. G. Lokhova, A. M. Yessengazyev, E. I. Kuldeyev, K. K. Kassymzhanov**

**Study of fluoroammonium processing of reduction smelting dusts from ilmenite concentrate.** The article presents the results of studies on the processing of fine waste dusts of electric smelting of ilmenite concentrates. The main silicon impurity was preliminarily removed from the dusts. The process of dust fluorination with titanium fluorides extraction is studied. The influence of temperature and time on sublimation degree of titanium fluorides was studied. The optimum conditions for sublimation of titanium fluorides were determined:  $T=600^\circ C$ , time – 2 hours. The extraction of titanium in sublimations was up to 99 %. The X-ray phase methods showed that phases of heptofluorotitanate, hexafluorosilicate and ammonium hexofluoroferrate are present in the sublimations. Process conditions have a strong influence on predominance of this or that phase in sublimations. The investigation of sublimation of impurity components during fluorination of sintered titanium showed that iron, manganese, chromium sublimed together with titanium at a rather low degree.

**71. T. Q. He, Y. Gao, L. Y. Huang, Z. J. Xue**

**Strength Analysis of shearer body based on Ansys.** Taking a certain type of shearer as the research object, using the large-scale finite element analysis software ANSYS, according to the actual situation of load distribution, the stress model of the shearer body is established, the stress and deformation of the shearer body are analyzed, and the deformation curve and equivalent stress nephogram of the shearer body under working state are fitted. The stress and strain distribution of fuselage structure under working conditions are analyzed. The calculation results show that the structural design of the shearer body is more reasonable and has better stiffness and strength under normal working conditions. The calculation results have a certain reference value for the analysis and research of high-power shearer.

**72. T. Karkoszka**

**Industrial safety in Metallurgical Company.** In the study, one has presented the scheme of solutions within the range of safe realisation of the processes and loss prevention, concerning both: technical aspects of used technological and measurement control devices as well as the organisational aspects of processes realisation. For the chosen threats one has proposed actions for prevention, protection and limitation realised as technological and organisational layers of protection, which can be applied in the regular conditions as well as during dangerous event.

**73. Sz. Pawlak**

**Stability of the rolling process of ribbed bars based on the analysis of strength parameters.** The article presents the results of the strength properties of 12-24 mm ribbed bars used for concrete reinforcement. The strength properties and the ribbing geometry of the ribbed bars is a key factor in ensuring the safety of building structures. Therefore, the continuous analysis of the mechanical parameters of ribbed bars and the reasons for their change is essential for any rolling mill. This article aims to present an analysis, of the strength properties of ribbed bars made of high ductility steel in 2021 in a selected production plant, and then, based on the obtained results, to perform an analysis aimed at verifying the stability of the rolling process.