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Paper TitlePage
Preface

Evaluation of Wear Properties of Stir Cast AA7050 -10% B_4C *Ex Situ* Composite through Fuzzy-TOPSIS MCDM Method

Authors: Arvind Kumar, Ram Naresh Rai

Abstract: The present paper discussed the dry sliding wear and friction behavior of flux assisted stir cast AA7050-10% B_4C composite. The K_2TiF_6 flux improves the wettability of B_4C in molten aluminium. The casted composite were heat treated as per T-6 standard. The microstructure studies confirm the uniform distribution of B_4C with the layers of Ti compound around it. Both As Casted Composite hereafter called as ACC and Heat Treated Composite hereafter called as HTC under gone dry sliding wear test at room temperature. The experiments were designed using Taguchi L_{18} mixed design. The responses of the experiment were optimized using fuzzy-TOPSIS MCDM method. From the experimental investigation it was concluded that wear rate of the composite material is a function of normal loads and sliding speed. Moreover, wear rate, coefficient of friction and amount of heat generation for HTC is comparatively less than ACC. This may due to the homogeneous distribution of particles and also formation proper interfacial bond between matrix and reinforcements after heat treatment.

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The Elaboration of Modernized Technology of Controlled Rolling Directed at the Formation of High Strengthening and Viscous Qualities in HSLA Steel

Authors: Dmytro Laukhin, Oleksandr Beketov, Nataliia Rott, Anatoliy Schudro

Abstract: Under industrial conditions, it is common to avoid undesirable costly modernization of the existing equipment and increase the production efficiency. That is why as a basis of the solution to the scientific-applied problem, the authors took the idea of the adjustment of temperature-deformation regimes of metal-roll thick plate rolling for building constructions of the certain assignment in the way to initiate heterogeneous origination of ferrite on the polygonal boundaries of austenite as well as to form, before the finish rolling, as much as possible dispersed grain of hypoeutectoid ferrite. It must guarantee the formation of highly-dispersed final ferrite-perlite structure and the high level of strength and plasticity of the thick plate.

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Porous Structures and their Effect on Thermophysical Properties of Thermal Protection Elements

Authors: Anatolii Pavlenko, Andrii Cheilytko, Serhii Ilin Ilin, Hanna Koshlak

Abstract: The improvement of the thermal insulating material thermophysical characteristics of the thermal protection elements by studying the porous structure is a promising direction of research. The article describes the effects of the porosity and coupling of the porous structure on the thermophysical characteristics of thermal insulating materials. The article uses standard systematized techniques and instruments of scientific research applied in thermophysics. The research methodology of highly-porous material thermophysical properties is based on performance of empirical laboratory investigations of the samples obtained. It was found that for the pore structure effect on the material characteristics it is rational to use the following complex indices: porosity, number of pores, pore position in space, the pore form, pore formation energy. The article shows the effect of the porous structure on the thermophysical characteristics of the material. The complex parameters of the porous structure, which will allow to develop a new method of control of the porous structure, are proposed. As a result of the experiment planning method, the regression equation of an effective coefficient of thermal conductivity for porous thermal protection structures was developed. It was established that for a more even distribution of the mixture in a volume it is necessary to minimize the size of the dispersed components, thereby increasing the area of their contacts. The experimental method revealed that the moisture evaporation caused the formation of pores inside the clay. The shape of the pores was determined using electron microscope MMP-2P, both on the sample section and surface. The clearest clay has the greatest porosity (no iron oxide and calcium oxide). The pores have a spherical shape in it. The presence of impurities reduces the material porosity due to the increased clay viscosity.

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Statistical Express Control of the Peak Values of the Differential-Thermal Analysis of Solid Materials

Authors: Andriy Semenov, Serhii Baraban, Olena Semenova, Oleksandr Voznyak, Andrii Vydmysh, Leonid Yaroshenko

Abstract: The method of non-destructive control of the molecular structure of solid materials is improved, the distinguishing feature of which is a new sign of suitability for the peak values of the thermodynamic process in solid materials, which made it possible to increase the reliability of the non-destructive control. A statistical norm for deciding on the suitability of solid materials was introduced, which made it possible to organize statistical express control of solid materials under conditions of industrial production of electronic devices. In the practical plan, a structural scheme and an algorithm for measuring control of the peak values of the differential-thermal analysis of solid materials are proposed, on the basis of which a microprocessor based device for statistical express control is developed.

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Influence of Overheating and Cooling Rate on the Structure and Physicochemical Properties of Al-Cu Alloys

Authors: Nataliia Filonenko, Oleksandr Babachenko, Ludmila Bartashevska, Ganna Kononenko, Nikita Ivanov

Abstract: The effect of overheating of the melt and cooling rate of alloys of the Al-Cu system with a copper content of 25.0 – 36.0% (mass.), the rest of the aluminum is investigated. It is shown that an overheating of the liquid at 50 – 100 K above the liquid-liquid line leads to the formation of a fine-dispersed eutectic structure and the inhibition of the formation of primary aluminum crystals in the pre-evacuation of alloys and the Al_2Cu phase in hypereuvtectic alloys, in accordance. An increase in the melt overheating temperature by 150 K above the liquid-liquid line and the subsequent cooling at 10^3 – 10^4 K/s leads to the complete inhibition of the formation of primary crystals. An overheating of the melt on 100 – 150 K alloys above the liquid line and subsequent cooling with a velocity of 10^3 – 10^4 K /s reduces the rate of corrosion by 30 – 45% and increases the numerical value in 1.3 – 1.45 times the relative wear resistance, and the brittleness of alloys decreases in 1.2 – 1.35 times in comparison with the samples after casting.

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Characteristic of Possible Obtained Products during the well Underground Coal Gasification

Authors: Roman Dychkovskyi, Jaroslav Shavarskyi, Edgar Cáceres Cabana, Adam Smoliński

Abstract: This article is a summarizing of the results of the author's team on the establishment of technological parameters of underground gasification. It provides a justification of the final chemical and energy products that can be obtained as a result of complex physical and chemical transformations of coal. The thermodynamic processes of formation of the gasification source when changing the composition of the blast furnace mixture and the modes of its application to the georeactor are considered. Moreover, the change in the stress-strain state of rocks depending on the composition of the lateral rocks is taken into account. To better ensure the results are consistent with the well-known principles of thermodynamics and phase formation under the influence of the temperature field and the main chemical reactions occurring in complex gasification processes are presented. The main phase transitions in the georeactor are given for the maximum reception of different energy gases. Particular attention is given to the formation of an appropriate relationship between hydrogen and carbon monoxide, which form a synthesis gas. The Anderson-Schultz-Flory reaction is used to determine the maximum CO concentration in the outlet mixture. In general, the system for determining the material and thermal balance is proposed. These approaches were checked both for working out the coal reserves and for utilization of the mining waste products. Results of this investigation were included to the Roman Dychkovskyi thesis of the scientific degree of the Doctor of the Technique Sciences “Scientific Principles of Technologies Combination for Coal Mining in Weakly Metamorphoses Rockmass”. Also, this results were partially presented on international scientific and practical conferences “Forum of Miners” from different years. They contain the researches, which were conducted within the project GP – 489, financed by Ministry of Education and Science of Ukraine.

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Thermomechanical Controlled Rolling of Hot Coils of Steel Grade S355MC at the Wide-Strip Rolling Mill 1700

Authors: Oleksandr H. Kurpe, Volodymyr V. Kukhar, Eduard S. Klimov, Andriy H. Prysiazhnyi

Abstract: There has been developed technology, and pilot batch of hot rolling coils (6×1500 mm, steel grade S355MC) has been produced using thermo-mechanical controlled process (TMCP) for the wide-strip rolling mill 1700. The integrated technology for TMCP coil production (steel grade S355MC) has been firstly developed for the rolling mill 1700 in accordance with EN 10149-2. Air cooling for coils to 450°C after coiling has been firstly used in the developed technology, which provides for decrease in air scale and improvement of surface quality for the customers. It is possible to manufacture rolled products up to 6×1500 mm (steel grade S355MC) in accordance with EN 10149-2 using the existing equipment without exceeding the existing process constraints during its operation and without upgrading. It is possible to further master the rolled products, which are manufactured according to the TMCP technology.

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Simulation of Electrical Heating of Materials in Metallic Capacity of Cylindrical Form

Authors: Gennadiy Pivnyak, Natalia Dreshpak, Stanislav Vypanasenko, Leonid Meshcheryakov, Liudmyla Zaika, Michał Potempa

Abstract: Electrical and thermal processes, occurring while heating materials in metallic capacities of cylindrical form, are examined. The peculiarities of those processes are defined, and it is shown that their essence is in the way of distributing the sources of heat, while using different methods of electrical heating, in the change of properties of the heated material under varying temperature and in the course of the process in time. Mathematical model to calculate the thermal process, taking place in the heated material, taking into consideration the changes of its thermal parameters, as well as the character of the controlling electrical actions, is developed. On the basis of differential equation of the process of heating and boundary conditions, difference equations are formed, which allow to solve the task by numerical method. The solution is carried out by the method of passing. Analytical dependences to determine the coefficient of the method of passing, and temperature in the random point of the heated material are obtained. It is proposed to carry out the correction of the thermal parameters of the heated material while calculating the coefficients in the process f the “direct” course of the method of passing. The values of temperature of the material, obtained in the period of the preceding “reverse” course of passing, are taken into consideration with that. The opportunity to concentrate the sources of heat both in the internal and external covers of the installation is realized. The change of intensity of their action in time is possible, and that allows to reproduce a wide range of the controlling actions. Algorithm for task solution on the electronic computer is developed. The example for calculating the thermal process of concrete heating in winter time is considered.

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Preparation and Study of the Mechanical Properties of Unsaturated Polyester Resin/Graphene Nanocomposite

Authors: Hanaa G. Attiya, Tagreed M. Al-Saadi, Anaam W. Watan

Abstract: Nanocomposite was prepared using unsaturated polyester (UP) resin as a matrix and graphene nanoparticles as a reinforcement material in six percentage weights (0, 0.1, 0.2, 0.3, 1 and 1.5%). Mechanical, calorimetric and thermal studies were performed on the (UP) resin/graphene nanocomposite. All tests showed a clear improvement of all mechanical properties examined (hardness, flexural strength (F.S), impact strength (I.S) and tensile strength (T.S)) with increasing graphene percentage. In addition, the temperature of glass transition and thermal conductivity of this composite increased with increasing graphene content.

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Statistical Express Control of the Peak Values of the Differential-Thermal Analysis of Solid Materials

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Keywords: differential-thermal analysis, solid materials, express control, peak values, statistical criteria, F-test, t-test

Abstract. The method of non-destructive control of the molecular structure of solid materials is improved, the distinguishing feature of which is a new sign of suitability for the peak values of the thermodynamic process in solid materials, which made it possible to increase the reliability of the non-destructive control. A statistical norm for deciding on the suitability of solid materials was introduced, which made it possible to organize statistical express control of solid materials under conditions of industrial production of electronic devices. In the practical plan, a structural scheme and an algorithm for measuring control of the peak values of the differential-thermal analysis of solid materials are proposed, on the basis of which a microprocessor based device for statistical express control is developed.

Introduction

Non-destructive control has always been one of the first measures that provide the required quality of finished products. However, in today's conditions it is necessary to change the approach to the implementation of non-destructive control.

Indirect methods of controlling the molecular structure are the measurements of the structural-sensitive characteristics of the material, on the basis of which the conclusion about its structure is made. One of these methods, which is the most informative, allows to carry out operational control in the process of industrial production, and also is the most sensitive to structural changes of solid materials, is a differential-thermal analysis [1].

To date, the development of the theory and practical application of technical means for the non-destructive control of semiconductor parameters are engaged in such scientific institutions as the Zaporizhzhya State Engineering Academy, the Institute of Physics of the National Academy of Sciences of Ukraine, the National University "Lviv Polytechnic". A significant contribution to the development of the theory of the non-destructive control was made by scientists Grishchenko V.T., Gorlov M.I. [2].

The further development of scientific research in this direction is the use of the theoretical foundations of statistical information processing for the organization of non-destructive control of the molecular structure of solid materials in order to determine the suitability or unsuitability of batches of solid materials in the conditions of industrial production of electronic devices. In addition, in order to improve the parameters of contactless temperature transducers of phase transitions of solid materials, it is expedient to use a negative differential resistance for the construction of integrated frequency converters. This area of research is based on the achievements