Research Progress of Microprecision Casting Technology

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Abstract: The micromachining of three-dimensional metal microparts with complicated shape is the emphasis and hotspot of micromechanical investigation all the times. Microprecision casting technology has particular advantages on fabricating efficiently the three-dimensional metal microparts with complicated shape compared with many other machining processes appeared in recent years. In this paper, the development and present status of microprecision casting technology abroad based on investment casting are summarized from aspects of micocasting process, micocasting alloy, micocasting mould materials and related theory. The shortage of current microprecision casting technology and the developing direction have been discussed. At the same time the author’s research work on metal mould microprecision casting technology are briefly introduced.

Key words: MEMS; micro-precision casting; microprecision; microparts

2 Micro-arc Oxidation of Die Cast Magnesium Alloy AZ91 in Different Constituents of Electrolyte

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Abstract: Recent advances in micro-arc oxidation of die cast magnesium alloy AZ91 are presented. The factors affecting the properties of micro-arc oxidation ceramic coating of die cast magnesium alloy AZ91, in different constituents of electrolytes including phosphate, silicate, aluminate and composite constituents of electrolyte, are discussed. Finally, the ideas about the research of micro-arc oxidation of die cast magnesium alloy AZ91 are summarized.

Key words: die cast magnesium alloy; AZ91; micro-arc oxidation
3 Influence of Melt Superheating Treatment on the Mechanical Property and Crystal Orientation of Directionally Solidified Al-4.7%Cu Alloy  

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Abstract: At 750 °C, 850 °C, 950 °C and 1 050 °C, respectively, the influence of melt superheating temperature T on the solidification microstructure and mechanical performance of directionally solidified Al-4.7%Cu alloy was studied. The characteristics of the melt were measured on universal thermo-analyzer. And the fracture morphology was analyzed using universal SEM. The results show that the mechanical properties of directionally solidified sample are much better; the strength is increased by 60% and the elongation is doubled. The fracture morphology shows that Cu-rich phase decreases obviously and dimple number increases evidently. The higher the superheating temperature and the longer the superheating time, the higher the strength and ductility. However, when held at low temperature, the strength and ductility get a decrease. The dendrites of Al-4.7%Cu alloy prefer (100) to grow. With the melt's superheating temperature rising, the diffraction intensity of (110) crystal face weakens, which indicates that the crystal orientations have embranchment. The superheating treatment of Al-4.7%Cu alloy makes the alloy microstructure changed to some extent.  

Key words: superheating treatment; mechanical properties; directional solidification; solidification microstructure; mechanical property; fracture morphology  

4 Influence of Mg-based Quasi-crystals on Microstructure and Mechanical Properties of AZ91 Alloy  

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Abstract: Effect of Mg-based quasi-crystals with different chemical compositions and morphologies on microstructure and mechanical properties of AZ91 alloy has been investigated by using XRD, SEM, EDS, TEM and a hydraulic universal material testing machine. The results showed that the addition of Mg-based quasi-crystals master alloy into AZ91 alloy results in dispersivity distribution of high-thermal-stable quasi-crystals in the grain boundaries, in addition to the Mg matrix and Mg-Al clad phase. The Mg-based quasi-crystals replaced Mg matrix to form a Mg-based quasi-crystal master alloy.  

Key words: Mg-based quasi-crystals; mechanical properties; AZ91 alloy; solidification microstructure; mechanical properties  

5 Near-net-shape Continuous Casting of a Cupronickel Tube  

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Abstract: The flow of the molten slag determines the temperature distribution and the pool profiles affecting the quality of ingot casting in the electroslag casting process. So the flow field of the molten slag was simulated by means of the large-scale finite element analysis software ANSYS, and the result was completely in accordance with that of the physical simulation. The influences of the current, filling ratio and the shape of the melting pattern at the electrode tip on the molten slag flow field were studied, provide the scientific basis for the production of the electroslag casting.  

Key words: near-net-shape casting; tube billets; solidification structure; mechanical properties  

6 Preparing Semi-solid AlSi6Mg2 Alloy by Novel Sloping Plate Process and Thixoforming  

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Abstract: By using self-made wave-like sloping plate setup, the preparation and thixoforming of AlSi6Mg2 alloy semi-solid billets were studied. The results showed that the semi-solid billets with good microstructures and properties can be prepared by the proposed process, and the billets are composed of fine spherical grains and a little part of rosette grains. Under the current experimental conditions, optimum casting temperature range of 660-680 °C for AlSi6Mg2 alloy is suggested. When the reheating temperature of the billets is 597 °C, holding 90 min; mould preheating temperature is 400 °C, holding 120 min, thixoforming products with fine surface and good microstructures can be manufactured. During the die casting, liquid flow is the main deformation pattern due to the liquid aggregation in the upper part of the product, and the corresponding hardness is lower. However, because of small plastic deformation of solidoid at the bottom of the product, the corresponding hardness is higher.  

Key words: wave-like sloping plate; semi-solid; AlSi6Mg2 alloy; thixoforming  

7 Main Points about Die Casting Process and Die Casting Die Design (Part 3)  

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Abstract: The die casting machine, die and alloy, the three on the basis of die castings, running through with the die casting process form organically a whole, and an effective method, etc., and the machines well to mate with dies, optimization of die casting construction, optimization of selecting die casting machine, optimization of the die design, and improving the flexibility of die casting process (operational point), thus all of these provide a secure guaranty for production. So to say the process conveys in the die, this has a profound intension.  

Key words: die casting machine; die; die casting process; die design  

8 Progress in Numerical Simulation of Directional Solidification  

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Abstract: Several simulation methods for directional solidification are given in this paper, such as 3D dendrite envelope tracking, electromagnetic shaping and the phase-field method, etc., and the phase-field method is introduced emphatically. Additionally, the existing problems and the development directions in the future are also pointed out. Finally, the problems need to be resolved urgently over the simulation of phase-field as well as the developing trends are proposed based on analyzing the disadvantages of the phase-field models available.  

Key words: directional solidification; simulation  

9 Realization of Parallel Computing with MPI for Temperature Field Simulation in Metal Solidification Process  

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Abstract: The MPI parallel programming based on Windows isomerous cluster platform was adopted to parallel the serial algorithm of temperature field simulation in metal solidification process with the method of decomposing the data domain, and the parallel algorithm was tested by simulating the temperature field of a T-shape casting. The results showed that the accelerated ratio achieves 1.27 and 1.57, respectively, under the condition of 2 nodes and 3 nodes when the total elements is 410 000.  

Key words: simulation; MPI parallel computing; data domain decomposition; Windows cluster  

10 Simulation Analysis of Slag Pool Flow Field in Electroslag Casting Process  

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Abstract: The flow of the molten slag determines the temperature distribution and the pool profiles affecting the quality of ingot casting in the electroslag casting process. So the flow field of the molten slag pool in the electroslag casting process was simulated by means of the large-scale finite element analysis software ANSYS, and the result was completely in accordance with that of the physical simulation. The influences of the current, filling ratio and the shape of the melting pattern at the electrode tip on the molten slag flow field were studied, provide the scientific basis for the production of the electroslag casting.  

Key words: electroslag casting; flow field; numerical simulation
11 Discrepancy Analysis of Ductile Iron Casting Quality and Accepting in Material for Automotive Brake System Produced in China and Abroad

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Abstract: For QT50-12 ductile iron castings used for automotive brake system, the requirements for the mechanical properties for the automotive casting providers in China and abroad are same, but have a great discrepancy in the microstructure and composition when checking and accepting the castings. Most of companies at home only concerned about the mechanical properties of graphite form, chemical composition and casting defects must be strictly controlled, so as to improve the comprehensive property and ensure the security of the applied castings.

Key words: automotive; casting; check and accept

12 Estimation of Stress Rupture of a Nickel-Base Single Crystal Superalloy

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Abstract: The Larson-Miller Curve of a nickel-based single crystal superalloy is calculated on the basis of Monkman-Grant Equation. Compared with the experimental results, it tallies well with real experimental curve. It shows that the rupture stress of the alloy can be estimated accurately by means of this method.

Key words: Ni-base single crystal superalloy; estimation; stress rupture

13 The Application of Color Metallograph to the Solidification Analysis for Grinding Ball of Metal Mould

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Abstract: Five groups of ductile iron grinding ball samples with hyper eutectic and hypo eutectic structures have been tested using color metallograph. The dynamic solidification process, morphology and crystal structure of the metal mould grinding ball during solidification were analyzed. The differences of crystal structure between equilibrium solidification and non-equilibrium solidification and the characteristic property of the non-equilibrium solidification were discussed.

Key words: color metallograph; non-equilibrium abnormal crystal; metal mould grinding ball

14 Study on Technology of Multifunction Counter Gravity Casting Equipment

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Abstract: Counter gravity casting equipment (GGCE), such as low pressure casting (LPC), counter pressure casting (CPC) and adjusted pressure casting (APC) equipment, have been extensively used in practice. However, most of the equipment only has single function. In this study, the multi-function counter gravity casting equipment (MCGCC) is developed, which can perform LPC, CPC, APC. Some key technologies, such as structure design of the main parts of equipment, multifunction pneumatic control system, electric control system, and high performance digital assembled valve and related control software, have been studied. The practical application proved that the MCCGE not only meets the needs of multi-production and research in different casting type, but also has the advantages, such as high pressure control precision and safe operation.

Key words: low pressure casting; counter pressure casting; adjusted pressure casting, multifunction; counter gravity casting equipment

15 Development of the Degassing and Purification Equipment with Rotary Impeller for Molten Aluminum Alloys

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Abstract: The equipment with rotary impeller for degassing and purification of molten aluminum alloys is investigated, aimed at the existent problems in the aspect of the degassing and purification of molten aluminum alloys. All these parts of the equipment are analyzed and designed. Especially, in the design of spinning rotor, a special pipeline is fixed inside the rotate pole, in order to decrease the temperature inside the rotate pole and prevent the spray flux softening owing to the high temperature and spinning rotor jamming. In the pneumatic system of the equipment, gas-in part and adjustment part are designed respectively. The flux can be altered continually, which can not cause the surging of molten aluminum alloys under some given rotate speed, while can increase the flux. Advanced controlling schemes for the equipment are investigated in the view of hardware and software. In hardware, the theory and methods to use Siemens PLC for control system are analyzed and designed. In software, the control software is programmed in STEP7. At the same time, the safety and steady of the equipment are fully considered. The manual control and auto-control models are designed, and the emergencies stop is set in auto-control model to avoid the problems worsen in emergency.

Key words: spinning rotor; degassing; purifying of molten Al alloys; PLC control

16 Technology of Quantitative Pouring with the Electromagnetic Power for Aluminum Alloy Squeeze Casting

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Abstract: The theory and controlling model of the electromagnetic power quantitative pouring technology for aluminum alloy squeeze casting is presented. Through experiment and mathematical fitting, the flux, pump height and mathematical model used for calculation of current were established, and the controlling method of quantitative pouring was decided. An actual squeeze casting was performed to validate the correctness of the model. The study proved that the precision of quantitative control can be controlled in the range of ±2%. The electromagnetic quantitative pouring is an advanced technology because of the good and reliable precision. It can improve the automatic level of squeeze casting and realize the near net forming.

Key words: aluminum alloy; squeeze casting; electromagnetism; quantitative pouring

17 Influence of Rare Earth Nd on Solidification Microstructure of Magnesium-Aluminum Alloys with High Aluminum Level

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Abstract: The transition and morphological characteristic of precipitated phase in the solidification microstructure of the high Al content Mg-Al alloys were studied after 0.4% rare earth Nd was added. The result showed that, the modification of Nd resulted in a large number of dendrites appearing in the solidification microstructure of the alloys; in the range of hypo-eutectic component, the α dendrite precipitated firstly. As the Al content gradually increasing and approaching the eutectic point, the β halo appeared around the α dendrite and thickened continuously, the amount of α dendrite decreased, and then the β halo changed into β dendrite, the amount of which increased and whose branch became advanced. The modification of Nd made the solidification microstructure of Mg-Al alloy, approaching the eutectic point, changed greatly from typical unmodified symbiotic eutectic to α dendrite, β dendrite and symbiotic eutectic concomitant structure.

Key words: magnesium-aluminum system alloys; modification; Nd; solidification structure; morphology of β-phase

18 Effects of Different Si/Al and Modification on Si Phases in ZA27 Alloys

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Abstract: The changing regularity of primary Si phases in Al-Si alloys was analyzed and compared with the Si phases in ZA27 alloys with same Si/Al in this paper. The modification technology of Si phases in Al-Si alloys was advised to apply into ZA27 alloys for refining the Si phases of the microstructure. The result showed that the changing regularity of Si phases in the ZA27 alloys was the same as that in the Al-Si alloys, and good modification effects can be gained with 1.5% Cu-P master alloy.

Key words: ZA27 alloys; Si phase; modification

19 Core-Assembly Moulding Process for Large-Sized Aluminum Alloy Castings

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20 Irreversibility of the Liquid-Liquid Structure Transition and Its Effect on the Solidification of Pb-Sb30% Alloy

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Abstract: The recent research on creep and corrosion properties of AZ91 magnesium alloy at high temperature was summarized. The effects of micro-alloy and composition on high temperature corrosion and creep performance of AZ91 magnesium alloy were presented emphatically. At last, the development trends of AZ91 magnesium alloy were proposed.

Key words: AZ91 magnesium alloy; creep; corrosion

2 Current Status and Development of Zinc Matrix Composites Reinforced by Particulates

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Abstract: The particle reinforced Zn-matrix composites is one of the metal matrix composites being more extensively developed and applied. Its current research status on fabrication methods, mechanical properties, wear resistance and interface problems are reviewed. The existent problems are discussed, and the further research emphasis and development directions are also predicted. Spray deposition is a novel rapid solidification technology. During spray deposition, a liquid metal stream is atomized into a spray of droplets by high-pressure gas jets and subsequently these atomized droplets are deposited and solidified on a substrate. Spray deposition is an available fabrication method to obtain zinc matrix composites reinforced by nano particles.

Key words: zinc matrix composites reinforced by particles; fabrication methods; particles; interface

3 Effects of Cooling Rate and B Content on the Microstructure of Near-Eutectic Al-13.0wt%Si Alloy

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Abstract: The influence of different B contents on the microstructure of near eutectic Al-13.0wt%Si alloy has been investigated under the cooling condition of about 2 °C/s and 10 °C/s to melt solidifying. The results showed that under both cooling conditions, the addition of boron resulted in refinement of eutectic alloy and suppression of the primary phases. With increased cooling rate, the refinement of eutectic alloy and the suppression of the primary phases were more obvious. When B was not added, high cooling rate condition promoted the α-Al dendrites formation. Under low cooling rate, the introduction of B did not cause a transition from columnar to equiaxed, however, under a high cooling rate, this transition is obvious. After the addition of B, the nucleation temperature TN ascended, the nucleation mode changed apparently, from nucleation mode of from the wall towards the centre without B addition to a nucleation mode that the eutectic nucleation spread evenly throughout the sample. It can be concluded that the addition of B affords a great number of nuclei for eutectic solidification, and, as a result, the eutectic become refined. Higher cooling rate will make more nuclei activated, so the refinement of eutectic is advanced.

Key words: Al-Si alloy; microstructure; nucleation; cooling rate

4 Effect of Heat Treatment on the Mechanical Property of Low Frequency Electromagnetic Casting 2024 Aluminum Alloy

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Abstract: This article describes the technology characteristics of AOD refining duplex stainless steel, and the 00Cr22Ni5Mo3N duplex stainless steel was refined using the 2 t AOD refining vessel. An alloy steel was obtained and a chemical box runner fan was poured. The mechanical properties and microstructure of the casting is in accordance with the technical requirements for AOD refining duplex stainless steel refining and casting production.

Key words: AOD refining; duplex stainless steel
5 Research on Rapid Solidification Magnesium Alloy Extrusion Bar and Structure Property

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Abstract: The microstructure can be refined obviously and solid solubility was increased by twin-roll rapid solidification method, and the mechanical properties of traditional structural material can be highly improved. In this study, rapid solidification bar was prepared with rapid solidified magnesium alloy foil; the extrusion equipment and process are introduced, and the microstructure and mechanical property of rapid solidification bar are analyzed. It is found that rapid solidified magnesium alloy extrusion bar can be prepared by using appropriate processing parameters; its structure and properties are much better than that of traditional magnesium alloy cast ingot extrusion bar.

Key words: twin-roll rapid solidification; magnesium alloy; structure and property

6 Effect of Mixed Rare Earth Oxides and CaCO3 Modification on Microstructure of In-Situ Mg2Si/Al-Si Composite

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Abstract: The effects of mixed rare earth oxides and CaCO3 on the microstructure of in-situ Mg2Si/Al-Si composite were investigated. The results showed that the morphology of initial MgSi phase particulate changed from irregular or crosses to polygonal shape, and its average size decreased from 75 µm to about 25 µm, which are better than that modified by single mixed rare earth oxides or CaCO3. Key words: Al matrix composite; mixed rare earth oxides; CaCO3 modification

7 Microstructure and Creep Resistance of Mg-2Nd Alloy

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Abstract: The microstructure, mechanical properties and creep resistance of as-cast alloy Mg-2Nd were studied. The as-cast microstructure consists of the dendritic α-Mg and divorced eutectic Mg_Nd distributing along the grain boundaries. Both tensile strength and yield strength increase slightly but the ductility increase obviously with the increase of the temperature. The as-cast alloy exhibits good creep resistance. The stress exponent value of 5-8.6 and apparent activation energy value of 108-142 kJ/mol were obtained at 150-250°C and 30-110 MPa, which suggest that the creep is controlled by dislocation climb while grain boundary sliding also has some effect. Key words: Mg-2Nd alloy; microstructure; mechanical properties; creep resistance

8 The Preparation and Elementary Research on Curing Mechanism of CO2-Cure Phenolic Resin

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Abstract: The CO2-cured phenolic resin is a novel molding and core-making binder, which is composed of high content phenolic resin, oxacid salt and alkali and so on. Performance and composition of phenolic resin are main factors affecting the compressive strength of resin bonded sand. Elementary curing mechanism was studied by means of measuring pH change of the resin aqueous solution, and the better dosage ranges of cross-linking agent and alkali were also gained. The effect of their content and surface-stabilizing agent on compressive strength was studied; finally the better composition of phenolic resin was acquired. Key words: phenolic resin; curing mechanism; surface-stabilizing agent; cross-linking agent

9 Study on an Aluminum Foam by Gas Injection Foaming

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Abstract: In allusion to the cracking phenomenon of ceramic shell, the better dosage ranges of cross-linking agent and alkali were also gained. The effect of their content and surface-stabilizing agent on compressive strength was studied; finally the better composition of phenolic resin was acquired. Key words: phenolic resin; curing mechanism; surface-stabilizing agent; cross-linking agent

10 Main Points about Die Casting Process and Die Casting Die Design (Part 4)

PAN Xian-zeng, LIU Xing-fu

(1. MG Technology (Shenzhen) Co., Ltd. of Kashuo Holdings Co., Ltd., Shenzhen 518111, China; 2. FAW Foundry Co., Ltd. Foundry Mould Plant, Changchun 130011, China)

Abstract: The die casting machine, die and alloy, the three on the basis of die castings, running through with the die casting process forms organically a whole and an effective system. Making the machines well to mate with dies, optimization of die casting construction, optimization of selecting die casting machine, optimization of the die design, and improving the flexibility of die casting process (operating point), thus all of these provide a secure guaranty for production. So to say the process convays in the die, this has a profound intensio. Key words: die casting machine; die; die casting process; die design

11 Effect of Pressure on Squeeze Cast Al-Cu-Mg Alloy

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Abstract: Based on the chemical composition of Al–5 Cu–1 Mg alloy, an alloy suitable for squeeze casting was prepared under a pressure of 70 MPa. It possesses an ultimate tensile strength of 288.8 MPa, elongation of 12.8% and a hardness of HRB 48.5 in as-cast state. Microstructure and mechanical properties of the as-cast alloy were studied to determine the effect of the squeeze pressure on the casting. Results showed that the ultimate tensile strength, elongation and density of the as-cast alloy increase with the applied pressure and reach maximum at a pressure of approximately 70 MPa, then level off with a slightly drop. Effects of squeeze pressure on the density and electrical conductivity of the cast alloy were also studied. The density of the cast alloy increases sharply as the squeeze pressure increases, then leveled off at a squeeze pressure of approximately 70 MPa, which is in harmony with the maximum of mechanical property. Key words: squeeze casting; Al-Cu-Mg alloy; mechanical property

12 Research on Pattern Removing Technique of EPS Precision Casting

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Abstract: In allusion to the cracking phenomenon of ceramic shell, the pattern removing technique of EPS mold was investigated. The maximum expansion coefficients of EPS samples with different
densities were measured under different temperatures, and the relationship between the expansion of ceramic shell and temperature of pattern removing was analyzed. The measurement of temperature distribution in the EPS mold revealed that the density of EPS model affected the temperature field during the pattern removing process. On the basis of experiments and analyses the mechanisms of pattern removing were discussed, and the elevated temperature mechanism of removing pattern was put forward. It is suggested that removing pattern at elevated temperature may help reduce the EPS expansion force acted on ceramic shell and provide a secure guarantee for obtaining the sound and clean shell.

Key words: EPS mold precision casting; pattern removing technique; cracking of ceramic shell; mechanisms of pattern removing

13 Application of ZG30SiMnTi Wear Resistant Steel to Investment Casting Sprocket
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Abstract: The chemical composition, smelt method, casting technique and heat treatment method were investigated to cast ZG30SiMnTi wear resistant sprocket using investment casting, and the main technical function index and economic target of ZG30SiMnTi and ZG45Mn, two kinds of sprockets materials were compared and analyzed. It was found that after the substitution of ZG45Mn for ZG30SiMnTi, not only the intensity, abrasion resistance and service life of sprocket are improved, but also the cost reduce.

Key words: ZG30SiMnTi; investment casting; sprocket; ZG45Mn

14 Preparation of TiC/Fe Composites on Cast Steel Surface by SHS
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Abstract: By coating pressed self-propagating high-temperature synthesis (SHS) powder on the wear resistant surface of evaporative pattern, the powder can be lit automatically through pouring high temperature molten steel and form the reinforced ceramics phase (CR). In this study, the molten steel will be penetrated into the layer of ceramics, which can make the TiC spread around molten steel surface equably, so the in-situ composite layer at casting surface can be obtained. The hardness of composite layer can reach HRC54-59, and many fine secondary TiC grains can be found after 900 °C × 2 h treatment.

Key words: evaporative pattern casting; self-propagating high-temperature synthesis (SHS); TiC/Fe composite

15 Microstructure Simulation of AM50 Mg Alloy Die Casting with Cellular Automaton Method
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Abstract: A two-dimensional mathematical-physics model for the nucleation and equiaxed grain growth of AM50 magnesium die casting alloy during solidification process was developed, which was based on the cellular automaton (CA) method. The model coupled the temperature field calculation and microstructure simulation. The temperature field of a step-shape die casting of AM50 magnesium alloy was calculated using the inverse heat transfer method, and the microstructure of the surfaces at different steps of the die casting was simulated. The microstructure of the die casting was also investigated utilizing metallographic analysis. Through comparison of the experimental results and simulation results, it was found that the grain size of them was in good agreement.

Key words: AM50 magnesium alloy die casting; microstructure simulation; Cellular Automaton method; grain size

16 Numerical Simulation of Solidification Process of Horizontal Continuously Cast BFe30-1-1 Hollow Billets
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Abstract: Based on the solidification characters of hollow billets, a mathematical model was established to study numerically heat transfer during horizontal continuous casting of BFe30-1-1 alloy. The influence of parameters such as pouring temperature, cooling intensity and casting speed on the mushy zone and depth of sump was investigated. The results showed that the pouring temperature, casting speed and cooling intensity are the dominating factors determining the solidification process. However, the pouring temperature has little influence on the depth of mushy zone. Moreover, hollow billets of BFe30-1-1 alloy free from crack defect were produced by horizontal continuous casting.

Key words: horizontal continuous casting; BFe50-1-1 alloy; hollow billets; numerical simulation

17 Strategy of Continuous Development in Low Cost for Medium and Small-Sized Foundry Enterprises
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Abstract: The important of studying on continuous development strategy for medium and small-sized foundry enterprises was put forward in this paper. According to the characteristic of the medium and small-sized foundry enterprises in China, it was pointed out that the enterprises should establish strategies of reducing cost and enhancing competition ability, and persist in the principle of “Quality is the first, Cost is the first”. The low-cost sustainable development strategy must not be undertaken at the cost of decreasing quality, heavy pollution and destroying the ecological environment. Running in low cost can get more advantageous chances for enterprises to occupy the market, therefore realize continuous development.

Key words: continuously developing enterprise strategy; low cost

18 Study on Metallographic Techniques for Cast Mg Alloy
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(Department of Mechanical Engineering, Key Laboratory for Advanced Materials Processing Technology of Ministry of Education, Tsinghua University, Beijing 100084, China)
Abstract: The metallographic techniques for observing the microstructure, especially the grains of cast magnesium alloy were studied. The techniques involve traditional etching and observing method, polarized light aided observing method, and a side-light aided observing method developed in the study. The results showed that the traditional method can be used to observe the dendrite morphology, however, it is not suitable for identifying the grain boundaries. The polarized light aided method is applicable to the observation of grain boundaries for sand mold and permanent mold castings, even to thick parts of a die casting, in which the grain size is relatively large. Anyway, it is not effective yet for identifying the small grains in a thin part of die castings, further, good experimental skills are required for using the polarized light aided observing method. The side-light aided observing method based on a recently developed etching method can be used conveniently to observe either the dendrite morphology or the grain size of the cast magnesium alloy, which makes the solid solution procedure in traditional grain observing method unnecessary, thus eliminating the morphology change of the dendritic microstructure and secondary phase in the solution treatment.

Key words: magnesium alloy; as-cast microstructure; grain size; observation method

19 Design and Research on Automatic Detection Device of Green Sand Properties
ZHANG Guo-ling
(Engineering and Training Center of Shandong University, Jinan 250061, Shandong, China)
Abstract: In order to control the quality of the casting sand, a new type of automatic detection device was developed. It can sample continually while mixing the green sand; using the floating pinch wheel to compact the sand specimen, so as to detect the compactability continuously. The cantilever length of bar-type sand specimen is measured continuously, by which the bending strength is detected. The principle, the control process and the mechanical structure design are introduced. Finally the experiment results are given.

Key words: green sand; compactability of green sand; bending strength; on-line detection

20 Thermal Test of Blast Furnace Cooling Stave
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(1. School of Material Science and Engineering, Zhengzhou University, Zhengzhou 450002, Henan, China; 2. Machinery Equipment Manufacture Co., Ltd., Anyang Iron and Steel Group, Anyang 455004, Henan, China)
Abstract: The thermal test system of cooling stave was designed and information...
established to conduct the industrial experiment of the heat transfer for the cast steel cooling stave and ductile iron cooling stave. When the water flow velocity was 3.0 m/s and the water temperature was 30 °C and the furnace temperature was 800 °C, the hot side temperatures of cast steel cooling stave and ductile iron cooling stave were 282 °C and 410 °C and the temperature difference between hot side and cold side were 148 °C and 148 °C respectively. When the furnace temperature was 1200 °C, the hot side temperatures of the cast steel cooling stave and the ductile iron cooling stave were 446 °C and 795 °C respectively. The experiment results showed that when the hot side temperature of ductile iron cooling stave reach the phase transform temperature, the temperature gradient is bigger and the heat transfer efficiency was lower, so the service life was decreased. When the hot side temperature of cast steel cooling stave was far below the phase transform temperature, the temperature gradient was smaller, the heat transfer efficiency was favorable, and so the service life was prolonged.

**Key words:** cast steel cooling stave; ductile iron cooling stave; thermal test

21 Research on the Effect Factors of Accicular Structure Cast Iron

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(Iron Foundry of Qiqihar Rolling and Stock Group, Qiqihar 161002, Heilongjiang, China)

**Abstract:** Elements Mo, Cu were added into the molten grey iron, and the type and content of inoculants, pouring time, cooling time, shake-out time were adjusted to get accicular structure. The effects of alloy elements and process parameters on the microstructure and mechanical properties of accicular structure grey iron were studied. Accicular structure grey iron was applied to friction shoe successfully.

**Key words:** accicular structure; friction shoe; nucleating agent; shakeout time; metallographic structure

22 Effects of Rare Earth Modification on Structures and Properties of Low-Alloy Cast Steel

**WANG Jian-min, ZHU Hui, YANG Sen, REN Fu-hua**

(School of Material Science and Engineering, Inner Mongolia University of Technology, Hohhot 010051, Inner Mongolia, China)

**Abstract:** Modification treatment has an important effect on structure and properties of wear resistant steels. Using appropriate kinds and amounts of modification agent are effective methods to improve properties of the steels. The influences of rare earth modification on hardness and the impact toughness of low-alloy cast steel were investigated. The results showed that the steel modified with 0.25% Re-Si-Fe alloy have good comprehensive properties, fine grain size, and the mirostructure of upper and lower bainites plus martensite in the substrate. The addition of proper quantities of Re-Si-Fe can improve the microstructure and mechanical properties of low-alloy steel.

**Key words:** rare earth; modification; low alloy steel

23 Effect of Ca and Ce on Growth of Dendrite α in Magnesium Alloys

**ZHANG Hong-jun, HUA Qin, LI Ren-xing, QIU Yong-fei, ZHAI Qi-je**

(School of Materials Science and Engineering, Shanghai University, Shanghai 200072, China)

**Abstract:** The effect of adding Ca or Ce into Mg-6Al-0.6Zn-0.3Mn alloy on the morphology of dendrite α phase during solidification process was investigated by liquid quenching. The volume fraction of α phase and the characteristic parameters were also measured. The results indicated that Ca addition can promote the nucleation of α phase and restrain the growth of dendrite α. But Ce addition restrains the nucleation of α phase and promotes the growth of columnar dendrite α. It was found that Ca addition and Ce addition both can restrain the coarsening of the secondary dendrite arms and decrease the secondary dendrite arm spacing.

**Key words:** magnesium alloys; quenching; dendrite growth

24 Effects of K/Na-Si and K/Na-Mo Dual-Modification on Structure and Property of High-Speed Steel Used for Mill Roll

**JIAO Jin-lin, YANG Hua, WEI Dai-bin**

(Key Laboratory of Liquid Structure and Heredity of Materials, Ministry of Education, Shandong University, Jinan 250061, Shandong, China)

**Abstract:** The dual-modification effect of K/Na-Si and K/Na-Mo on as-cast high-speed steel (HSS) used for rolls was researched and the effects on the structures and properties of as-cast HSS were also analyzed. The results showed that the structures of HSS dual-modified by K/Na-Si and K/Na-Mo are obviously refined, the morphologies are more homogeneous, and the eutectic carbide networks are changed into spherical. After modification, the impact toughness is obviously increased; all of the mechanical properties of inoculation HSS is close to that of forging HSS.

**Key words:** high-speed steel; mill roll; dual-modification; homogeneous; mechanical property

25 Study on Scandium’s Role in Al-Si Piston Alloy

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**Abstract:** The application of scandium in Al-Si piston alloy was studied. It was found that the distribution of eutectic Si becomes more dispersed and that the α-Al matrix becomes finer after addition of trace Sc. The size of primary Si is also reduced. All of these result in the increase of the tensile strength of the alloy at ambient temperature. Moreover it was also found that some scandium exist in a kind of AlNiCu intermetallic compound and reinforce the phase, therefore the elevated temperature tensile strength of the alloy is increased.

**Key words:** scandium; Al-Si alloy; elevated temperature strength; piston

26 The Influence of Molten Iron Chemical Composition on Carbon Pick-Up Effect of Melting Cast Iron

**WEN Hong**

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**Abstract:** The influence of molten iron chemical composition such as C, Si, Mn, and P on carbon pick-up effect of melting cast iron was studied. The results indicated that the chemical composition such as C, Si, Mn, and P had different influence on carbon pick-up effect. However, the influence of Si was the biggest, C, Mn, and S took second place, and P was the smallest. Moreover, too high initial carbon amount in the molten iron was unfavorable to the absorption of carbon, and Si, P, and S also hindered the absorption of carbon, but conversely, Mn is helpful for it. During practical carbon pick-up of melting cast iron, manganese should be increased firstly, then carbon was increased, and silicon was increased finally, moreover, S and P in the molten iron must be controlled strictly.

**Key words:** chemical composition; carbon pick-up; melting cast iron; absorptivity

27 Difference between Extruded Ceramic Filter and Foam Filter

**MEING Ping**

(Beijing Trend Asia Fine Ceramics Co., Ltd., Beijing 101109, China)

**Abstract:** The difference between extruded ceramic filter and foam filter was comprehensively introduced in this paper, through aspects of filtration efficiency, consistent flow rate, strength, capacity and cost.

**Key words:** filtration efficiency; consistent flow rate; strength; cost
Key words: heavy steel casting; large and heavy equipment; key technology

2 Overview of the Research Status on Metal Solidification under Electric Current Pulse

MA Jian-hong, GAO Yu-lai, LI Jie, ZHAI Qi-jie
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Abstract: Application of electric current pulse (ECP) in metal solidification has increasingly become a new type of technique for microstructuring refinement of metals. This paper describes the investigation status of the effect of ECP on refining metal solidification microstructures. Based on a review of the facts, the author first presents the current special effect of electric current pulse, material selection, choice of the electric current parameters and mechanism discussion. Besides, an expectation was given on the studies of ECP in metal solidification microstructure.

Key words: electric current pulse; solidification structure; microstructure refinement

3 Current Status and Development of Rapidly Solidified Magnesium Alloys

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Abstract: Rapid solidification technology can improve structure and properties of magnesium alloys. In this paper, the rapid solidification technology used to prepare the magnesium alloys was presented and the characteristics of rapidly solidified magnesium alloys were described, so as to put forward the direction and way for the research of high performance magnesium alloys.

Key words: magnesium alloy; rapid solidification; single roller; spray forming

4 Effects of Electromagnetic Field on Solidification Structure of Magnesium Alloys in EMC Process

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(State Key-laboratory of Materials Modification by Laser, Ion and Electromagnetic Beams, School of Materials Science and Engineering, Dalian University of Technology, Dalian 116024, Liaoning, China)

Abstract: Soft-contact electromagnetic continuous casting and common continuous casting were adopted to produce AZ61 magnesium alloys ingots separately. The results showed that the microstructure of EMC is homogenous, the grains are refined, and the second-phase at the grain boundary are reduced. The second-phases are discontinuous and distributes disperseeley. The Al element content is increased inside the grain, whereas decreased at the grain boundary. According to above phenomena, solidification mechanism of AZ61 by soft-contact electromagnetic continuous casting is investigated. The idea of second-phases distribution dispersedly by electromagnetic field is put forward, and the thermodynamic relation of soft-contact electromagnetic continuous casting is derived.

Key words: electromagnetic continuous casting; magnesium alloy; microstructure; solidification mechanism

5 Effects of Melt Treatments and Electromagnetic Stirring on the Microstructures of AZ91D Alloy

LIU Qian, TANG Jing-lin, ZENG Da-ben
(Department of Mechanical Engineering, Tsinghua University, Beijing 100084, China)

Abstract: The influence of different melt treatments and electromagnetic stirring processes on the grain size of AZ91D alloy was investigated. The result showed that carbon powder has a significant refining effect on the AZ91D, which is better than C6, and AI-10Sr master alloys, while FeC, and Al-5Ti-B have little effect. The complex process of melt treatment and electromagnetic stirring makes the grain shape of AZ91D transform to uniform and fine spheroid. The complex process has better effects than the single process of electromagnetic stirring.

Key words: AZ91D alloy; grain refinement; melt treatment; electromagnetic stirring process

6 Research and Application of Alcohol-Base Resisting Penetration Sand-State Coating Substituting for Zinc Coat

HUANG Jin, ZHANG You-shou, XIA Lu, LI Si-nian
(Hubei University of Technology, Wuhan 430008, Hubei, China)

Abstract: A new type of alcohol-base sand state coating that may replace zinc coating for steel castings is presented. The refractory of the coating is comprised of 70-200 mesh chromite and alumina sand materials. This coating has some favorable features such as good suspension stability, easy brushing, no stripping off when painting repeatedly, high adhesive strength and low gas evolution. It also has very high heat stability, and no erosion reaction happen with Fe or other metal oxides. The coating material is produced by using special mode of electric current pulse, material selection, choice of the electric current parameters and mechanism discussion. Besides, an expectation was given on the studies of ECP in metal solidification microstructure.

Key words: electric current pulse; solidification structure; microstructure refinement

7 Application of Metallic Coating on Semi-Solid Rheologic Squeeze Casting of Steel

TAN Yan-long, ZHANG Li-zhong, HU Rui-sheng, HU Yuan-meng, XIAO Li-ting
(School of Mechanical Electronic and Control Engineering, Beijing Jiaotong University, Beijing 100044, China)

Abstract: In the process of rheologic squeeze casting of the semi-solid steel, it's the metallic coating on the surface of cavity that mainly endures the impact of semi-solid steel slurry with high temperature, which reduces the wear of mold. The serving life of the mold can be improved remarkably. On the basis of the working circumstance and characteristic of semi-solid squeeze casting of steel, a great many experiments have been done on the composition, proportion and process parameter of the coating. The influence of metallic coating on rheologic squeeze casting of semi-solid steel has been confirmed.

Key words: metallic coatings; semi-solid rheologic squeeze casting; serving life of mold; steel

8 Research on Internal Quality of Billet Produced by Electroslag Continue Casting

ZANG Xi-min, JIANG Zou-hua, PAN Tie-ji
(School of Materials and Metallurgy, Northeastern University, Shenyang 110004, China)

Abstract: The factors affecting internal quality of billets were analyzed and the macrostructure, microstructure and inclusion were analyzed on the 90 mm × 90 mm remelted billets produced by the electroslag continuous casting (ESCC), under the condition of 60 V and 5 400 – 4 200 A. The results showed that the rational voltage and current, strong cooling condition, stable pulling speed and good mold status were all favorable for internal quality of billets.

Key words: ESCC; billets; internal quality; 1G18N19Ti

9 The Experimental Research on Linear Expansion Characters and Processing Properties of Low Expansion Cast Iron

JIANG Lei, YANG Yi-tao, LI Xiao-hui, LIU Tai-kai, SHAO Guang-jie
(School of Material Science and Technology, Shanghai University, Shanghai 200072, China)

Abstract: The research focused on the relationship between main element Ni, heat processing technology (including heat treatment and casting process) and linear expansion of low expansion cast iron. The results indicated that the sample containing about 5% Ni has the lowest expansion coefficient, which could be reduced more by proper heat treatment. Otherwise, low expansion cast iron also showed a good castability.

Key words: low thermal expansion cast iron; Ni; heat treatment; casting process

10 Effect of Ce Combined with Ca or Sr on Microstructure of AZ91 Magnesium Alloy

HAN Hui, LIU Sheng-fa
(School of Materials Science and Engineering, Wuhan University of Technology, Wuhan 430070, Hubei, China)

Abstract: The effect of 0.5%Ce addition combined with 0.2%Ca or 0.2%Sr on the microstructure of AZ91 alloy was investigated by using optical microscope (OM), scanning electron microscope (SEM) and X-ray diffraction analyzer (XRD). The results showed that the as-cast microstructure can be refined greatly by adding 0.5%Ce and 0.2%Ca or 0.2%Sr. In the case of adding 0.5%Ce, 0.2%Ca and 0.2%Sr simultaneously, the grain-refining effect on AZ91 alloy is the best. In addition, some new phases (A1Ce) were found in the alloy.

Key words: AZ91 magnesium alloy; alloying; microstructure

11 Main Points about Die Casting Process and Die Casting Die
Design (Part 5)  

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Abstract: The die casting machine, die and alloy, the three on the basis of die castings, running through with the die casting process forms organically a whole and an effective system. Making the machines well to mate with dies, optimization of die casting construction, optimization of selecting die casting machine, optimization of the die design, and improving the flexibility of die casting process (operational point), thus all of these provide a secure guarantee for production. So to say the process conveys in the die, this has a profound intensity.

Key words: die casting machine; die; die casting process; die design

12 Technological Design of EPC Casting of the Support HEB Guo-jiang  
(Jinduicheng Molybdenum Group Co., Ltd., Huaxian 714102, Shaanxi, China)

Abstract: In this paper the technological design of EPC casting of support was presented, and technical difficulties in production were analyzed. A positioning device was designed to ensure the correct assembly of the support pattern. The results indicated that producing support castings by EPC is feasible.

Key words: support; EPC; technological design

13 Parting Surface Design of Investment Casting Mould for Turbine Blade Based on Feature and Case YANG Ying-chang, WANG Wen-hu, JUAN Ying-chang, LIU Xiao-hui, ZHANG Jun, ZHANG Lin  
(Key Laboratory of Contemporary Design and Integrated Manufacturing Technology, Ministry of Education, Northwestern Polytechnical University, Xi’an 710072, Shaanxi, China)

Abstract: The parting surface designing of investment casting mould for turbine blade is a difficult job which needs more experience and influences the construction design and processing of the mould. Using expert system to translate experience and rules into knowledge and influences the construction design and processing of the mould. Optimization of the die design, and improving the flexibility of die casting process (operational point), thus all of these provide a secure guarantee for production. So to say the process conveys in the die, this has a profound intensity.

Key words: feature; case-based; investment casting mould; parting surface

14 Research and Application of Rationality Verification Methods of Parameter Setting for Solidification Simulation QIU Gui-yong, HAN Jin-mian, YANG Zhi-yong, LI Wei-jing, WANG Jin-hua  
(School of Mechanical Electronic and Control Engineering, Beijing Jiaotong University, Beijing 100044, China)

Abstract: The solidification simulation software of ProCAST, as a tool of process designing and optimization, is finding an extensive application in the foundry industry worldwide. On the base of the vacuum adjustable pressure casting process, the study was focused on the rational verification methods of parameter setting for solidification simulation in this paper. With the help of the method, the casting process of the aluminum matrix composite brake disk was simulated by ProCAST. By comparing the simulation results with the inspection results of the brake disk casting, the feasibility of the method was verified.

Key words: solidification simulation; parameter; ProCAST; brake disk

15 Research on Construction of Casting and Forging Industrial Park of Tiexi District in Shenyang DONG Feng  
(School of Economics, Wuhan University of Technology, Wuhan 430070, Hubei, China)

Abstract: During the manufacturing of machinery products, the casting and forging technology is the most important basic working procedure. Moreover, the casting and forging parts contribute 60% to the whole working operation. How to further improve the level of casting and forging technology, skill and manufacture will be major items of study for us. Therefore, building up Casting and Forging Industrial Park is a breakthrough to upgrade the casting and forging technical level and competitive power of Tiexi District.

Key words: casting and forging technology; resources combination; Casting and Forging Industrial Park

16 Dynamic Measurement of Thermal Stress during Solidification of Casting ZHANG Jia-feng, KANG Jin-wu, LIU Rui-cheng  
(Key Laboratory for Advanced Manufacturing by Materials Processing Technology, Department of Mechanical Engineering, Tonghua University, Beijing 100084, China)

Abstract: A method was presented for the indirect measurement of dynamic stress. A stress sensor embedded in the sand mold close to the casting was used to reveal the pressure because of the shrinkage of casting which could figure out the dynamic stress of the frame-shaped casting indirectly. The numerical simulation was also carried out by using FDM/FEM method. The results showed that the pressure grew up quickly in the rapid cooling period and then kept on a steady value. The experimental and calculated results were in good agreement.

Key words: sand casting; stress; dynamic measurement; numerical simulation

17 Automatic Measurement of Casting Surface Roughness Based on Digital Image Processing LI Da-yong, WANG Wen-zhuo, SHI De-quan  
(Material Science & Engineering College, Harbin University of Science & Technology, Harbin 150040, China)

Abstract: Based on the digital image processing technique, a method for automatically measuring the three-dimensional parameters of casting surface roughness is put forward. In this method, the casting surface image is acquired by CCD and stored in the computer. Firstly, the mid-value filtering, the edge strengthen and the image binary conversion are used to pre-process the image, and then the values of casting surface roughness are got through characteristic acquisition. It is proved by the initial experiment that the three-dimension evaluation method put forward in the paper is feasible.

Key words: casting surface roughness; three-dimension evaluation; digital image processing; CCD

18 Design and Making about the Device of Curing Sodium Silicate Bonded Sand by Blowing Carbon Dioxide LIU Qun-shan, LIU Rui-ling, LIN Yong-zhang, WANG Bin  
(College of Material Science and Technology, Hebei University of Science and Technology, Shijiazhuang 050004, Hebei, China)

Abstract: The purpose of designing and manufacture about the device that is used for curing sodium silicate bonded sand by blowing carbon dioxide was introduced. A distributor is installed on the device which makes carbon dioxide of every pipeline branch well-distributed. Every branch linked to corresponding work position on the test bed has respective valve which is used for opening or closing the pipeline. The assembly made of a cylinder with sand sample and a auxiliary cylinder for adding sand was set on every work position, which is firm and sealed up by another cylinder with felt pads to prevent carbon dioxide from leaking out. There are eight work positions on the test bed and eight samples can be blown and cured simultaneously, so the tested data of sand prosperities are steady. Cylinder samples that have a diameter of 30 mm and a height of 50 mm were made successfully using the above-mentioned device.

Key words: sodium silicate sand; carbon dioxide; curing; experiment device

19 Effects of Heat Treatment Process on Microstructure and Rolling Wear Properties of High Vanadium High Speed Steel BAI Wan-zhen1, WEI Shi-zhong2, LONG Rui2, XU Liu-jie2, DONG Zhan-wu, YANG Xiong1  
(1. Institute of Material Science & Engineering, Henan University of Science & Technology, Luoyang 471003, Henan, China; 2. Henan Engineer- ing Research Center for Wear Resistant Material, Luoyang 471003, Henan, China)

Abstract: The effects of 20 types of heat treatment processes on hardness, impact toughness, retained austenite amounts and rolling wear resistance of high vanadium high speed steel were studied, and their microstructures were analyzed by using SEM, optimal heat treatment technology for rolling wear was acquired. The results show that, when the quenching temperature increases, retained austenite amounts increase. When tempering temperature increases, retained austenite amounts decrease. Tempering at 900-1000 °C, the tempering temperature has a little effect on rolling wear properties. At the tempering temperature of 1 050-1 100 °C and tempering temperature
of 450-550 °C, rolling wear properties increase at a great extent. Considering the effects on mechanical properties, rolling wear resistance, equipment loss and production costs, optimal heat treatment technology is quenching at 1 050 °C and tempering at 450-550 °C.

**Key words:** high vanadium high speed steel; heat treatment; microstructure; rolling wear properties; hardness; impact toughness

### 20 Technological Design of Riser Deviating from Hot Spot for Stainless Steel Castings

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**Abstract:** In order to prevent the formation of the shrinkage and dispersed shrinkage in the riser pad of steel casting, the dynamic directional solidification theory of riser deviating from hot spot and the mold calculation method were used for designing riser for the 150FYL 1Cr18Ni9Ti stainless steel body of submerged pump and body of heat insulating closing valve, which are produced by sand molding and investment casting respectively. When the feeding safety factor is 1.14-1.20, these defects such as shrinkage and dispersed shrinkage can be eliminated, and the compact casting can be obtained. Hydraulic tests show that no valves have leakage under 2-4 MPa holding for 3 min. It is verified from batch production that the technical design is practical and reliable, and the quality of product is stable, thus it has good technical and economical effects.

**Key words:** stainless steel casting; riser deviating from hot spot; dynamic directional solidification; design of riser

### 21 Technical Study of Microwave Dewaxing

**Liu Hong-bao**, **Shen Bin**, **Mao Xie-min**, **Li Chong-he**

(Department of Materials and Engineering, Shanghai University, Shanghai 200072, China)

**Abstract:** In this paper, the process and the influencing factors of microwave dewaxing were studied, including the powder to liquid ratio, slurry, quantity of back-up coatings, power of microwave, etc. The study indicated that the most important impaction factors were quantity of back-up coatings, designs of wax pattern and the composition of the wax.

**Key words:** microwave; dewaxing; investment casting

### 22 Mechanism and Application of Vibrant Crystal Improving Aluminum Alloy Casting Density

**Zhu Li-juan**, **Dong Xi-qing**, **Li Zhong**, **Zhang Li-bao**, **Jiang Da-feng**, **Wang Xiao-ji**, **Yan Meng-ling**, **Chen Li-ying**, **Liu Ji-hong**

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**Abstract:** Through analysis and practices the vibration crystal is validated in effect for improving aluminum alloy casting’s density, and the vibration crystal must be parallel to the gravity that is vertical wave vibration. The lower model’s chink exponential of vibration A0 ≥ 1, which is good for heat transfer. It can bigger than 1 for the upper model, while for the side model the value between above two is advanted to improve the heat preservation function of riser. The pouring mode of increasing velocity can intensify vibrant feeding and the vibrant direction must be parallel to the gravity that is vertical.

**Key words:** propitious vibrant crystal; aluminum alloy; compact

### 23 Selection and Application of Foam Ceramic Filter in Foundry Production

**Zhang Yun-hua**, **Liu Yu-ling**, **Gao Peng**, **Sun Shao-bo**, **Huang Dan-zhong**


**Abstract:** The purification mechanics and basic parameters of foam ceramic filter were introduced in this paper. The method of selecting foam ceramic filter reasonably and exactly during foundry production was presented from such aspects as size and material of the filter, calculation of filtering capacity, positioning and so on.

**Key words:** foundry; foam ceramic filter; selected method

### 24 As-Cast Microstructures and Properties of Al-9.0Zn-2.5Mg-1.2Cu-0.15Zr Alloys Adding Sc

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**Abstract:** Three kinds of alloys Al-9.0Zn-2.5Mg-1.2Cu-0.15Zr, Al-9.0Zn-2.5Mg-1.2Cu-0.15Zr, and Al-9.0Zn-2.5Mg-1.2Cu-0.15Zr were produced by ingot-slug casting and SBT process. The mechanical properties of the alloys at different treatment conditions were tested and their microstructures were studied by using optical microscope (OM), scanning electron microscope (SEM) and transmission electron microscope (TEM). The results show that the enhancement of the Sc content can improve the tensile strength and elongation of the Al-Zn-Mg-Cu-Zr alloys. After solution and T6 treatment, the tensile strength of AlZn-2.5Mg-1.2Cu-0.15Zr is up to 774.6 MPa, and the elongation is 8.3%. The reason is that the higher the content of Sc, the more obvious the fine grain strengthening, substructure strengthening and dispersion strengthening caused by Al(S, Zr).

**Key words:** Sc; Al-Zn-Mg-Cu-S-Zr alloys; mechanical property; microstructure

### 25 Influence of Hardening Heat on Microstructure and Properties of Cast Fe-B-Ti Alloy

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**Abstract:** The microstructure of cast Fe-B-Ti alloy was changed under different hardening heat. The relations between different structures and properties were discussed. The results show that the change of boride is small and the network distribution of boride is very obvious while the quenching temperature is slow. When the quenching temperature is higher, the network breaking and aggregating tendency of boride becoming quicker obviously. When the quenching temperature reaches 1 050 °C, the network boride disappears, which transforms into block, grain and rod boride. The hardness and impact toughness of cast Fe-B-Ti alloy increase while increasing the quenching temperature, but have no obvious change while exceeding 1 000 °C. When the quenching temperature is 1 050 °C, cast Fe-B-Ti alloy has excellent comprehensive properties.

**Key words:** Fe-B-Ti alloy; quenching temperature; boride; hardness; impact toughness

### 26 Study on Improving Graphite for Centrifugal Nodular Cast Iron Sleeve

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**Abstract:** On the base of analyzing the effects of centrifugal sleeve materials, mold parameter, pouring parameter and cooling parameter on the graphite of centrifugal cast nodular iron sleeve, the technical design research and iron modification was researched. The adoption of such methods as optimizing ingredient proportioning; adding alloying element molybdenum, copper; late inoculation; adding microelement bismuth and forced cooling technique of water-cooling combine air-cooling was able to improve nodular graphite numbers and distribution.

**Key words:** centrifugal casting; nodular graphite; optimizing; inoculation; forced cooling

### 27 Development of Autoclaved Bricks from Waste Foundry Sand

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**Abstract:** An autoclaved brick has been prepared using waste foundry sand, crushed stone and fly ash, with addition of suitable amount of activators, such as hydrated lime and special composite. The preparation process comprises wheel-rolling blending, molding with high pressure and autoclaved curing process. Autoclaved bricks have been tested by authoritative testing department. The result show that the strength reaches the standard of 15C (GB11945-1999); and the density of the products is lower than that of the standard materials (GB6566-2001); the coefficient of carbonization and the data of drying shrinkage accord with Chinese fly ash brick standard (JC 249-2001). Moreover, the heating toxicity results of waste foundry sands, fly ash and autoclaved bricks are lower than the standard of GB5085.3-1996. The strengthening form mechanism is investigated by using XRD and SEM techniques. Cast of autoclaved brick made from waste foundry is lower than that of traditional autoclave bricks, which shows potential application market.

**Key words:** waste foundry sands; autoclaved bricks; radioactivity; leaching toxicity