

**特种铸造及有色合金**  
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# 特种铸造

2010 年第 30 卷  
目

## 特别报道

目标: 精品期刊  
——《特种铸造及有色合金》杂志创刊 30 周年系列报道之八 ..... (1-51)

## 试验研究

添加剂对自蔓延法制备 Cu-Cr 合金的影响 ... 豆志河 张延安 张志琦 等 (687)  
喷射沉积 SiC<sub>p</sub>/7090Al 复合材料板材高温拉伸变形行为  
..... 孙有平 严红革 陈刚 等 (691)

## 实用研究

一种铸件/铸型界面传热系数的反求法 ..... 许征兵 曾建民 (694)  
基于小波分析的镁熔液第一气泡检测方法研究  
..... 许四祥 马爱萍 汪敏 等 (697)  
Ca、Si 复合合金化对 AZ31 镁合金显微组织的影响  
..... 李继强 张磊 刘文 等 (699)  
镁合金表面锌铝合金冷喷涂层性能的研究  
..... 赵惠 黄张洪 李平仓 等 (702)

## 计算机应用技术

铸铜冷却壁充型过程数值模拟 ..... 杜晓明 黄勇 赵敏 (705)  
基于 Pro/E 的压铸模具设计及其变形分析 ..... 朱蓉英 葛正浩 (708)

## 半固态加工

二次加热工艺对半固态 Al-6Si-2Mg 合金组织的影响  
..... 管仁国 赵占勇 朱立杰 等 (710)  
6063 铝合金半固态反挤压数值模拟 ..... 王姣姣 路贵民 尚淑珍 等 (714)  
成形工艺参数对沿程流动初生固相演变的影响  
..... 谭建波 李增民 李立新 (718)  
镁合金半固态注射成形试验及注射速度控制方法  
..... 张涛 刘勇兵 隋铁军 等 (722)  
泡沫铝半固态制备工艺及组织研究 ..... 游晓红 王录才 靳彪 (724)

## 压力铸造

ADC12 铝合金汽车缸盖罩压铸件浇口 CAE 分析 ..... 夏建生 龚沙沙 (729)  
高速列车制动装置中气室压铸件 ADC1 疲劳失效起因分析  
..... 董普云 赵海东 张璟 等 (731)  
工艺参数对 ADC12 铝合金连杆端盖挤压铸造过程的影响  
..... 唐全波 姜巨福 王迎 (734)  
3Cr2W8V 钢和 H13 钢模具在纯铜压铸中的使用寿命  
..... 杨红梅 杨旭 梁栋 等 (737)

## 精密铸造

涂敷浆砂陶瓷型熔模铸造在铜艺术铸件中的应用 ..... 周本植 (739)  
再谈熔模铸造中缩孔缩松的特殊解决方案 ... 罗均强 黄光兴 吴大波 (742)

## 消失模铸造

直列式六缸发动机的消失模铸造三维数值模拟 ..... 张志莲 肖云峰 (743)  
铝合金缸体、缸盖的消失模铸造 ..... 高成勳 刘伟明 颜鹏远 (746)

## 复合材料

钢基材表面无机熔融盐电镀铝的研究 ... 周启来 沈涛 薛丽红 等 (748)  
电渣熔铸双金属复合材料锤头的组织性能 ... 杨勇勤 黄年喜 胡须忠 (751)  
Ni 诱导无压浸渗法制备不锈钢/Al<sub>2</sub>O<sub>3</sub> 陶瓷复合材料  
..... 韩孟岩 陈维平 杨少锋 (753)

# 及有色合金

## 第8期(总第209期) 次

### 轻 有 色 合 金

- 低压电弧喷涂 Ti 涂层组织形态及其制备工艺 ..... 宋 丹 李德元 张广伟 等(758)
- NaVO<sub>3</sub> 对 AZ91D 镁合金微弧氧化膜的影响 ..... 吴召刚 马 颖 马跃洲 等(761)
- 铸造 Al-25Si-xFe-yMn 合金凝固组织的研究 ..... 黄海军 冯 皓 张济山(766)
- 高能超声对 Al-20Si 合金组织和力学性能的影响 ..... 杨 俊 程和法 黄芙蓉 等(769)
- Ca 对快速凝固 Mg-6Zn 合金薄带组织与性能的影响 ..... 张先满 朱叔利 周 涛(772)

### 重 有 色 合 金

- 再生铜熔炼过程节能与提质关键技术研究 ..... 谭易君 周 萍 闫红杰 等(776)
- 大型铝青铜衬套的离心铸造工艺研究 ..... 杨为勤(779)

### 艺 术 铸 造

- 错金银四龙四凤铜方案——经多次铸、焊成形的复杂结构杰作  
——《中国古代艺术铸件系列图说之四十四》 ..... 谭德睿(783)

### 述 评

- 铸造强国正在崛起——透过 2010 中国国际铸造博览会看中国铸造业的发展 ..... (2-1, 2-2)

### 国 际 会 议

- 第 69 届世界铸造会议·2010 中国铸造活动周 ..... (1-20, 1-21, 1-22, 1-23)
- 第十一届合金与复合材料半固态成形国际会议(S2P2010) ..... (1-25)
- 第十一届合金与复合材料半固态成形国际会议(S2P2010)论文题录 ..... (2-3, 2-4, 2-5, 2-6)

- 海外文献速报 ..... (2-7)
- 专利文献信息 ..... (2-8)
- 英文摘要 ..... (I)
- 广告索引 ..... (IX)
- 会议消息

第十三届全国特种铸造及有色合金学术年会、第七届全国铸造复合材料学术会议征文通知(1-46)、2010 年中国有色金属工业暨铝加工国际论坛在上海举行(701)、2010 年中国国际铝工业展览会在上海举办(728)

### 国内行业动态

关于举办铸造自动化装备应用培训班的通知(1-24)、铝资源清洁生产与循环利用技术创新战略联盟成立(690)、铝产业链体现中国速度,产量同比增幅 26%以上(736)、有色加工材 5%出口退税取消(745)、中铝连续 3 年进入世界 500 强(775)

### 国际行业新闻

俄罗斯 5 月铜、锌、镍和铝产量同比增加(696)、WBMS:1-4 月全球铝市供应过剩 28.8 万吨(704)、印度钛业发展势头迅猛(721)、大型黄铜铸造企业落户美国俄亥俄州(733)、新路虎将配备 CGL(蠕墨铸铁)发动机缸体(738)、WBMS:1-4 月全球铝市过剩 29.5 万吨(741)、日铝协预测 2020 年全球铝需求缺口 1000 万吨(757)、IAI:5 月全球铝库存月增 3.1%(757)、欧盟对铝进口继续征收 3%的关税(765)、英国铝合金价格下跌(771)、巴克莱:铜价可能跌至 6037 美元/吨(778)、力拓投资 4.69 亿美元在美建镍、铜矿(782)

### 刊 讯 、 网 讯

欢迎订阅《特种铸造及有色合金》杂志(2-4)、《特种铸造及有色合金》稿件要求(2-11)、《特种铸造及有色合金》稿件远程采编系统使用说明(2-12, 2-13)

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### 报 道 内 容

各种(黑色和有色合金)特种铸造方法、各种(砂型铸造和特种铸造)有色合金及复合材料的理论、工艺、设备、测试与控制、计算机应用等方面的科技成果、生产技术和现场经验,以及上述内容的国内外发展动向、行业活动、学术会议消息等。

### 广 告 业 务 范 围

- (1)铸造合金材料;(2)铸造原辅材料;  
(3)熔炼设备;(4)铸造机械;(5)铸造生产线;  
(6)铸造模具;(7)铸造仪器仪表;(8)计算机软件、控制设备等。

### 网 站 简 介

及时报道《特种铸造及有色合金》杂志每期刊登的主要内容,迅速传递行业活动的各种信息,有文章库、人才库、企业库等数据库可供查询。

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## CONTENTS & ABSTRACTS

**Effect of Additive on Structure and Purity of CuCr Alloy Prepared by Self-propagation High Temperature Synthesis (SAS)** Dou Zhihe, Zhang Ting'an, Zhang Zhiqi, Niu Liping, He Jicheng (Key Laboratory for Ecological Utilization of Multimetallic Mineral, Ministry of Education, Northeastern University, Shenyang, China) 2010, 30(8)0687~0690

**Abstract** CuCr alloy was prepared with CuO, Cr<sub>2</sub>O<sub>3</sub> and Al as reactants by SHS, and effects of different additives on the microstructure and purity of alloy prepared were investigated. The results reveal that the alloy is composed of Cu phase, Cr phase and a little Cr<sub>23</sub>C<sub>6</sub> phase, and slag consists of Al<sub>2</sub>O<sub>3</sub> and Na<sub>3</sub>AlF<sub>6</sub> as well as a little Cr phase. Cr existence shows the dis-ideal separation effects of metal from slag. With increasing in Na<sub>3</sub>AlF<sub>6</sub> addition, microstructure of the alloy exhibits uniform and compact as a result of effectively removing oxides inclusion in the CuCr alloy, meanwhile, oxygen content in the alloy is decreased with increasing in residual Al content, and purity of the alloy is more than 97%.

**Key Words:** SHS, CuCr Alloy, Slag, SEM

**Tensile Deformation Behavior of Spray-deposited SiC<sub>p</sub>/7090 Aluminum Matrix Composites at Elevated Temperature** Sun Youping<sup>1,2</sup>, Yan Hongge<sup>2</sup>, Chen Gang<sup>2</sup>, He Jiangmei<sup>1</sup> (1. Mechanical Engineering Department, Guangxi University of Technology, Liuzhou, China; 2. College of Materials Science and Engineering, Hunan University, Changsha, China) 2010, 30(8)0691~0694

**Abstract** Mechanical properties and deformation behavior of sprayed-deposited SiC<sub>p</sub>/7090Al composites rolling sheet were investigated by uniaxial tensile testing on WDW-E200 tensile tester at ambient temperature and 300~450 °C with stain rate of 0.1s<sup>-1</sup>. Meanwhile, microstructure, mechanical properties and fractographies of the composites at different tensile temperatures were also observed. The results show that tensile flow stress in the composites sheet is decreased with increasing in deformation temperature. In addition,

interface of Al/SiC is weakened and particle breakage is reduced with tensile temperature increase, while the elongation of the composites is increased from 3.0% to 85.07%.

**Key Words:** Spray Deposition, High Strength Aluminum Alloy, Composites, Flow Stress, Fracture Behavior

**Inverse Method to Interfacial Heat Transfer Coefficient of Casting/Mold** Xu Zhengbing, Zeng Jianmin (State Key Laboratory of Solidification Processing, Northwestern Polytechnical University, Xi'an, China) 2010, 30(8)0694~0696

**Abstract** During the actual casting process, the heat resistance exists at the interface of casting/mold because of air gap or coatings. Boundary conditions at the interface are changed with temperatures to result in complex heat transfer, which influences the solidification and cooling rate remarkably. Interfacial heat transfer coefficient (IHTC) is a key parameter used to characterize the heat resistance between the castings and the mold. During the numerical simulation of solidification, the IHTC is an important boundary condition. A new method was presented to determine the equivalent IHTC at the castings/mold interface during solidification based on deducting the solvent. A simple shaped part was used as benchmark. Different constants of IHTC were used to simulate the temperature curves, which were compared with the actual temperature curves, when the former is nearly to the later, then the coefficient was regarded as the equivalent IHTC at the castings/mold interface. The blade with different thickness was used to conduct verification experiment. The results reveal that the method is simple, convenient and feasible, exhibiting a wide engineering application prospect.

**Key Words:** Equivalent IHTC, Inverse Method, Solidification Simulation

**Detection Method to the First Bubble of the Surface**

**Based on Wavelet Analysis in Magnesium Alloy Melt** Xu Sixiang, Ma Aiping, Wang Min, Huang Guofang (Mechanical Engineering Institute, Anhui University of Technology, Ma'anshan, China) 2010, 30(7)0697~0699

**Abstract** Background around bubbles exhibits very complex due to the characteristics of very easy oxidation and ignition of the alloy melt. The wavelet analysis in differential scale was employed to keep track of time and frequency information of character signal. With the scale zooming out, true signal was enhanced and noise was weakened. Existence of the first bubble was effectively detected based on wavelet analysis in differential scale combining with open operation of mathematic morphology according to difference of target, disturbed background and noise. The results verify that the method is feasible and effective.

**Key Words:** Magnesium Melt, First Bubble, Wavelet Analysis, Mathematic Morphology

**Effects of Ca and Si Compound Alloying on Microstructure of AZ31 Magnesium Alloy** Li Jiqiang<sup>1</sup>, Zhang Lei<sup>2</sup>, Liu Wen<sup>1</sup>, Zhang Zhao<sup>1</sup> (1. School of Mechanical and Energy, Ningbo Institute of Technology, Zhejiang University, Ningbo, China; 2. State Key Laboratory of Material Processing and Die & Mould Technology, Huazhong University of Science and Technology, Wuhan, China) 2010, 30(8)0699~0701

**Abstract** Effects of Ca and Si compound alloying on as-cast microstructure of AZ31 magnesium alloy were analyzed by optical microscope (OM), SEM (scanning electron microscope), XRD (X-ray diffraction) and EDS (energy dispersive spectrometer). It is found that Ca element exists in the AZ31 magnesium in form of solid solution phase, and Si element is irrelative with the distribution of Ca in the alloy.  $Mg_2Si$  phase is created by Si reacting with Mg, meanwhile,  $Mg_{17}Al_{12}$  phase distributed along boundary is gradually converted into particle and acicular phase dispersedly distributes around boundary or in the grain. With increasing in Si addition, partial particles become coarse, and Chinese script  $Mg_2Si$  phase appears in the matrix alloy. The desirable as-cast microstructure of the alloy can be observed with 0.3% Ca and 0.4% Si compound addition.

**Key Words:** AZ31 Magnesium Alloy, Ca, Si, Microstructure

**Properties of Zn-Al Alloy Cold Spraying Coatings on Magnesium Alloy** Zhao Hui<sup>1</sup>, Huang Zhanghong<sup>2</sup>, Li Pingcang<sup>1</sup>, Wang Hunian<sup>1</sup> (1. Xi'an Tianli Cladding Metal Materials Co., Ltd., Xi'an, China; 2. Xi'an Western Metal Materials Co., Ltd., Xi'an, China) 2010, 30(8)0702~0704

**Abstract** ZA20 coatings were prepared on the surface of AK63 magnesium alloys by cold spraying method. Microstructure of interface between cold sprayed coatings and magnesium alloy matrix was observed by OM (optical microscope), EMP and EDX. Hardness, bonding strength and wear resistance, corrosion behavior of the samples before and after cold sprayed treatment were investigated. The results reveal that absence of diffusion between matrix alloy and coating and of defects in interface, such as crack, pore and separation, can be observed, showing desirable interface bonding. The hardness of the coating is approximately higher 3 times than that of the alloy substrate. In addition, wear resistance of the magnesium alloy after cold sprayed ZA20 coating is greatly superior to that of magnesium alloy matrix in condition of dry friction or oil lubrication. Self-erosion potential of cold sprayed samples (-0.26V) is far higher than that of magnesium alloy matrix (-1.62V), leading to in the significant improvement of corrosion resistance.

**Key Words:** Cold Spraying, Magnesium Alloy, Zn-Al Coating, Wear Resistance, Corrosion Resistance

**Numerical Simulation of Filling Process in Copper Stave Casting** Du Xiaoming<sup>1</sup>, Huang Yong<sup>1</sup>, Zhao Min<sup>2</sup> (1. School of Materials Science and Engineering, Shenyang Ligong University, Shenyang, China; 2. Shenyang Donghuan Non-ferrous Metal Manufacture Co., Ltd., Shenyang, China) 2010, 30(8)0705~0707

**Abstract** Influence of inlet velocity and pouring temperature of the metal melt on flow field in the copper stave in metal-sand molds was simulated using a finite element software ANSYS. The results reveal that obvious disturbance on the curves of filling velocities can be observed in condition of lower inlet velocities, such as 0.3 m/s and 0.8m/s, while absence of disturbance on the filling velocity curves can be observed with inlet velocity of 1.0 m/s, exhibiting smooth filling process, which can be used for the recommended value of pouring parameters during practical production. Varied-viscosity was adopted in the numerical simulation to predict the effects of pouring temperature on filling

velocities. It is found that with increasing in pouring temperature, the filling velocity of metal melt is obviously accelerated, which is beneficial for obtaining larger velocity gradient.

**Key Words; Copper Slave, Numerical Simulation, Inlet Velocities, Flow Field**

**Design of Die Casting Die Based on Pro/E and Analysis of Die Distortion** Zhu Rongying<sup>1,2</sup>, Ge Zhenghao<sup>1</sup> (College of Electromechanical and Engineering, Shaanxi University of Science and Technology, Xi'an, China; 2. Department of Material Science and Engineering, Shaanxi Polytechnic Institute, Xianyang, China) 2010, 30(8)0708~0710

**Abstract** Die casting machine was selected by analyzing component structure, and 3D design of die casting die was conducted by Pro/E software. And then, through finite element analysis module MACHANIC from Pro/E, the distortion induced by the die locking force and the thermal loading in using process of the die was visualized. Distortion characteristics of the 3D die was observed, which provided a reference to further optimize die design.

**Key Words; Die Casting, Pro/E, Die Distortion**

**Effects of Reheating Process Parameters on Microstructure of Semi-solid Al-6Si-2Mg Alloy** Guan Renguo, Zhao Zhanyong, Zhu Lijie, Huang Hongqian (Materials and Metallurgical College, Northeastern University, Shenyang, China) 2010, 30(8)0710~0713

**Abstract** Semi-solid Al-6Si-2Mg alloy billets with fine spherical grains were prepared by self-developed vibrating wave-like sloping plate device, and effects of different reheating processes on microstructure of the billets were observed. The results reveal that solute diffusion is accelerated, and liquid region near grain boundary tends to be continuous and liquid fraction rises with increasing in holding temperature at a given holding time. Due to the role of interface free energy, average grain size exhibits firstly increase and then decrease, meanwhile, average grain roundness and density show gradually decrease. At a given holding temperature, with extending in holding time, eutectic liquid phase is increasingly raised to be formed a continuous liquid network to separate the grain. To decrease interface free energy, grain size exhibits firstly increase and then decrease, while grain roundness is decreased with raising in liquid fraction. Desirable semi-

solid slurry with spherical grain suspending on liquid phase can be obtained with holding at 610 °C for 60 min.

**Key Words; Semi-solid, Reheating, Al-6Si-2Mg Alloy, Microstructure**

**Numerical Simulation of Inverse-squeezing Semi-solid 6063 Aluminum Alloy** Wang Jiaojiao<sup>1</sup>, Lu Guimin<sup>1</sup>, Shang Shuzhen<sup>2</sup>, Fang Zhou<sup>3</sup>, Li Honghua<sup>3</sup> (1. College of Resource and Environmental Engineering, East China University of Science and Technology, Shanghai, China; 2. College of Mechanical and Power Engineering, East China University of Science and Technology, Shanghai, China; 3. Zhejiang Geely Research Institute for Automobile Co., Ltd., Shanghai, China) 2010, 30(8)0714~0717

**Abstract** Thermal simulation compressive experiment was conducted for semi-solid 6063 aluminum alloy billets which was prepared by near-liquidus semi-continuous casting. Based on stress-strain curves at varied temperatures and strain rates, inverse-squeezing process of the semi-solid 6063 aluminum alloy was simulated by the Deform-3D software at 615~625 °C with strain rate of 0.1~5s<sup>-1</sup> and 60% deformation rate to understand effects of deformation rate, deformation temperature, punch velocity and frictional coefficient and to optimize the processing parameters. The results reveal that with increasing in deformation rates, flow velocity and flow orientation of the alloy in severe deformation zone are distinctly changed, meanwhile, light deformation zone is gradually evolved, which results in the remarkable non-uniformity of deformation. With raising in punch velocity, flow velocity of the billets is accelerated, which is harmful for the formation as a result of aggravating non-uniformity of the whole deformation process. With deformation temperature increase, equivalent strain of the billets in severe deformation zone is obviously increased, while equivalent stress in the billets is decreased. Effects of frictional states on the deformation of billets can be neglected.

**Key Words; 6063 Aluminum Alloy, Semi-solid, Inverse-squeezing Process, Numerical Simulation**

**Effects of Forming Parameters on the Evolution of Primary Phase along Filling Process** Tan Jianbo, Li Zengmin, Li Lixin (School of Material Science and Engineering, Hebei University of Science and Technology,

Shijiazhuang, China) 2010, 30(8)0718~0721

**Abstract** Semi-solid alloy melt with different primary structure was prepared by inclined cooling-shearing rheocasting, and spiral samples were made by semi-solid squeezing casting. Characteristic parameters, such as solid phase fraction, grain size and shape factor, of primary phase structure and spiral sample at different filling length were investigated by quantitative metallographic technique to understand effects of filling pressure and filling velocity on primary structure of the semi-solid alloy melt during filling process. The result show that when spiral samples are made by semi-solid squeezing casting with filling pressure of 20~120MPa and filling velocities of 0.2~1.2 m/s, the solid phase fraction, grain size and shape factor along the filling length exhibits wave-like change with little amplitude, and the position of peak and trough has no definitely relation with the filling length.

**Key Words:** Microstructure Evolution, Forming Process Parameters, Semi-solid, Filling Process, Flow along the Filling Process

**Semi-solid Injecting Forming Magnesium Alloy and Its Injecting Velocity Control** Zhang Tao<sup>1</sup>, Liu Yongbing<sup>2</sup>, Sui Tiejun<sup>1</sup>, Li Binli<sup>1</sup>, Shen Fengli<sup>1</sup>, Cui Xiaopeng<sup>3</sup> (1. Guangdong Yizumi Precision Machinery Co., Ltd., Shunde, China; 2. School of Materials Science and Engineering, Jilin University, Changchun, China; 3. School of Materials Science and Engineering, Changchun University of Technology, Changchun, China) 2010, 30(8)0722~0724

**Abstract** Main technological requirements on semi-solid injecting forming for magnesium alloy were described. Based on experiments, control ways of injecting velocity in semi-solid injecting forming were investigated to realize the improvement of some performance in magnesium alloy semi-solid injecting forming machine such as fast dynamic response, stable pressure control and excellent velocity control.

**Key Words:** Magnesium Alloy, Semi-solid, Injecting Forming, Velocity Control, Control Ways

**Semi-solid Preparing Aluminum Foam and Its Microstructure** You Xiaohong<sup>1</sup>, Wang Lucai<sup>1</sup>, Jin Biao<sup>2</sup> (1. College of Materials Science and Engineering, Taiyuan University of Science and Technology, Taiyuan, China; 2. Foundry Branch of Jinxi Railway Rolling Stock Co., Ltd., Taiyuan, China) 2010, 30(8)0724~0728

**Abstract** Based on semi-solid forming technology, a two-step forming process for aluminum foam that is semi-solid foaming (SSF) was put forward to control the cell structure of closed-cell aluminum foam. Effects of basic processing parameters of SSF on foaming process and cell structure as well as its optimization were investigated. The results reveal that SSF can control decomposing time of TiH<sub>2</sub>, realizing secondary foaming process, and Al-Si aluminum foam with uniform cell structure in which cell porosity is 74.6% with cell diameters of 2.1~3.2 mm and average roundness of 0.812 can be obtained. The optimized processing parameters are as follows: stirring temperature of 580 °C, stirring time of 0.5 min and stirring velocities of 1200 r/min, re-forming temperature of furnace of 720 °C and heating time of 15 min.

**Key Words:** Aluminum Foam, Semi-solid Forming, Non-dendrite Structure, Mechanical Stirring, Two-step Foaming

**CAE Analysis of Gate in ADC12 Aluminum Alloy Cam Cover for Automobile Engine** Xia Jiansheng, Dou Shasha (1. Youji School of Yancheng Institute of Technology, Yancheng, China) 2010, 30(8)0729~0730

**Abstract** Flow distribution of liquid aluminum alloy and its solidification behavior in ADC12 aluminum alloy cam cover for automobile engine were simulated by MAFMA soft at different gate thickness to predict potential defect positions during filling process. The results reveal that gate thickness greatly affect the filling process and distribution of pressure. There exists large temperature-difference and centralized high pressure as well as high velocity impaction around thin-walled gate, resulting in the formation of hot crack. Pressure distribution, entrapped-gas and gas hole defects in the parts are acceptable in condition of gate with thickness of 2.0mm and filling at 50 m/s.

**Key Words:** ADC12 Aluminum Alloy, Die Casting, MAGMA Soft

**Origination of Fatigue Failure on ADC1 Die Castings in High Speed Train Braking Gas Chamber** Dong Puyun<sup>1</sup>, Zhao Haidong<sup>1</sup>, Zhang Jing<sup>2</sup>, Gao Junmin<sup>2</sup> (1. National Engineering Research Center of Near-net-shape Forming for Metallic Materials, South China University of Technology, Guangzhou, China; 2. Guangdong Wencan Die Casting Corporation, Foshan, Chi-

na)2010, 30(8)0731~0733

**Abstract** Fracture samples were prepared from different positions in practical fatigue failure ADC1 castings, and surface morphology and characteristics of the fracture samples were analyzed by SEM (scanning electron microscope) and EDS (energy dispersive spectrometry) to understand origination of fatigue failure of the castings. The results show that there exists pore with a larger size near surface and congregation of large area oxide film in the casting, which are responsible for the fatigue failure of the castings. In addition, the role of pore and oxide film in the process of failure was described.

**Key Words:** Practical ADC1 Castings, Fatigue Failure, Pore, Oxide Film

**Effects of Processing Parameters on Squeezing Casting ADC12 Aluminum Alloy Connecting Rod's Cap** Tang Quanbo<sup>1</sup>, Jiang Jufu<sup>2</sup>, Wang Ying<sup>3</sup> (1. College of Mechanical Engineering, Chongqing Technology and Business University, Chongqing, China; 2. School of Materials Science and Engineering, Harbin Institute of Technology, Harbin, China; 3. School of Mechatronics Engineering, Harbin Institute of Technology, Harbin, China) 2010, 30(8)0734~0736

**Abstract** ADC12 aluminum alloy connecting rod's cap was manufactured by squeezing casting. Effects of pouring temperature and specific pressure on mechanical properties of connecting rod's cap formed were investigated. The results reveal that ADC12 alloy connecting rod's cap with a higher surface quality and mechanical properties can be successfully manufactured by squeezing casting. Pouring temperature and specific pressure are closely related to the mechanical properties of the connecting rod's cap formed. Tensile strength and elongation of the connecting rod's cap formed by squeezing casting with 250MPa at 700 °C can make 366 MPa and 6.5%, respectively.

**Key Words:** Squeezing Casting, ADC12 Aluminum Alloy, Connecting Rods Cap, Mechanical Properties

**Service Life Analysis of 3Cr2W8V Tool Steel and H13 Tool Steel for Die Casting Pure Copper Parts** Yang Hongmei<sup>1,2</sup>, Yang Xu<sup>1</sup>, Liang Dong<sup>3</sup>, Gang Hongliang<sup>1</sup>, Wang Qin<sup>1</sup> (1. Yunan Copper Die Casting Co., Ltd., Kunming, China; 2. Yunnan University, Kunming, China; 3. International Copper Association (China), Beijing, China) 2010, 30(8)0737~0738

**Abstract** Service life of H13 and 3Cr2W8V hot working tool steel in die casting pure copper was analyzed. H13 steel mould and 3Cr2W8V steel mould are failure in die casting pure copper as a result of high temperature resulting in the occurrence of thermal fatigue crack with large size, so their service life in the die casting pure alloy is far lower than those in die casting aluminum alloy. Although service life of H13 steel is superior to that of 3Cr2W8V steel, it only reaches up to 160 cycles.

**Key Words:** Pure Copper, Die Casting, H13 Steel, 3Cr2W8V Steel

**Application of Coating Slurry-sand in Investment Casting Copper Art Parts** Zhou Benzhi (Tongguan Electrical Co., Ltd., of Tongling Non-ferrous Co., Ltd., Tongling, China) 2010, 30(8)0739~0741

**Abstract** Operation process of coating slurry-sand ceramic mold investment casting and its application in copper art castings were introduced, meanwhile, characteristics of the ways and points for attention in operation process were analyzed.

**Key Words:** Coating Slurry-sand, Ceramic Mold Investment Casting, Copper Art Castings

**Three Dimension Simulation of Lost Foam Casting Straight Six-cylinder Engine Housing** Zhang Zhilian, Xiao Yunfeng (School of Mechanical Engineering, Beijing Institute of Petrochemical Technology, Beijing, China) 2010, 30(8)0743~0745

**Abstract** There often exists gas hole and leakage defects in lost foam casting aluminum alloy straight six-cylinder engine housing. Origination of the defects is very complex. Filling and solidification process of the engine housing were simulated to predict potential defect position. The results reveal that existing gating system can result in severe temperature gradient in the engine housing after filling. Meanwhile, different ingates exhibit distinctly different in fluid volume, where the maximum different value reaches up to 20%, which is responsible for the formation of gas hole in engine housing as a result of not realizing self-feeding.

**Key Words:** Straight Six-cylinder Engine, Lost Foam Casting, Numerical Simulation, Gas Hole

**Lost Foam Casting Aluminum Alloy Cylinder Cover and Cylinder Body** Gao Chengxun<sup>1</sup>, Liu Weiming<sup>2</sup>, Yan

Pengyuan<sup>2</sup> (1. Shandong Sanxin Huifeng Automobile Parts Co., Ltd., Guanxian, China; 2. Huineng Electromechanical (Fujian) Co., Ltd., Fujian, China) 2010, 30(8)0746~0747

**Abstract** The production of lost foam casting aluminum alloy cylinder cover and cylinder body was described, focusing on pattern assemble, gating system design, coating brushing and pouring as well as process control.

**Key Words:** Lost Foam Casting, Aluminum Alloy, Cylinder Body, Cylinder Cover

**Electroplating Aluminum on Steel in Inorganic Molten Salt** Zhou Qilai, Shen Tao, Xue Lihong, Yan Youwei (State Key Laboratory of Materials Processing and Die & Mould Technology, Huazhong University of Science and Technology, Wuhan, China) 2010, 30(8)0748~0750

**Abstract** Continuous and compact aluminum coatings on steel was prepared by electroplating in inorganic molten salt. Effects of  $AlCl_3$  content and electroplating time on quality and thickness of the coatings were analyzed. The results show that the prepared aluminum coating exhibits continuous and compact as well as uniform with 80%  $AlCl_3$  content, in which aluminum particle is densely arranged. With extending in electroplating time, thickness of the aluminum coatings is increased with the coarseness of aluminum particle.

**Key Words:** Steel, Molten Salt, Electroplating Aluminum Coating, Surface Morphology

**Microstructure and Properties of Electroslag Casting Bi-metal Composite Hammer Head** Yang Yongqin<sup>1</sup>, Huang Nianxi<sup>2</sup>, Hu Xuzhong<sup>2</sup> (1. School of Mechanical Engineering, Hubei University of Technology, Wuhan, China; 2. Research Institute of Machinery of Wuhan, Wuhan, China) 2010, 30(8)0751~0753

**Abstract** Bi-metal composite hammer head was produced by electroslag casting, in which high Cr cast iron was used for hammer head production and carbon structural steel was adopted in hammer handle. Microstructure and properties of the composite hammer head were analyzed. The results show that there exists a deeper metallurgical bonding zone between the hammer head and hammer handle, showing occurrence of the diffusion in two materials and realizing the desirable bonding. The experimental results verify that the service life of bi-metal composite hammer head is

about 2 times higher than that of high Mn steel ones.

**Key Words:** Electroslag Casting, Bi-metal, Composite Layer, Microstructure and Properties

**Preparation of Stainless Steel / $Al_2O_3$  Ceramic Composites by Ni-induced Pressureless Infiltration** Han Mengyan, Chen Weiping, Yang Shaofeng (National Engineering Research Center of Near-net-shape Forming for Metallic Materials, South China University of Technology, Guangzhou, China) 2010, 30(8)0753~0757

**Abstract** A new method of fabricating ceramic matrix composites using Ni-induced pressureless infiltration was presented, that is, firstly,  $Ni/Al_2O_3$  composite ceramic preforms were prepared by powder metallurgical method, then, the  $Ni/Al_2O_3$  composite ceramic preforms were infiltrated with stainless steel melt at 1600°C in vacuum, finally, stainless steel infiltrated reinforced aluminum ceramic matrix composites were successfully prepared. Microstructure of steel/ceramic bonding interface was observed by SEM (scanning electron microscope), and elemental content in around bonding interface of the composites obtained was analyzed by EDS (energy dispersive spectrometer), and interfacial reactive products were characterized by XRD (X-ray diffraction), and interface bonding strength was measured by tensile testing. The results reveal that the steel melt can be infiltrated into the ceramic preforms through Ni liquid channels and form new Ni-Fe alloy. Interfacial reaction occurs between stainless steel and the composite ceramic, and the maximum interfacial bonding strength reaches up to about 67.5MPa.

**Key Words:**  $Ni/Al_2O_3$  Composite Ceramic Preforms, Pressureless Infiltration, Stainless Steel/alumina Ceramic Composites, Bonding Interface

**Microstructure of Ti Coatings Prepared by Low Pressure Arc Spraying and Its Preparation Processing** Song Dan, Li Deyuan, Zhang Guangwei, Zhao Lingyan (School of Materials Science and Engineering, Shenyang University of Technology, Shenyang, China) 2010, 30(8)0758~0761

**Abstract** Composition and microstructure of Ti coating prepared by low pressure arc spraying method were investigated, and effects of spraying parameters on impurity content in the coating prepared and morphology of sprayed particle were analyzed. The results reveal



that it is still difficult to prevent the coating from oxidation and nitridation in Ar atmosphere, so it is necessary for the preparation of a dense coating in low pressure. In addition, the role of deformation plus recrystallization treatment in the boundary among sprayed particles was described. Meanwhile, corrosion resistance of the coating was examined.

**Key Words:** Low Pressure Spraying, Ti, Coating, Sprayed Particle, Microstructure, Corrosion

**Effects of  $\text{NaVO}_3$  on Micro-arc Oxidation Coatings on AZ91D Magnesium Alloys** Wu Zhaogang, Ma Ying, Ma Yuezhou, Pan Zhenfeng, Hao Yuan (State Key Laboratory of Gansu Advanced Non-ferrous Metal Materials, Lanzhou University of Technology, Lanzhou, China) 2010, 30(8)0761~0765

**Abstract** Brown ceramic oxide coatings were prepared on AZ91D magnesium alloys by micro-arc oxidation, and effects of different  $\text{NaVO}_3$  concentration on the color, microstructure and properties of the coatings were investigated. The results reveal that with increasing in  $\text{NaVO}_3$  concentration, growth rate of the oxidation coatings is increased, and corrosion resistance of the coating exhibits firstly increase and then decrease, meanwhile, the color of the coatings becomes dark brown gradually. However, excessive  $\text{NaVO}_3$  concentration is harmful for the micro-oxidation process. EPMA analysis shows that the coating is mainly contained Mg, Al, V, O and little P element, and absence of the phase containing P element can be observed in the XRD, which is attributed to little P content in the coating and thin coatings resulting in the little deposition containing P phase.

**Key Words:** Magnesium Alloy, Micro-arc Oxidation, Coloring

**Solidification Structure of Cast Al-25Si-xFe-yMn Alloy** Huang Haijun<sup>1</sup>, Feng Hao<sup>1</sup>, Zhang Jishan<sup>2</sup> (1. State Key Laboratory of Environmental Adaptability for Industrial Products, China Electric Apparatus Research Institute, Guangzhou, China; 2. State Key Laboratory for Advanced Metals and Materials, University of Science and Technology, Beijing, China) 2010, 30(8) 0766~0769

**Abstract** Solidification structure of cast Al-25Si-xFe-yMn alloy was observed by SEM (scanning electron microscope), EDX and XRD, where Mn/Fe in weight ratio is in range of 0~1. The results show that Mn

can greatly refine microstructure of the alloy as a result of creation of  $\alpha\text{-Al}_{15}(\text{Fe}, \text{Mn})_3\text{Si}_2$  phase substituting for acicular  $\delta\text{-Al}_4\text{FeSi}_2$  and  $\beta\text{-Al}_3\text{FeSi}$  phase. In addition, with increasing in Fe/Mn weight ratio,  $\alpha\text{-Al}_{15}(\text{Fe}, \text{Mn})_3\text{Si}_2$  phase is increased and acicular phase is decreased. When Fe/Mn weight ratio is 1,  $\alpha\text{-Al}_{15}(\text{Fe}, \text{Mn})_3\text{Si}_2$  phase is observed in the alloy only.

**Key Words:** High Si Aluminum Alloy, Fe Phase, Mn, Casting

**Effects of High-intensity Ultrasonic Treatment on Microstructure and Mechanical Properties of Hypereutectic Al-20Si Alloy** Yang Jun, Cheng Hefa; Huang Xiaomei, Xiao Zhiling, Liu Ming (School of Materials Science and Engineering, Hefei University of Technology, Hefei, China) 2010, 30(8)0769~0771

**Abstract** Effects of high-intensity ultrasonic treatment on microstructure and mechanical properties of hypereutectic Al-20Si alloy were investigated. The results reveal that primary Si phase in the Al-20Si alloy can be converted from coarse plate gradually into fine spherical particle with uniform distribution after high intensity ultrasonic treatment, which is responsible for the improvement of tensile strength and elongation of the alloy. Observation of tensile fracture morphology shows that tearing strips and dimples much occurs in the fracture of Al-20Si alloy treated by high intensity ultrasonic treatment, characterized by mixed fracture of brittle and toughness crack.

**Key Words:** Ultrasonic Treatment, Al-20Si Alloy, Microstructure, Mechanical Properties, Fracture Mechanism

**Effects of Ca Addition on Microstructure and Properties of Rapidly Solidified Mg-6Zn Alloy Ribbons** Zhang Xianman<sup>1</sup>, Zhu Quanli<sup>1</sup>, Zhou Tao<sup>2</sup> (1. School of Mechanical Engineering, South China University of Technology, Guangzhou, China; 2. College of Materials Science and Engineering, Hunan University, Changsha, China) 2010, 30(8)0772~0775

**Abstract** Microstructure and properties of Mg-6Zn ribbons with different Ca addition prepared by two-roll rapid solidification were investigated by OM, SEM, XRD and DSC as well as micro-hardness tester. The results indicate that besides rapid solidification can greatly refine primary phase and secondary phase, Ca can give a help for refining further microstructure of

the alloy too. The microstructure of the rapidly solidified Mg-6Zn alloy ribbons are composed of supersaturated  $\alpha$ -Mg,  $Mg_{51}Zn_{20}$  phase and a little  $Mg_2Zn_3$  and  $MgZn_2$  phase. With increasing in Ca addition,  $Mg_2Ca$ ,  $Ca_2Mg_6Zn_3$  and  $MgZn_2$  phase are gradually increased with the decrease of  $Mg_2Zn_3$  and  $Mg_{51}Zn_{20}$  phase, which is beneficial to improving the thermal stability of the alloy.

**Key Words:** Rapidly Solidified Ribbons, Mg-6Zn-xCa Alloy, Microstructure, Thermal Stability

**Key Technologies of Energy-saving and Quality-enhancing in Copper Scrap Smelting Process** Tan Yijun<sup>1</sup>, Zhou Ping<sup>1</sup>, Yan Hongjie<sup>1</sup>, Li Gang<sup>1</sup>, Ling Changwei<sup>2</sup> (1. School of Energy Science and Engineering, Central South University, Changsha, China; 2. Huanan Changjiang Copper Co., Ltd., Miluo, China) 2010, 30(8)0776~0778

**Abstract** By testing the thermal process of copper scrap smelting system and analyzing operation status of equipment, the problems existed in low oxidized copper rods production were found as follows: poor fuel quality, irrational burner structure, low metal recovery rate and high impurity in products. To eliminate these problems, a set of gravity duster separator with purification and water seal integrated is employed to improve the fuel-gas quality, the high-velocity spiral burners are used to enhance the combustion efficiency and the temperature uniformity in the furnace, low temperature slag skimming technology is applied to

prevent the ferrous impurities into the liquid copper, and temperature control during oxidation-reduction period technology is adopted to improve copper percentage recovery and product quality, shortening smelting cycle. Through above mentioned measures, the energy consumption and copper loss in the copper scrap smelting process are reduced, and quality of copper rods is improved, and the properties of low-oxidized copper rods such as elongation and torsion are superior to industry standard, moreover, pollution of scrap-gas on environment is relieved.

**Key Words:** Reclaimed Copper, Reverberatory Furnace, Smelting, Energy-saving

**Centrifugal Casting Large Al Bronze Bush** Yang Weiqin (Wuchang Shipbuilding Industry Co., Ltd, Wuhan, China) 2010, 30(8)0779~0782

**Abstract** Large Al bronze bush was produced by centrifugal casting. Matching relationship between equipment parameters and mould parameters, between mould parameters and bush parameters as well as among centrifugal casting parameters were described in condition of limited state of centrifugal machine. Possibility of centrifugal casting for mould with occurrence of offcenter was discussed during process. Meanwhile, prevention of defects in centrifugal casting large Al bronze bush was introduced.

**Key Words:** Al Bronze, Centrifugal Casting, Large Bush, Parameters Matching

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