

# steel research

international

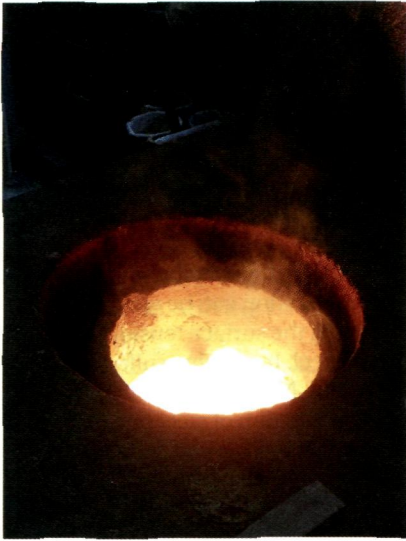
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## Cover Photo:

The cover shows the recycling of red filter dust in a pig iron melt. More details can be found in the article by Christiane Scharf et.al.

## Publishing company:

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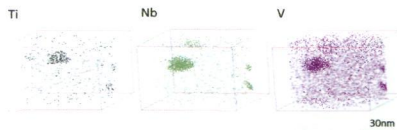
## Contents

### Full Paper

M. Nöhler\*, S. Zamberger and H. Leitner

### Strain-Induced Precipitation Behavior of a Nb–Ti–V Steel in the Austenite Phase Field

827

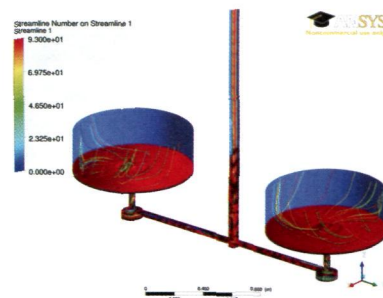


After deformation in the austenite region and an isothermal heat treatment in this region in a 0.2 wt% carbon steel, micro-alloyed with Nb, V, and Ti, strain induced precipitates are formed. These precipitates are carbonitrides, which mainly consists of Nb and V. For the formation process N is more important than C and for the growing process the C is more important.

Z. Tan\*, M. Ersson, P. Lidegran and P. G. Jönsson

### Uphill Teeming Utilizing TurboSwirl to Control Flow Pattern in Mold

837

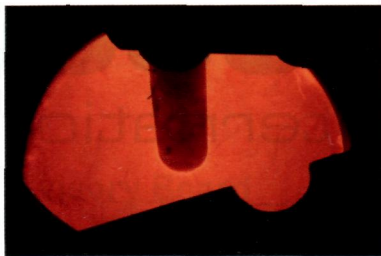


In this work, a new novel swirling flow generation component, TurboSwirl, is presented for the next generation of ingot casting. Due to its great potential in enhancing the steel cleanliness, it is highly recommended to apply this component in the steel producing industry so as to further improve the yield and quality of ingots.



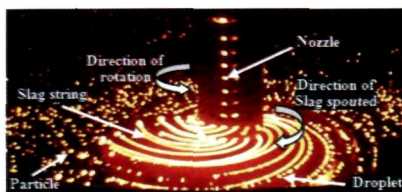
# Contents

T. Dubberstein\* and H.-P. Heller  
**Effect of Surface Tension on Gas Atomization of a CrMnNi Steel Alloy**  
 \_\_\_\_\_ 845



In the present research, the steel powder particle size for the sulfur-containing Fe–16% Cr–7% Mn–9% Ni steel alloys produced by vacuum inert gas atomization can be affected by adjusting the surface tension of the liquid steel. Increasing sulfur content in Cr–Mn–Ni steels will shift particle size distribution of steel powders to finer particle sizes and decreases the fraction of coarse particles.

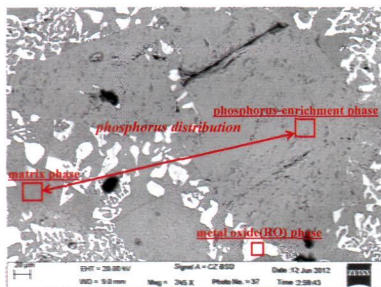
Y. L. Qin, X. W. Lv\*, C. G. Bai, P. Chen and G. B. Qiu  
**Dry Granulation of Molten Slag using a Rotating Multi-Nozzle Cup Atomizer and Characterization of Slag Particles**  
 \_\_\_\_\_ 852



Dry slag granulation presents an opportunity to simultaneously generate a glassy slag and recover the sensible heat. The rotary multi-nozzles cup atomizer was proposed to granulate the molten slag at a high cooling rate without water consumption in this study. The rotation speed and nozzles diameter are the controlling factors for particle size and the slag particles are amorphous.

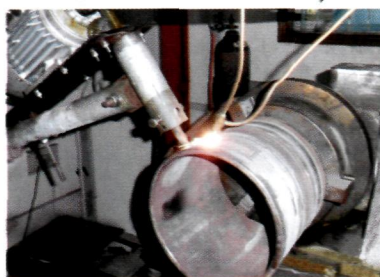
EDITOR'S CHOICE

H.-M. Zhou, Y.-P. Bao\* and L. Lin  
**Distribution of P<sub>2</sub>O<sub>5</sub> between Phosphorus-Enrichment Phase and Matrix Phase in Phosphorus-Containing Slag**  
 \_\_\_\_\_ 863



To make better recovery utilization of the phosphorus in the phosphorus-containing slag, the influencing factors on distribution of P<sub>2</sub>O<sub>5</sub> between the phosphorus-enrichment phase and the matrix phase in the slag are analyzed in this study. It has been found out that %(CaO) in the matrix phase, adding P<sub>2</sub>O<sub>5</sub> or CaF<sub>2</sub> and increasing the basicity of slag, are the main influencing factors.

Y. Zhang, C. J. Qiu\*, Y. Chen, J. Yu, J. Zhou, L. Li and Z. Wang  
**Influence of High-Frequency Micro-Forging on Microstructure and Properties of 304 Stainless Steel Fabricated by Laser Rapid Prototyping**  
 \_\_\_\_\_ 870



We report the use of a new technology to fabricate the 304 stainless steel by the laser rapid prototyping harmonized with high-frequency micro-forging and demonstrate that microstructure and properties of the prepared steels are enhanced significantly. This new method may hold technological promise for improving the fabrication of the 304 stainless steel so as to suit practical applications in industrial aerospace or other aspects.

# Contents

W. Yang, X. Wang, L. Zhang\* and W. Wang

## Characteristics of Alumina-Based Inclusions in Low Carbon Al-Killed Steel under No-Stirring Condition

878

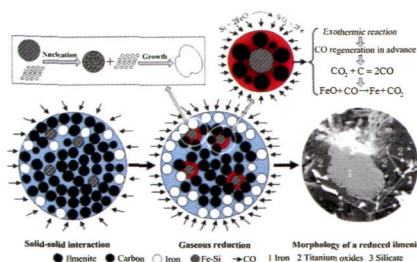


Immediately after the Al addition into molten steel for deoxidation, many individual  $Al_2O_3$  inclusions with different morphologies are generated, including flower shape, dendritic, spherical, plate-like, and so on. The precipitation mechanisms of these individual  $Al_2O_3$  particles are different along with the decrease of supersaturation degree of deoxidizing elements.

R. Huang, X. Lv\*, C. Bai, K. Zhang and G. Qiu

## Enhancement Reduction of Panzhihua Ilmenite Concentrate with Coke and Conglomeration of Metal with Ferrosilicon

892

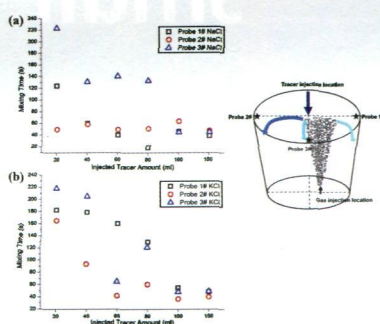


This study aims to investigate the strengthening of the conglomeration of the metallic phase of Panzhihua ilmenite with the addition of Fe-Si. The metallization ratio of iron and iron particle size significantly increased with increasing Fe-Si amount and reduction time. The results indicate that Fe-Si can function as reductants, nucleating agents, and exothermic agents.

C. Chen\*, Q. Rui and G. Cheng

## Effect of Salt Tracer Amount on the Mixing Time Measurement in a Hydrodynamic Model of Gas-Stirred Ladle System

900



The hydrodynamic modeling method in gas-stirred ladle is reconsidered and discussed. The obtained mixing time decreases with the tracer amount increased. The error of mixing time measurement is mainly from the tracer concentration fluctuation beyond the 5 or 1% criterion range when a much smaller amount of tracer has been injected. Finally, the optimized tracer is put forward.

S.-M. Jung\* and S. H. Yi

## A Kinetic Study on Carbothermic Reduction of Hematite with Graphite Employing Thermogravimetry and Quadruple Mass Spectrometry

908



Recently, great attention has been paid to the technology of direct reduced iron (DRI) production using low grade of ores and noncoking coals for alternative iron source. The carbothermic reduction of hematite in an Ar atmosphere has been investigated by employing thermogravimetry and quadruple mass spectrometry (QMS) gas analysis with the intention of understanding in detail the reduction phenomena of carbon composite iron ore agglomerates in the rotary kilns.



# Contents

C. Scharf\* and A. Ditze

**Processing of Agglomerated Red Filter Dust in the Converter Operation from Metallurgical Point of View**

917



Red filter dust (RFD) from steel works contains up to 50 mass% iron, which can serve as raw material for iron production. The applicability in a converter process is the aim of the investigation of the reduction behavior of iron oxide in RFD in pig iron. Also the zinc circulation is considered and kinetic investigations were made.

## No small Matter

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