# TABLE of CONTENTS

**Advances in Molten Slags, Fluxes, and Salts: Proceedings of the 10th International Conference on Molten Slags, Fluxes and Salts**

Preface ........................................................................................................... xxiii
Conference Organizing Committees ................................................................ xxv
Proceedings Reviewers .................................................................................. xxix

## Plenary Session

**Waste to Value in Steelmaking** ................................................................. 3
*Samane Maroufi, Irshad Mansuri, Paul O’Kane, Catherine Skidmore, Zheshi Jin, Andrea Fontana, Magdalena Zaharia, and Veena Sahajwalla*

**Current Status of Slag Design in Metallurgical Processes** ....................... 17
*Dong Joon Min and Sung Mo Jung*

**Refractory Metals Recovery from Industrial Wastes** ............................. 29
*Tran Van Long, Hironori Murase, Takahiro Miki, Yasushi Sasaki, and Mitsutaka Hino*

## Industrial Applications: Ferroalloys and Silicon

**Softening and Melting of SiO₂, an Important Parameter for Reactions with Quartz in Si Production** ................................................................. 43
*Eli Ringdalen and Merete Tangstad*

**High Temperature Corrosion Mechanisms of Refractories and Ferro-Alloy Slags** ........................................................................................................ 53
*Stefan Luidold, Christine Wenzl, Christoph Wagner, and Christoph Sagadin*

**Fundamental Investigation of Reduction and Dissolution Behavior of Manganese Ore at High Temperature** ......................................................... 63
*Yusuke Fujii, Yoshie Nakai, Yu-ichi Uchida, Naoki Kikuchi, and Yuji Miki*

**An Investigation on the Formation of Molten Salt Containing Chromium Oxide during Roasting of Chromite Ore with Sodium and Potassium Hydroxides** .......................................................... 71
*L. Escudero-Castejon, S. Sanchez-Segado, S. Parirenyatwa, and A. Jha*
Effect of the CaO Addition in the Fusion Process of Nickeliferous Laterites for Ferronickel Production ............................................................79
Sandra Díaz Bello, Oscar J. Restrepo, and Álvaro H. Forero P

Defining the Operating Regime and Methodology for the Furnace Method for the Production of Low Carbon Ferrochrome ........................................87
Heine Weitz and Andrie Garbers-Craig

Optimized Slag Design for Maximum Metal Recovery during the Pyrometallurgical Processing of Polymetallic Deep-Sea Nodules ....................97
David Friedmann and Bernd Friedrich

Review of Liquidus Surface and Phase Equilibria in the TiO₂-SiO₂-Al₂O₃-MgO-CaO Slag System at PO₂ Applicable in Fluxed Titaniferous Magnetite Smelting ..................................................105
Xolisa Goso, Johannes Nell, and Jochen Petersen

Inclusions and Clean Steelmaking

Effect of Ladle Furnace Slag Composition in Si-Mn Killed Steel Transient Inclusion Changes .................................................................117
Stephano P.T. Piva and P. Chris Pistorius

Reduction of Slag and Refractories by Aluminium in Steel and Inclusion Modification .................................................................127
Haoyuan Mu, Bryan A. Webler, and Richard J. Fruehan

Reactivity of Selected Oxide Inclusions with CaO-Al₂O₃-SiO₂-(MgO) Slags .....................................................................................135
B.J. Monaghan, H. Abdeyazdan, R.J. Longbottom, N. Dogan,
M.A. Rhamdhani, and M.W. Chapman

A Study on Calcium Transfer from Slag to Steel and Its Effect on Modification of Alumina and Spinel Inclusions .................................145
Deepoo Kumar and P. Chris Pistorius

Effect of Al₂O₃ Content in Top Slag on Cleanness of Stainless Steel Fe-13Cr .....................................................................................155
Qi Wang, Lijun Wang, and Kuochih Chou
Slag and Salt Structure

Understanding of Cr-Containing Slags by Sulphide Capacity and Structural Study ................................................................. 167
   Lijun Wang and Kuo-chih Chou

Structure Studies of Silicate Glasses by Raman Spectroscopy ............. 175
   Chen Han, Mao Chen, Ron Rasch, Ying Yu, and Baojun Zhao

Relation between Acoustic Properties and Structures on Molten Alkali Silicates ............................................................................ 183
   Miyuki Hayashi

Use of Slags, Fluxes and Salts in Recycling

Equilibria of Gold and Silver between Molten Copper and FeOₓ-SiO₂-Al₂O₃ Slag in WEEE Smelting at 1300 °C ......................................................... 193
   Katri Avarmaa, Hugh O’Brien, and Pekka Taskinen

Experimental Study on Smelting of Waste Smartphone PCBs Based on Al₂O₃-FeOₓ-SiO₂ Slag System ................................................................. 203
   Youqi Fan, Yaowu Gu, Qiyong Shi, Songwen Xiao, and Fatian Jiang

Recovery of Valuable Metals from Spent Lithium-Ion Batteries by Smelting Reduction Process Based on MnO-SiO₂-Al₂O₃ Slag System .................. 211
   Ren Guoxing, Xiao Songwen, Xie Meiqiu, Pan Bing, Fan Youqi, Wang Fenggang, and Xia Xing

Crystallization/Freeze Linings

In-Situ Observation of Rare Earth Containing Precipitated Phase Crystallization and Solidification of CaO-SiO₂-Nd₂O₃ and CaO-SiO₂-Nd₂O₃-P₂O₅ Melts ................................................................. 221
   Thu Hoai Le, Mayu Aketagawa, Annelies Malfliet, Bart Blanpain, and Muxing Guo

In-Situ Studies on the Crystallization of CaO-SiO₂-CaF₂-CeO₂ System by a Confocal Laser Scanning Microscope ........................................... 229
   Zengwu Zhao, Zhuang Ma, Fushun Zhang, Yongzhi Li, Yongli Jin, Xuefeng Zhan, and Baowei Li
Crystallization Kinetics of CaO-SiO$_2$-Al$_2$O$_3$-MgO Slags ...............................237
  Shaghayegh Esfahani and Mansoor Barati

Freeze-Lining Formation from Fayalite-Based Slags .................................245
  Liugang Chen, Muxing Guo, Shuigen Huang, Peter Tom Jones,
  Bart Blanpain, and Annelies Malfliet

Mold Flux

Root Cause Analysis of Surface Defects in Coils Produced through Thin
Slab Route ........................................................................................................ 255
  Diptak Bhattacharya, Siddhartha Misra, Avinash Kumar,
  and Vinay V Mahashabde

Advanced Mold Flux Development for the Casting of High-Al Steels ..........263
  Dan Xiao, Wanlin Wang, Boxun Lu, and Xinwang Zhang

A Reaction Model to Simulate Composition Change of Mold Flux during
Continuous Casting of High Al Steel ............................................................... 271
  Min-Su Kim and Youn-Bae Kang

Evaluation of Mold Flux for Continuous Casting of High-Aluminum Steel ...279
  Wei Yan, Alexander McLean, Yindong Yang, Weiqing Chen,
  and Mansoor Barati

The Structure and the Crystallization Behaviour of the
CaO-SiO$_2$-Al$_2$O$_3$-Based Mold Flux for High-Al Steels Casting ...............291
  Jinxing Gao, Guanghua Wen, Ting Huang, and Ping Tang

Fundamental Investigations for the Design of Fluorine Free Mold Powder
Compositions ....................................................................................................... 299
  Irmtraud Marschall, Xiao Yang, and Harald Harmuth

Cold-Finger Measurement of Heat Transfer through Solidified Mold Flux
Layers ............................................................................................................... 307
  Karina Lara Santos Assis and P. Chris Pistorius

Application of Cathodoluminescence in Analyzing Mold Flux Films ..........317
  Elizabeth Nolte, Jeffrey D. Smith, Michael Frazee, Neil Sutcliffe,
  and Ronald J. O’Malley

Effects of CaF$_2$ on the Radiative Heat Transfer in Mould Fluxes for
Continuous Steel Casting .................................................................................. 327
  Masahiro Susa, Yuta Kono, Rie Endo, and Yoshinao Kobayashi
Effect of Na$_2$O on Crystallisation Behaviour and Heat Transfer of Fluorine-Free Mould Fluxes .................................................................335
   Jian Yang, Jianqiang Zhang, Yasushi Sasaki, Oleg Ostrovski, Chen Zhang, Dextiang Cai, and Yoshiaki Kashiwaya

Effect of Carbon Pickup on the Slab with Slag Pool Thickness in Ultra-Low Carbon Steel .................................................................343
   Min-Seok Park and Shin Yoo

Techniques for Controlling Heat Transfer in the Mould-Strand Gap in Order to Use Fluoride Free Mould Powder for Continuous Casting of Peritectic Steel Grades .........................................................349
   Adam Hunt and Bridget Stewart

Reduction of Iron Oxides in Mould Fluxes with Additions of CaSi$_2$ ........357
   Min Wang, Rie Endo, Yoshinao Kobayashi, Zuoyong Dou, and Masahiro Susa

Physical Properties: Viscosity

Viscosity Measurement at the International Conferences on Molten Slags and Fluxes from 1980 to the Present .................................................369
   Steven Wright and Wan-Yi Kim

A Structure-Based Viscosity Model and Database for Multicomponent Oxide Melts .................................................................397
   Guixuan Wu, Sören Seebold, Elena Zayhenskikh, Klaus Hack, and Michael Müller

Thermo-Physical-Chemical Properties of Blast Furnace Slag Bearing High TiO$_2$ .................................................................405
   Chenguang Bai, Zhiming Yan, Shengping Li, Pingsheng Lai, Chen Shan, Xuewei Lv, and Guibao Qiu

The Effect of TiO$_2$ on the Liquidus Zone and Apparent Viscosity of SiO$_2$-CaO-8wt.%MgO-14wt.%Al$_2$O$_3$ System ........................................415
   Zhiming Yan, Xuewei Lv, Jie Zhang, and Jian Xu

Electrorheology of Ti-Bearing Slag with Different Composition of TiC at 1723 K .................................................................423
   Tao Jiang, Hongrui Yue, Xiangxin Xue, and Peining Duan
Study on Apparent Viscosity of Foaming Slag - Cold Model and High Temperature Experiments .................................................................431
Johan Martinsson, Björn Glaser, and Du Sichen

Effect of Al$_2$O$_3$ and SiO$_2$ Addition on the Viscosity of BOF Slag ..........439
Zhuangzhuang Liu, Lieven Pandelaers, Peter Tom Jones, Bart Blanpain, and Muxing Guo

Viscoelastic Properties of Calcium Silicate Based Mold Fluxes at 1623 K ....447

Viscosity Property and Raman Spectroscopy of FeO-SiO$_2$-V$_2$O$_3$-TiO$_2$-Cr$_2$O$_3$ Slags ..............................................................................455
Weijun Huang, Min Chen, Xiang Shen, Yu Shan, Meile He, and Nan Wang

Physical Properties: Thermal Properties and Electrical Conductivity

Techniques for Measuring Solubility and Electrical Conductivity in Molten Salts .........................................................................................465
Shizhao Su, Thomas Villalon Jr., Uday Pal, and Adam Powell

A New Method for Apparent Thermal Conductivity Measurement of Mould Flux .....................................................................................477
Mu Li, Rie Endo, Li Ju Wang, and Masahiro Susa

Controlling Heat Transfer through Mold Flux Film by Scattering Effects ......485
Dae-Woo Yoon, Jung-Wook Cho, and Seon-Hyo Kim

Diffusion Coefficients and Structural Parameters of Molten Slags ............493
Samane Maroufi, Shahriar Amini, Sharif Jahanshahi, and Oleg Ostrovski

The Cationic Effect on Properties and Structure of CaO-MgO-SiO$_2$ Melts ....501
Yong-Uk Han and Dong Joon Min

Effects of Structure on the Thermodynamic and Transport Properties of Na$_2$O-CaO-SiO$_2$-FeO-Fe$_2$O$_3$ Melts ...........................................511
Lesley J. Beyers, Geoffrey A. Brooks, Bart Blanpain, and Frederik Verhaeghe
Thermal Conductivity of Borosilicate Melt .................................................................519
  Tsuyoshi Nishi, Junpei Ojima, Yoshitaka Kuroda, Hiromichi Ohta,
  Sohei Sukenaga, Hiroyuki Shibata, and Hidenori Kawashima

Melting Point and Heat Capacity of MgCl$_2$ + Mg Salts .................................525
  Yuxiang Peng and Ramana G. Reddy

**Interfacial Phenomena**

Does Interfacial Tension Play the Most Important Role in Slag-Metal
Reactions? An Important Aspect in Process Optimization ..............................535
  Du Sichen and Jesse F. White

Control of Molten CaO – Al$_2$O$_3$ Oxide Jets with Focus on Thermophysical
Property Measurements and Some Limitations .............................................547
  Luckman Muhmood, Mirco Wegener, Shouyi Sun, and Alex Deev

Slag Surface Tension Measurements with Constrained Sessile Drops ..........557
  Marc A. Duchesne and Robin W. Hughes

Interactions between Liquid CaO–SiO$_2$ Slags and Graphite Substrates ........565
  Jesse F. White, Jaewoo Lee, Oscar Hessling, and Björn Glaser

Initial Wetting and Spreading Phenomena of Slags on Refractory
Ceramics ........................................................................................................573
  Yongsug Chung, Tae Hee Yoon, and Kyuyong Lee

Modelling and Experimental Studies of Diffusivity of Sulfur and Its
Relevance in Observing Surface Oscillations at the Slag Metal Interface
through X-ray Imaging ....................................................................................581
  Luckman Muhmood, Nurni N Viswanathan,
  and Seshadri Seetharaman

SPH Analysis of Interfacial Flow of the Two Immiscible Melts .....................589
  Shungo Natsui, Ryota Nashimoto, Tatsuya Kikuchi,
  and Ryosuke O. Suzuki

Surface Properties of Molten Fluoride-Based Salts ....................................597
  Thomas Villalón Jr., Shizhao Su, and Uday Pal

Foaming Index of CaO -SiO$_2$-FeO-MgO Slag System ...............................607
  Youngjoo Park and Dong Joon Min
Modeling Slag and Salt Properties

Development of Slag Management System .....................................................619
  Kyei-Sing Kwong and James P. Bennett

Gaseous Fuel Production Using Waste Slags - Going beyond Heat Recovery ..........................................................................................................627
  Jinichiro Nakano, James Bennett, and Anna Nakano

Efficient Storage and Recall of Slag Thermochemical Properties for Use in Multiphysics Models .................................................................635
  Johannes H. Zietsman

Industrial Applications: Non-Ferrous

Production of Cobalt and Copper Alloys from Copper Slags via Reduction Smelting in DC Arc Furnace .................................................................647
  Onuralp Yücel

Slag Reduction Kinetics of Copper Slags from Primary Copper Production .............................................................................................................657
  Boyd Davis, Trevor Lebel, Roberto Parada, and Roberto Parra

Fluxing Strategies for the Direct to Blister Smelting of High Silica and Low Iron Copper Concentrates .................................................................667
  Michael Somerville, Chunlin Chen, Gerardo R.F. Alvear F., and Stanko Nikolic

Behavior of Selenium in Copper Smelting Slag ..............................................677
  Bhavin Desai, Vilas Tathavadkar, Somnath Basu, and Kaushik Vakil

Selective Precipitation of Magnetite in Copper Slag by Controlled Molten Oxidation .................................................................687
  Yong Fan, Etsuro Shibata, Atsushi Iizuka, and Takashi Nakamura

Thermodynamics: Iron and Steel

Applications of ArcelorMittal Thermodynamic Computation Tools to Steel Production .................................................................697
  Jean Lehmann
Phase Equilibria Study of the CaO-‘Fe₂O₃’-SiO₂ System in Air to Support Iron Sintering Process Optimisation .................................................................707
Peter C. Hayes, Jiang Chen, and Evgueni Jak

Understanding Sulfide Capacity of Molten Aluminosilicates via Structural Information from ‘Raman’ and ‘NMR’ Spectroscopic Methodologies ..........715
Joo Hyun Park

Thermodynamic Properties of the CaO-AlO₁₋₅-CeO₁₋₅ System ............723
Ryo Kitano and Kazuki Morita

Distribution Behavior of Cr between CaO-SiO₂-Al₂O₃ (-MgO) Slag and Fe-Cr (-Si/Al) Metal Phase .............................................................................731
Yanling Zhang, Xinlei Jia, Tuo Wu, Qiuhan Li, and Zhancheng Guo

Thermodynamics of ‘ESR’ Slag for Producing Nickel Alloys ............745
Jun-Gil Yang and Joo Hyun Park

Production Using Molten Salts

Recycling Titanium and Its Alloys by Utilizing Molten Salt ..................751
Toru H. Okabe and Yu-ki Taninouchi

Electrochemical Upgrading of Iron-Rich Titanium Ores ....................761
Farzin Fatollahi-Fard and Petrus Christiaan Pistorius

Investigations for the Recycle of Pyroprocessed Uranium ....................771
B.R. Westphal, J.C. Price, E.E. Chambers, and M.N. Patterson

Zero-Direct-Carbon-Emission Aluminum Production by Solid Oxide Membrane-Based Electrolysis Process ..............................................781
Shizhao Su, Uday Pal, and Xiaofei Guan

Alumina Concentration Gradients in Aluminium Reduction Cells ............791
Pascal Lavoie and Mark P. Taylor

Approach of the Molten Salt Chemistry for Aluminium Production: High Temperature NMR Measurements, Molecular Dynamics and DFT Calculations ......................................................................................................799
Kelly Machado, Didier Zanghi, Vincent Sarou-Kantian, Sylvain Cadars, Mario Burbano, Mathieu Salanne, and Catherine Bessada
Electrochemical Study of Colbalt in Urea and Choline Chloride .......................... 807
Min Li, Zhongning Shi, Zhaowen Wang, and Ramana G. Reddy

The Current Efficiency for Aluminium Deposition from Molten Fluoride
Electrolytes with Dissolved Alumina ................................................................. 817
Geir Martin Haarberg

Recycling and Reuse of Slag and Dust

Dissolution Mechanisms of Nutrient Elements from Steelmaking Slag into
Seawater ............................................................................................................ 829
Hiroyuki Matsuura, Qian Zhou, Fuminori Katabe, Likun Zang,
Guohua Zhang, and Fumitaka Tsukihashi

Effects of Three Types of Iron and Steel Slag on Fresh andHardened
Properties of Ordinary Portland Cement .......................................................... 837
Seyed Vahid Hosseini, Shahnawaz Eilbeigi,
and Mohammad Reza Nilforoushan

Modification of BOF Slag for Cement Manufacturing ................................. 847
João B. Ferreira Neto, Catia Fredericci, João O.G. Faria,
Fabiano F. Chotoli, Tiago R. Ribeiro, Antônio Malynowskyj,
Andre N.L. Silva, Valdecir A. Quarcioni, and André A. Lotto

Reaction between Synthesized Calcium Aluminates and Cr₂O₃ in Air
and CO₂ ............................................................................................................. 855
Shengqiang Song and Andrie Garbers-Craig

Immobilization of Hexavalent Chromium in Stainless Steelmaking Slag ....... 865
Ryo Inoue, Yoshiya Sato, Yasushi Takasaki,
and Atsushi Shibayama

Smelting Reduction of Bottom Ash in Presence of Liquid Steel Bath for
Recovery of Aluminium ..................................................................................... 873
A.K. Mandal and O.P. Sinha

A Review of Slag Chemistry in Lead Recycling ............................................. 879
Doug Schriner, Patrick Taylor, and Joseph Grogan

Characterization and Recovery of Valuables from Waste Copper
Smelting Slag .................................................................................................... 889
Sarfo Prince, Jamie Young, Guojun Ma, and Courtney Young
Development of Secondary Antimony Oxides from Metallurgical Slags for the Application in Plastic Products

Florian Binz and Bernd Friedrich

Improving the Dissolution of Phosphorus from $2\text{CaO} \cdot \text{SiO}_2 - 3\text{CaO} \cdot \text{P}_2\text{O}_5$

Chuan-ming Du, Xu Gao, Sun-joong Kim, Shigeru Ueda, and Shin-ya Kitamura

Thermodynamics: Non-Ferrous Production

Chromium Distribution between Liquid Slag and Matte Phases

R Hurman Eric

Thermophysical Property Measurements of Molten Slag and Welding Flux by Aerodynamic Levitator

Kenta Onodera, Airi Nakamura, Shinya Hakamada, Masahito Watanabe, and Florian Kargl

Solubility of CaO and Al$_2$O$_3$ in Metallic Copper Saturated Molten Phase

Joseph Hamuyuni and Pekka Taskinen

Integrated Experimental and Modelling Research for Non-Ferrous Smelting and Recycling Systems

Evgueni Jak, Taufiq Hidayat, Denis Shishin, Ata Fallah Mehrjardi, Jiang Chen, Sergei Decterov, and Peter Hayes

Experimental Study of Slag/Matte/Metal/Tridymite Four Phase Equilibria and Minor Elements Distribution in "Cu-Fe-Si-S-O" System by Quantitative Microanalysis Techniques

Jeff (Jiang) Chen, Charlotte Allen, Peter C. Hayes, and Evgueni Jak

Experimental Determination of the Liquidus Surface (1473 K) in Cu-ZnO-SiO$_2$-O System at Various Oxygen Partial Pressures

Longgong Xia, Zhihong Liu, and Pekka Antero Taskinen

Liquidus Measurement of Te-O-Na$_2$O-SiO$_2$ System between 1000 and 1200 °C in Equilibrium with Air

Imam Santoso and Pekka Taskinen
Industrial Applications: Steel

Kinetics of Phosphorus Mass Transfer and the Interfacial Oxygen Potential for Bloated Metal Droplets during Oxygen Steelmaking ................................989
Kezhuan Gu, Neslihan Dogan, and Kenneth S. Coley

Physical Modelling of the Effect of Slag and Top-Blowing on Mixing in the AOD Process ........................................................................................................999
Tim Haas, Ville-Valtteri Visuri, Aki Kärnä, Erik Isohookana, Petri Sulasalmi, Rauf Hürman Eric, Herbert Pfeifer, and Timo Fabritius

3D CFD Modeling of the LMF System: Desulfurization Kinetics ............1009
Qing Cao, April Pitts, Daojie Zhang, Laurentiu Nastac, and Robert Williams

Slag Formation – Thermodynamic and Kinetic Aspects and Mechanisms ....1017
Lauri Holappa and Yilmaz Kaçar

Effects of Various Slag Systems on Metal/Slag Separation of CCA and Slag Composition on Desulfurization and Dephosphorization of Iron Nugget .................................................................1025
Ji-Ook Park and Sung-Mo Jung

Use of Al-killed Ladle Furnace Slag in Si-killed Steel Process to Reduce Lime Consumption, Improve Slag Fluidity .........................................................1031
Narottam Behera, Ahmad Raddadi, Shahreer Ahmad, Neeraj Tewari, and Othman Zeghaibi

Refractories

Influence of Physical Properties of Slag and Operational Parameters on Slag Splashing Process in an Oxygen Convertor .................................................1043
Paula Maria Gomes Cunha Leão, Eliana Ferreira Rodrigues, Carlos Antonio da Silva, Itavahn Alves da Silva, and Varadarajan Seshadri

Corrosion Mechanisms in Refractory Castables by Liquid Oxides ............1053
L. Tadeo Ibarra, A.M. Guzmán, D.I. Martínez, and G. Alan Castillo

Viscous Behavior of Alumina and Titania in Amphoteric Slags and Their Influence on Refractory Corrosion .................................................................1063
Frank Kaußen and Bernd Friedrich
Phase Chemistry Study of the Interactions between Slag and Refractory
in Coppermaking Processes .................................................................1071
Ata Fallah Mehrjardi, Peter C. Hayes, Turarbek Azekenov,
Leonid Ushkov, and Evgueni Jak

The Study of Molten Liquid - Refractory Interactions – It Is All about the
Phase(s) ........................................................................................................1077
Andrie Garbers-Craig

Effect of Slag Impregnation on Macroscopic Deformation of
Bauxite-based Material .................................................................1093
Antoine Coulon, Emmanuel De Bilbao, Rudy Michel,
Marie-Laure Bouchetou, Séverine Brassamin, Camille Gazeau,
Didier Zanghi, and Jacques Poirer

Corrosion Resistances of Cr-Free Refractories to Copper Smelting Slags ....1101
Mao Chen, Junhong Chen, and Baojun Zhao

Gasification Slag and the Mechanisms by Which Phosphorus Additions
Reduce Slag Wear and Corrosion in High Cr₂O₃ Refractories .................1109
James Bennett, Anna Nakano, Jinchiro Nakano,
and Hugh Thomas

Additional Technical Papers

A High Temperature Double Knudsen Cell Mass Spectrometry Study of
Gas Species Evolved from Coal-Petcoke Mixed Feedstock Slags ..........1119
Jinchiro Nakano, Takashi Nagai, James Bennett, Anna Nakano,
and Kazuki Morita

An Assessment of Slag Eye Formation Using Mathematical and Physical
Modeling ...............................................................................................1127
Augusto Pereira de Sá, Filipe de Menezes Torres,
Carlos Antonio da Silva, Itavahn Alves da Silva,
and Varadarajan Seshadri

An Effect of Phosphorus Gas Generated in Slagging Gasifiers on Pt-Rh
Sensor Degradation ..............................................................................1135
Anna Nakano, Jinchiro Nakano, and James Bennett

An Experimental Study of Viscosity in FeO-SiO₂-V₂O₃-TiO₂ System .......1143
Shiyuan Liu, Lijun Wang, and Kuo-chih Chou
Capturing and Condensation of SiO Gas from Industrial Si Furnace ..........1153
Ksiazek Michal, Grådahl Svend, Rotevant, Eirik Andersen, and Wittgens Bernd

Corrosion Testing of Zirconia, Beryllia and Magnesia Ceramics in Molten
Alkali Metal Carbonates at 900°C .................................................................1161
Valery Kaplan and Igor Lubomirsky

Density, Viscosity, Vapor Pressure and Thermal Conductivity of MgCl₂
+ Mg Salts ......................................................................................................1169
Yuxiang Peng and Ramana G. Reddy

Development of “Slag-Remaining+Double-Slag” BOF Steelmaking
Technology in Shougang Co. ........................................................................1177
Haibo Li, Yanchun Lu, Guosen Zhu, and Xinhua Wang

Effect of Basicity on Basic Oxygen Furnace (BOF) Slag Solidification
Microstructure and Mineralogy .................................................................1185
Chunwei Liu, Muxing Guo, Lieven Pandelaers, Bart Blanpain, and Shuigen Huang

Effect of Slag Prepared with Different Cooling Methods on Cleanliness
of Bearing Steel GCr15 ...............................................................................1191
Dong-ping Zhan, Yang-peng Zhang, Lei Tang, Kun Fan, Zhou-hua Jiang, and Hui-shu Zhang

Effect of Zr Inhibitor on Corrosion of Haynes 230 and NS-163 Alloys in
FLiNaK ........................................................................................................1199
Yuxiang Peng and Ramana G. Reddy

Experimental Study of Gas/Slag/Matte/Spinel Equilibria and Minor
Elements Partitioning in the Cu-Fe-O-S-Si System ..............................1207
Taufiq Hidayat, Ata F Mehrjardi, Peter C Hayes, and Evgueni Jak

Experimental Study of Liquidus of the “FeO”-SiO₂-PbO Slags in
Equilibrium with Air and with Metallic Lead ........................................1221
Maksym Shevchenko, Taufiq Hidayat, Peter C Hayes, and Evgueni Jak

Formation of Copper Sulfide Precipitate in Solid Iron ..........................1229
Kentaro Urata and Yoshinao Kobayashi

xviii
Yongqi Sun, Zuotai Zhang, and Seetharaman Sridhar

Interfacial Phenomena and Thermophysical Properties of Molten Steel and Oxides ........................................................................................................ 1245
Masahito Watanabe, Kenta Onodera, Shoya Ueno, Takao Tsukada, Toshihiro Tanaka, Haruka Tamaru, and Takehiko Ishikawa

Investigation of Molten Salt Phase Formation during Alkali Roasting of Titaniferous Minerals with Sodium and Potassium Hydroxide ............... 1253
S. Parirenyatwa, L. Escudero-Castejon, S. Sanchez-Segado, Y. Hara, and A. Jha

Precipitation Behavior of Titanium Bearing Blast Furnace Slag ............... 1261
Meilong Hu, Zhengfeng Qu, Xuewei Lv, and Yunhua Gan

Production of Ceramic Balls by High Temperature Atomization of Mine Wastes ........................................................................................................... 1271
Hyunsik Park, Minchul Ha, Dong-hyo Yang, Jeong-soo Sohn, and Joohyun Park

Properties of Bayer Red Mud Based Flux and Its Application in the Steelmaking Process ...................................................................................... 1277
Yanling Zhang, Fengshan Li, and Ruimin Wang

Reduction Behavior of Assmang and Comilog Ore in the SiMn Process ...... 1285
Pyunghwa Peace Kim, Joakim Holtan, and Merete Tangstad

Regeneration of WC-Co Nanopowders via Sodiothermic Reduction in Molten Salts ................................................................................................. 1293
Na Wang, Xue-Mei Liu, Li-Hua Chai, Jinyu Wu, and Xuyang Shen

Rheological Behavior of Fayalite Based Secondary Copper Smelter Slag in Iron Saturation .................................................................................. 1301
Huayue Shi, Liugang Chen, Annelies Malfliet, Tom Peter Jones, Bart Blanpain, and Muxing Guo

Silicon and Manganese Partition between Slag and Metal Phases and Their Activities Pertinent to Ferromanganese and Silicomanganese Production .... 1309
Hakan Cengizler and H Furman Eric

xix
Stability of Fluorine-Free Mould Fluxes SiO$_2$-CaO-Al$_2$O$_3$-B$_2$O$_3$-Na$_2$O for Steel Continuous Casting .................................................................1319
   Lin Wang, Jianqiang Zhang, Yasushi Sasaki, Oleg Ostrovski, Chen Zhang, and Dexiang Cai

Study of MnO Activity in CaO-SiO$_2$-MnO-Al$_2$O$_3$-MgO Slags ................1327
   Jun Tao, Dongdong Guo, Baijun Yan, and Longmei Wang

Study on Electrical Conductivity of CaO-SiO$_2$-Al$_2$O$_3$-FeO, Slags ..........1335
   Guo-Hua Zhang, Jun-Hao Liu, and Kuo-Chih Chou

The Distribution Rules of Element and Compound of Cobalt/Iron/Copper in the Converter Slag of Copper Smelting Process .......................................1343
   Hongxu Li, Ke Du, Shi Sun, Jiaqi Fan, and Chao Li

The Management of Lead Concentrate Acquisition in “Trepca” ..............1351
   Ahmet Haxhiaj, Maoming Fan, and Bajram Haxhiaj

The Mineral Constitution and Leachability Characteristics of Dusts from Different Lead Smelting Furnace .................................................................1359
   Hongxu Li, Yang Xie, Chao Li, Zhaobo Liu,
   and Mengmeng Huang

The Wetting Behavior of CrMnNi Steel on Mg-PSZ as a Function of Phosphorous, Sulphur and Titanium Content .......................................................1371
   Tobias Dubberstein, Hans-Peter Heller, Claudia Wenzel,
   and Christos G. Aneziris

Thermodynamic Modelling of Liquid Slag-Matte-Metal Equilibria
Applied to the Simulation of the Peirce-Smith Converter ..........................1379
   Denis Shishin, Taufiq Hidayat, Sergei Decterov, and Evgueni Jak

Thermodynamics of the 2CaO-SiO$_2$-3CaO-P$_2$O$_5$ Solid Solution at Steelmaking Temperature ..............................................................1389
   Hiroyuki Matsuura, Ming Zhong, Xu Gao,
   and Fumitaka Tsukihashi

Understanding Phase Equilibria in Slags Containing Vanadium ............1397
   Jinichiro Nakano, Marc Duchesne, James Bennett, Anna Nakano,
   Robin Hughes, and In-Ho Jung