ENVIRONMENT: Towards Sustainable Energy Practices in Metal Processing

Paper 783813
Low Emission Technology Developments in the Iron and Steel Industry
Alisha Giglio and Janice Bolen, Hatch Ltd.

Paper 808698
Mineral Phase Separation in CaO-FeO-P2O5 based Slag at Elevated Temperature for Phosphorus Recovery
Yu-ichi Uchida, Nippon Institute of Technology
Saki Kobayashi and Katsunori Takahashi, JFE Steel Corporation

Paper 810513
High-performance Aluminum Battery Employing Cost-effective Chloroaluminate Ionic Liquid Electrolyte
Gisele Azimi, Kok Long Ng, Tony Dong, and John Anawati, University of Toronto

Paper 812386
Study of Cost-effective AlCl3/urea Ionic Liquid Analog for Aluminum-Ion Batteries
Gisele Azimi, Monu Malik, and Kok Long Ng, University of Toronto

Paper 812817
Industrial Water Recovery via Energy-Efficient Freeze Concentration
Chenbo Xu and Vladimiros G. Papangelakis, University of Toronto

Paper 814780
Direct Extraction of Nickel into Ferronickel by Iron Addition
Fanmao Wang, University of Toronto
Leili Tafaghodi Khajavi, University of British Columbia
Sam Marcuson and Mansoor Barati, University of Toronto

Paper 815747
Roles of Impurity Trappers on the Extraction of Phosphorus from Metallurgical Grade Silicon
Liuqing Huang, Liuqing Huang, Sa Zhang, Liuying Huang, Chentong Zhang, and Xuetao Luo, Xiamen University

Paper 817863
A Western Australian Gold Mine Powered by Wind, Solar, Battery and a Gas Microgrid
Damian Connelly, METS Engineering Group

Paper 818354
Tailor-Made PlascosynGas™ Obtained from Heterogeneous Flows of Feedstock as a Fuel Gas and Precursor to Hydrogen and Other Fuels
Shadi Saberi and Marc Bacon, Plasco Conversion Technologies
Paper 818493
**Slag Refining of Aluminum Silicon Alloy**
*Sridevi M. Thomas and Mansoor Barati, University of Toronto*

Paper 819276
**Current Situation and Future Perspective of Ironmaking Industry and Technologies in China**
*Jianliang Zhang, Kejiang Li, Zhengjian Liu, and Chunhe Jiang, University of Science and Technology, Beijing*

Paper 819293
**Comprehensive Technologies for Iron Ore Sintering with an Ultra-Thick Bed of 1000 mm to Reduce Fuel Consumption and Achieve High-Efficiency Production**
*Zhengjian Liu and Jianliang Zhang, University of Science and Technology, Beijing*
*Shijun Zhang, Tianjin Tiangang United Special Steel Co., Ltd.*
*Lele Niu and Guilin Wang, University of Science and Technology Beijing*

Paper 819874
**Highlights from “mining, Ecological Engineering and Metals Extraction for the 21st Century”**
*Margarete M. Kalin and William Wheeler, Boojum Research Limited*
*Michael P. Sudbury, Michael P Sudbury Consulting*
*Bryn Harris, NMR360 Inc.*
*Anne Herbst and Hendrik Schubert, University of Rostock*
*Carlos Paulo, Trent University*

Paper 820075
**Lithium-ion Battery Technology Application for Renewable Power Integration at Off-Grid Mine**
*Mohammad Sedighy, Hatch Ltd.*
*Mahdi Raoofat, Tugliq Energy*
*Mark Mitchell, Hatch Ltd.*

Paper 820435
**Silicon Refining by Simultaneous Slag Refining with CaO-Al$_2$O$_3$-SiO$_2$-Na$_2$O and Solvent Refining with Si-Fe Alloy**
*Golam Ismot Ara Taposhe and Leili Tafaghodi Khajavi, University of British Columbia*

Paper 822208
**Vanadium Flow Batteries for Industrial Scale Energy Storage**
*Lee Barker, Sparton Resources Inc.*

Paper 824832
**Decarbonization of Remote Mine Electricity Supply and Vehicle Fleets**
*Jocelyn Zuliani, Joel Guilbaud, and Michel Carreau, Hatch Ltd.*
Metallurgists’ Sustainability Challenges in the 21st Century
Ashok D. Dalvi, Dalvi Associates Inc.

The LCL&L Process: a Sustainable Solution for the Treatment and Recycling of Spent Pot Lining
Laurent Birry, Rio Tinto Aluminium

Production of Electricity Using Small Modular Reactors (SMRs) for Off-Grid Mining and Other Applications
Jennifer A. Abols and Francois Caron, Mirarco/Laurentian University

Sustainable Ironmaking at a Blast Furnace Based Integrated Steel Plant
Abraham A. Adeleke, Simeon A. Ibitoye, Kunle Michael Oluwasegun, and Obafemi Awolowo University

HYDROMETALLURGY: Processing of Critical Materials

Synthesis of Al-Sc Master Alloys through Induction Supported High Temperature Synthesis - Process Kinetics and Technical Feasibility
Frederic Brinkmann and Bernd Friedrich, RWTH Aachen University / IME Process Metallurgy and Metal Recycling

Recycling of Lithium Ion Batteries - Part 1: Review of Physical Separation Methods
Ryan Monteith and Erin Legault, SGS Canada Inc.

Electrodialysis Separation of Light Rare Earth Elements from Their Binary Solutions
Sanaz Mosadeghsedghi, Maziar E. Sauber, Soha Issa, and Saviz Mortazavi, CanmetMINING-Natural Resources Canada

Acid Baking Water Leaching of Electric Arc Furnace Slag for the Recovery of Niobium and Titanium
Gisele Azimi and Jihye Kim, University of Toronto

Crystallization of Li₂CO₃ from Li₂SO₄ Solution– A Fundamental Investigation
Gisele Azimi and Hongting Liu, University of Toronto

Re-Treatment of Tailings Using Chloride-Based Processing
Bryn Harris and Mike Dry, NMR360
Paper 810527
Recycling of Rare Earth Elements from Waste Fluorescent Lamps Utilizing Supercritical Fluid Extraction
Gisele Azimi, Jiakai Zhang, and John Anawati, University of Toronto

Paper 810719
Recovery and Secondary Use of Nickel-Manganese-Cobalt-Material from Cathodes of Electric Car Traction-Batteries
Jens Markowski, Brandenburg University of Technology
Matthias Schelter, Intilion GmbH
Joerg Acker and Jana Ducke, Brandenburg University of Technology

Paper 811706
Conceptual Recovery Processes for Cu and Au from GlyCat™ Leaching System
Zixian Deng, Elsayed Oraby, and Jacques Eksteen, Curtin University, Western Australian School of Mines

Paper 812791
Bench Scale Optimization of Acid Baking and Water Leaching of Rare Earth Elements from a Canadian Concentrate
Georgiana Moldoveanu and Vladimiro G. Papangelakis, University of Toronto

Paper 813524
Using Forward Osmosis for Water Recovery from a Gallium Recycling Solvent Extraction Effluent
Noel Devaere and Vladimiro Papangelakis, University of Toronto

Paper 817782
A Unique, Innovative and Integrated Hydrometallurgical Process for the Recovery of Germanium Contained in Complex Materials at Hydrometal
Alice Noël, Florent Sassi, and Thomas Boiselle, Hydrometal S.A.
Philippe Henry, Jean Goldschmidt S.A.

Paper 818672
Lessons Learned from New Hardrock Lithium Projects
Damian Connelly, METS Engineering Group

Paper 818750
Spodumene Beneficiation and Lithium Extraction from a Sample Taken from the Sirmac Lithium Property
Massoud Aghamirian, Syed Saad Ali, Irina Bylina, and Mykolas Gladkovas, SGS Canada Inc.
Yves Rougerie, Vision Lithium
Gary Pearse, Equapolar Resource Consultants Inc.

Paper 818822
A Case Study for Niobium Beneficiation by Froth Flotation
Massoud Aghamirian, Syed Saad Ali, Jing Liu, and Chris Gunning, SGS Canada Inc.
Pierre Pelletier, Consultant, Claude Dufresne, Niobay Metals Inc.
Charlotte Gibson, Vale Canada
Optimization of Rare Earth Elements Leaching from a Nechalacho Concentrate

Sample Maziar E. Sauber, Antonio Di Feo, and Tesfaye Negeri, CanmetMINING, Natural Resources Canada

Advanced Process Technology for Spherical Graphite

Reiner Haus, Christian Graf, and Thomas Felbinger, Dorfner Anzaplan

Rare Earths: How to Optimize the Separation Process Design?

Clémence Berger, Alain Rollat, and Alain Leveque, Carester

Sustainable Resource Recovery from Battery Materials Using Deep Eutectic Solvents

Kerstin M. Forsberg and Michael Svärd, KTH Royal Institute of Technology

Reza Younesi, Uppsala University

Hydrometallurgical Recycling of Lithium from Off-Gas Dust Generated in Pyrometallurgical Treatment of Lithium-Ion Batteries

Anton Andersson and Lena Sundqvist Ökvist, Luleå University of Technology

Precipitation of Lithium Carbonate from Simulated Sulfate Leach Solution

George P. Demopoulos and Fuqiang Guo, McGill University

Algal Biofilms for the Recovery of Rare Earth Elements from Dilute Aqueous Solutions Using Lanthanum as a Model REE

Mitchell Zak, Vladimiros G. Papangelakis, and D. Grant Allen, University of Toronto

Closed Loop Recycling of Postconsumer Lithium-Ion Battery of Electric Vehicles Gisele Azimi, Ka Ho Chan, Munu Malik, and John Anawati, University of Toronto

Thorium Removal from a Rare Earth Sulfate Solution in the Search Minerals Direct Extraction Process

David Dreisinger, University of British Columbia

Niels Verbaan and Mike Johnson, SGS Canada

Greg Andrews, Search Minerals
Paper 819587
The First Vanadium Carlin Vanadium Project Metallurgical Process Development
David Dreisinger, University of British Columbia, Jodi Esplin, First Vanadium
Mike Johnson, SGS Canada, Gary Kordosky and Michael Mracek, First Vanadium

Paper 819731
Development of a Thermodynamic Model for the Prediction of Solvent Extraction Distribution Coefficients
Alind Chandra, Joshua Werner, and Rick Honaker, University of Kentucky

Paper 819851
Critical Materials Recovery from Base Metals Operations
Jeff Adams, Jacqueline Fossenier, and Jack Shannon, Hatch Ltd.

Paper 819893
Recovery of Scandium and Iron from Bauxite Residue
Gisele Azimi and John Anawati, University of Toronto

Paper 819937
Supercritical Fluid Extraction of Rare Earth Elements from Avalon Concentrate
Gisele Azimi, Adrian Lambert, and Jiakai Zhang, University of Toronto
Maziar E. Sauber, CanmetMINING-NRCan
Kimberly Watada, University of Toronto

Paper 820018
A New Approach to Solubilize REE Values: Acid Soaking Water Leaching (ASWL) Process
Chen Xia, Wesley Griffith, Ceferino Soriano, and Eden Barry, CANMET Mining

Paper 820110
A Study on the Behavior of Light and Heavy REEs in Fe and Al Removal Process of Rare Earth PLS
Farzaneh Sadri and Ahmad Ghahreman, Queen’s University

Paper 820125
Solvent Extraction Flowsheet Design for the Separation of Rare Earth Elements: Tools, Methods and Application
Joshua Werner, University of Kentucky

Paper 820181
Cobalt Recovery from a Pyrite Concentrate
Lyn Jones, M.Plan International
Gregg Bush, Capstone Mining
Ron Molnar, MetNetH2O
Cesare J. Ferron, HydroProc Consultants
Chris Martin, Blue Coast Research
Paper 820196
**Pilot Plant Evaluations of Rare Earth Element Recovery and Concentration from Pre-Combustion Bituminous Coal Sources**
Rick Honaker and Alind Chandra, University of Kentucky
Wencai Zhang, Virginia Tech
Joshua Werner and Xinbo Yang, University of Kentucky
Aaron Noble, Virginia Tech

Paper 820352
**Microwave Pretreatment of Phosphogypsum for Extraction of Rare Earth Elements**
Gisele Azimi, Adrian Lambert, John Anawati, Mugdha Walawalkar, and Jason Tam, University of Toronto

Paper 820384
**The Solubility of Rare Earth (REE) Sulphates in Sulfuric Acid Solutions**
Liuyin L. Xia, Saskatchewan Research Council

Paper 820673
**Critical Material Production through Solvent Extraction Applications**
Tyler McCallum, Troy Bednarski, and Boban Jakovljevic, Solvay

Paper 821118
**Combined Recycling of Jarosite and Magnesium Salt Slags – An Innovative Way for the Recovery of Indium and Silver with Reduced Carbon Emissions**
Lukas Hoeber and Stefan Steinlechner, Montanuniversität Leoben / Chair of Nonferrous Metallurgy

Paper 821119
**Selective Recovery of PGMs and Cerium by a Hydrochloric Leaching Process for Automotive Catalysts**
Stefan Steinlechner, Montanuniversität Leoben / Chair of Nonferrous Metallurgy

Paper 821549
**Development of the Mineral Processing Flowsheet for Crater Lake Scandium Project**
Yemi Oyediran, Nok Associates Limited
Peter Cashin and Pierre Guay, Imperial Mining Group Ltd.
Andreas Werner and Sebastian Prinz, Dorfner ANZAPLAN

Paper 823215
**Beneficiation and Hydrometallurgical Flowsheet Development of a Manganese Carbonate and Silicate Ore Deposit**
Krystal A. Davis, Ben Yu, and Andrzej Nicalek, National Research Council Canada

Paper 823991
**Beneficiation and Extraction of REE from Defense Metals’ Wicheeda Deposit in BC**
Niels Verbaan, Jing Liu, Mike Johnson, Massoud Aghamirian, and Tassos Grammatikopoulos, SGS Canada Inc.
Dale Wallster and Craig Taylor, Defense Metals
Paper 825484
**Standard Lithium’s Process Development to Recover Lithium from Smackover Brine**
Ron Molnar, MetNetH2O
Craig Brown, Chemionex Inc.
Andrew Robinson and Ross Lewis, Standard Lithium Ltd.

Paper 825651
**Solutions from Raw Materials to Battery Precursor**
Markus Koponen and Tuomas Van der Meer, Outotec (Finland) Oyj

Paper 826078
**Recovery of Rare Earth from Secondary Industrial Source**
Carlos A. Morais and Michelle L. Sa, CDTN/CNEN

Paper 826333
**Deep-sea Nodules: Lower Impact Processing to Enable the Green Transition**
Henry von Schroeter, Hatch Ltd.
Jeffrey Donald, DeepGreen Metals Inc.
Alexander Sutherland, Hatch Ltd.

Paper 826591
**The Recovery of Rhenium from Nickel-Base Super Alloy Scraps**
Cesare J. Ferron, HydroProc Consultants

Paper 826644
**Rare Earth, Uranium and Thorium Recovery from Processed Monazite Residue**
Baodong Zhao, Jack Zhang, and Eagle Tang, Saskatchewan Research Council
Kurt Forrester and Don Lay, Medallion Resources Ltd.

Paper 826904
**Mineral Processing Flowsheet Approaches for the Ashram Rare Earth and Fluorspar Deposit**
Tesfaye Negeri and Maziar E. Sauber, CanmetMINING, Natural Resources Canada
Darren Smith, Dahrouge Geological Consulting Ltd.

Paper 827512
**Process Technology Overview of the Current Estonian Production of Both Tantalum and Niobium Oxides and Metals at NPM Silmet**
Michael Robart, Sandeep Jain, Edgar Peek, and Andrei Litviniuk, Neo Rare Metals - Neo Performance Materials

Paper 827542
**Process Technology Overview for the Canadian Recycling of Gallium and Indium from Electronic Scrap and Its Conversion into High Purity Metals**
Michael Robart, Brandon Taylor, and Edgar Peek, Neo Rare Metals - Neo Performance Materials
Separation and Purification of Critical Metals from Aqueous Chloride Solutions by Solvent Extraction
Jonathan Chen, Vaikuntam Lakshmanan, Ramamritham Sridhar, Robert Delaat, and Md. Abdul Halim, Process Research Ortech

A Comparison of Acid Baking and Caustic Cracking for REE Recovery
John R. Goode, J.R. Goode and Associates

Flotation of Bastnaesite Ore Using Novel Collectors
Corby Anderson and Dylan Everly, Colorado School of Mines
Bruce Moyer, Vyacheslav Bryantsev, and Santa Jansone-Popova, ORNL

Recovering Rare Earths and Other Metallic Values from Fluorine-Containing Concentrates Using Carbochlorination and Aqueous Leaching
Kang Sun, Christel Bemelmans, and Nick Hazen, Hazen Research, Inc.

LIGHT METALS: Light Metals for the Transportation Industry

Grain Refinement during Solidification of Gamma Titanium Aluminides
Julien Zollinger, Institut Jean Lamour
Jacob R. Kennedy, University of Manchester
Emmanuel Bouzy, LEM3

Recent Developments in the Production, Application and Research of Titanium in Germany
Carsten Siemers, TU Braunschweig / Institut fuer Werkstoffe
Christian Stöcker, ARCONIC Engineered Structures
Fabian Haase and Lina Klinge, TU Braunschweig / Institut fuer Werkstoffe

Hot Nano-Indentation Behavior of Ultra-Fine Grained Alloy and Nanostructured Nanocomposite Produced by Accumulative Fold Forging
Farzad Khodabakhshi, University of Tehran
Adrian P. Gerlich, University of Waterloo

A Taxonomy of Low-voltage Perfluorocarbon Emissions in Primary Aluminium Production Cells
Joan Boulander, Francis Lalancette, Anne Gosselin, Lukas Dion, Simon Gaboury, Louis Guimond, Claude Simard, and Alexandre Blais, Rio Tinto
Aluminium Products for Automotive Applications – Challenges and Solutions
Paul Rometsch, Lei R. Pan, Francis Breton, Nick Parson, Josée Colbert, and Jerome Fourmann, Rio Tinto Aluminium

Quench Sensitivity of Solution Heat Treated B319 Al Alloy: Hardness and Electrical Conductivity
Eli Vandersluis, Payam Emadi, Bernoulli Andilab, and Comondore Ravindran, Ryerson University

Characterization of AA6111 Aluminum Alloy Thin Strips Produced via the Horizontal Single Belt Casting Process
Usman Niaz, McGill University
Roderick Guthrie and Mihaiela Isac, McGill Metals Processing Center

The Effect of Single and Double Impingement Types of Metal Delivery Systems Used in Horizontal Single Belt Casting for the Processing of Thin Strips of AA6111 Aluminum Alloy
Usman Niaz, McGill University
Roderick Guthrie and Mihaiela Isac, McGill Metals Processing Center

Microstructure and Compressive Properties of a Die Cast Al-Mg-Si-Mn-Fe Alloy
Sohail M. Mohammed, Daolun Chen, Dejiang Li, and Xiaoqin Zeng, Ryerson University

Effect of Alloying Composition on Humid-Gas Stress Corrosion Cracking Behavior in Al-Mg-Si Alloys
Goroh Itoh, and Akira Kurumada, Ibaraki University
Shohei Aoshima, Japan Technical Center, SMC Corporation
Takeshi Ogawa, Aoyama Gakuin University

Application of Inoculation Methods for Grain Refinement of Wire-Arc Additive Manufactured Ti-6Al-4V
Jacob R. Kennedy and Alec Davis, University of Manchester
Armando Caballero, Cranfield University
Ed Pickering, University of Manchester
Stewart Williams, Cranfield University
Phil Prangnell, University of Manchester
Effect of Alloying Elements and Heat Treatments on Electrical and Mechanical Properties of Al Alloy Produced by Conventional Casting Process
Asiful H. Seikh, King Saud University, Muneer Baig, Prince Sultan University, Ateekh Rahaman, King Saud University, Jabair A. Mohammed

Cold Spray Technology for Transportation Applications: A Process with Impact
Dominique Poirier, Phuong Vo, Francois Nadeau, Bruno Guerreiro, Jean-Gabriel Legoux, and Eric Irissou, National Research Council Canada

Study of Alternative Aircraft Paint Removal Technologies
Ali Merati, NRC / ARC
Justin C. Denne, Canadian National Research Council

Advanced Light Metals and Manufacturing for Automotive Lightweighting
Alan A. Luo, Ohio State University

LIGHT METALS: Manufacturing Involving Rapid Solidification

Influence of Minor Additions on Nucleation and Dendrite Growth during Rapid Solidification of fcc Alloys
Julien Zollinger, Félix Royer, and Bernard Rouat, Institut Jean Lamour
Michel Rappaz, EPFL

Dendrite Orientation Transition in Laser Remelted Titanium Alloys: Phase Field Simulation and Experiment Validation
Yu Zou and Yujian Wang, University of Toronto

On the Hot Tearing Susceptibility of Hybrid Additively Manufactured AA2618/ALSi10Mg Alloy within Functionally Graded Interfaces
Mohammad H. Ghoncheh, Marine Additive Manufacturing Centre of Excellence
Mehdi Sanjari, CanmetMATERIALS
Babak Shalchi-Amirkhiz, Natural Resources Canada
Mohsen Mohammadi, Marine Additive Manufacturing Centre of Excellence

The Influence of Post-Build Microstructure on the Performance of Additively Manufactured 17-4 Stainless Steel
Mark R. Stoudt, Richard Ricker, Carolyn E. Campbell, and Maureen Williams, National Institute of Standards and Technology (NIST)
Paper 821449
The Effect of Thin Strip Casting on the Mechanical Properties of Subsequently Cold-Rolled/Aged AA6005 Aluminum Sheets
Shengze Yin and Vahid Fallah, Queen's University

Paper 823168
The Critical Effect of Powder Attributes on the Optimized Parameters and the Corresponding Tensile Properties in Laser Powder Bed Fusion (LPBF) of AlSi10Mg Alloy
Vahid Fallah and Pusong Wang, Queen's University

Paper 826713
Effect of Pre-Solidified Grains (PSG) on the Filling Behaviour in High Pressure Die Casting Process
Stefan Heugenhauser, Sumanth Shankar, and André B. Phillion, McMaster University
Gabriel Birsan and Kumar Sadayappan, Natural Resources Canada – CanmetMATERIALS

Paper 826801
Modifying the Morphology of Si in Hypereutectic Al-Si Alloys
Daniela Diaz, Hani Henein, and Abdoul-Aziz Bogno, University of Alberta

Paper 830699
4D Characterization of Solidification in Al-20Zn and Al-20Zn-0.1cCr Droplets
Jonas Valloton and Abdoul-Aziz Bogno, University of Alberta
Christian M. Schlepütz, Paul Scherrer Institute
Michel Rappaz, EPFL
Hani Henein, University of Alberta

Paper 831329
Effect of Bi on the Rapid Solidification Microstructure and Properties of Hypoeutectic Al–Si
Marcelino Dias and Abdoul-Aziz Bogno, University of Alberta
Jose Eduardo Spinelli, Federal University of Sao Carlos
Amauri Garcia, UniCamp
Hani Henein, University of Alberta

MATERIALS: Accelerated Materials Design (ICME) in Structural & Energy Materials

Paper 819270
Exploring Small-Scale Quasicrystal Plasticity in Unknown Temperature Regimes
Yu Zou and Changjun Cheng, University of Toronto

Paper 819303
Activating Monolayer Mote2 for Hydrogen Evolution by Introducing 2H/1T' Phase Boundaries
Yiqing Chen and Jun Song, McGill University
Paper 819383
The Carbon Vacancy Configurations in Sub-Stoichiometric Carbides in Steels
Xiaohan Bie and Jun Song, McGill University

Paper 819414
Numerical Investigation of the Particles Impact and Interfacial Bonding in Cold Spray Process
Baihua Ren and Jun Song, McGill University

Paper 819442
Deformation Twinning Mechanism in Polycrystalline Magnesium: An Atomistic Study
Huicong Chen and Jun Song, McGill University

Paper 819469
Stability Improvement of Low-Cost Perovskite Solar Cells Processed in Ambient Condition by Incorporation of Inorganic Materials
M. Reza Mohammadi, University of Waterloo
Niusha Heshmati and Parvin Abachi, Sharif University of Technology

Paper 819550
Design of Mg Alloys with Improved Ductility: Assessment from the Aspect of Stacking Fault Energy
Qiwen Qiu and Jun Song, McGill University

Paper 826515
First-Principles Study of Metal/oxide Interface for Effective Photoelectrochemical Reduction of CO₂
Jun Song and Pengfei Ou, McGill University

Paper 827925
Theoretical Exploration of the Potential of MXenes as Electrode Materials in Batteries
Jun Fan, City University of Hong Kong

MATERIALS: Advances in Materials Manufacturing IV-Dr. Jason Lo Memorial Symposium

Paper 808127
Crystallographic Texture during Laser Additive Manufacturing of Stainless Steel
Farzad Khodabakhshi, University of Tehran
Adrian P. Gerlich, University of Waterloo

Paper 810808
Scale-Phobic Rare Earth Oxide Ceramics
Gisele Azimi and Runqian Zhang, University of Toronto
Paper 811238
Tracking the Microstructural Development in the Selective Laser Melting of Ti-185 with In-Situ Alloying
Farheen F. Ahmed, McMaster University
Samuel Clark and Peter D. Lee, University College London
Hatem S. Zurob and André B. Phillion, McMaster University

Paper 814645
Microstructures and Mechanical Properties of Fiber Laser Welded Ti-6Al-4V and CP-Ti Dissimilar Joints
Alireza Abdollahi, Ahmed Shaheer Ahnaf Huda, and Abu Syed Kabir, Carleton University

Paper 814875
Initial Boron Uptake and Kinetics of Transient Liquid Phase Bonding in Nickel-Based Superalloys
Eric D. Moreau and Stephen Corbin, Dalhousie University

Paper 815628
Effect of Stress Relief Annealing on the Microstructure and Mechanical Properties of Linear Friction Welded Ti-6Al-4V
Sidharth Rajan, Carleton University
Priti Wanjara and Javad Gholipour, National Research Council (NRC), Canada
Abu Syed Kabir, Carleton University

Paper 816842
Impact of Extended Heat Treatments on Additively Manufactured Ti-6Al-4V
Peter Walker, Abu Syed Kabir, and Mostafa El Sayed, Carleton University

Paper 817747
Joining of Additive Manufactured Aluminium Alloys by Friction Stir Processing Ming-Jen J. Tan, Nanyang Technological University
Zhenglin Du, Singapore Institute of Manufacturing Technology

Paper 818295
Evaluation of Zener-Hollomon Parameter in an Ultrasonic Spot Welded Al5182 Alloy
Soumya S. Dash, Sohail M. Mohammed, and Daolun Chen, Ryerson University
Xianquan Jiang, Southwest University
Dongyang Li

Paper 818790
The Study of the Performance of Additive Manufacturing and Powder Metallurgy Titanium Alloys in Drilling Process
Junhui Ma, Javad Mohammadi, Olufisayo A. Gali, and A R. Riahi, University of Windsor

Paper 819217
Supersolidus Liquid Phase Sintering and Grain Growth Activation of a Metal Injection Molded Nickel-Base Superalloy
Addison J. Rayner, Dalhousie University
Stephen Corbin, Dalhousie University
Paper 819294
In-situ X-Ray Characterization of Keyhole Dynamics in Laser-Based Additive Manufacturing of Aluminium Alloys
Yu Zou and Hongze Wang, University of Toronto

Paper 819474
Hot Tearing Susceptibility of Al-Fe-Ni Alloys
Abdallah Elsayed, Stephanie Kotiadis, Mehkansh Sharma, and Matthew Bolan, University of Guelph

Paper 819488
Microstructure Evolution and Mechanical Properties of a γ-TiAl/Ti2AlNb Dual Alloy Produced by Laser Direct Metal Deposition
Yu Zou and Haoxiu Chen, University of Toronto

Paper 819707
Mechanical and Fatigue Behavior of Direct Metal Laser Sintered (DMLS) Inconel 718
Anil Saigal, Tufts University
Ramesh Singh and Sachin Alya, IIT Bombay

Paper 820056
Atom Probe Tomography and Electron Backscattered Diffraction Correlative Study of Grain Boundary Role in Liquid Metal Embrittlement
Mohammad Hadi Razmpoosh, University of Waterloo
Brian Langelier and Hatem S. Zurob, McMaster University
Norman Zhou and Elliot Biro, University of Waterloo

Paper 820242
Role of Transient Softening at Fusion Zone in Failure Behavior of Resistance Spot Welds in Ultra-High Strength Hot-Stamped Steel
Alireza Mohamadizadeh, Elliot Biro, and Michael J. Worswick, University of Waterloo

Paper 820257
X-Ray Diffraction Analysis of Dynamic Transformation during High-Temperature Deformation of Niobium Steel
Clodualdo Aranas, University of New Brunswick
Samuel F. Rodrigues, Federal Institute of Maranhao
Fulvio Siciliano, Dynamic Systems Inc.
John Jonas, McGill University

Paper 820324
Materials Characterization of M789 Steel Produced by Means of Laser Powder Bed Fusion
Clodualdo Aranas, Robert Palad, and Kanwal Chadha, University of New Brunswick
Yuan Tian, voestalpine Additive Manufacturing Center Ltd.
Paper 821213
**Formation of Strain Induced Ferrite and its Retransformation above the \( \text{Ae}_3 \) under Plate Rolling Conditions**
*Samuel F. Rodrigues, Federal Institute of Maranhao*
*Fulvio Siciliano, Dynamic Systems Inc.*
*Clodualdo Aranas, University of New Brunswick*
*Eden S. Silva and Gedeon S. Reis, Federal Institute of Maranhao*
*John Jonas, McGill University*

Paper 821263
**An Investigation of the Effects of Welding Parameters on the Properties of Thin-Wall Pieces of Al-Si Alloy Made Using GMAW-Based Wire Arc Additive Manufacturing**
*Tan Pham and Mehdi Gharagozloo, École de technologie supérieure*

Paper 821662
**Is Cold Spray Additive Manufacturing?**
*Stephen Yue, McGill University*
*Phuong Vo, National Research Council Canada*
*Wilson Wong*

Paper 828982
**Hybrid Investment Casting**
*Abdoul-Aziz Bogno, Mubashir Chand Tamboli, Ahmed Qureshi, and Hani Henein, University of Alberta*

Paper 836927
**How Additive Manufacturing Changes Material Properties**
*Hadi Mozaffari-Jovein, Dennis Pede, Emre Özel, Mo Li, and Tobias Poleske, Furtwangen University*

Paper 836991
**Influence of Additive Manufacturing and Subsequent Treatments on the Corrosion Behaviour of Different Titanium Alloys**
*Dennis Pede, Mo Li, Tobias Poleske, and Hadi Mozaffari-Jovein, Furtwangen University*

**MATERIALS: Corrosion & Degradation**

Paper 814111
**Corrosion Protection with Thermal Sprayed Zinc Duplex Coatings**
*Martin Gagne, ZELIXIR Inc.*

Paper 815743
**Topographic and Crystallographic Analyses of Hydrogen-Related Fracture Surfaces in Notched Tempered Martensitic Steel**
*Muhammad Zakuan and Kenichi Takai, Sophia University*
*Kensuke Iwanaga, Tsukasa Okamura, and Norio Tanaka, Neturen Co., Ltd*
Paper 816577
Quantitative Evaluation of Strain-Induced Lattice Defects Enhanced by Hydrogen in Pure Iron
Kenichi Takai and Yuri Sugiyama, Sophia University

Paper 818179
Mass Transfer of Oxygen in Powder Coatings in Wet Diffusion Systems
Hossein Zargar and Edouard Asselin, University of British Columbia
Dennis Wong and Catherine Lam, ShawCor Ltd.

Paper 819698
Microbiologically Influenced Corrosion (MIC) in an Operating Gold Mine
Muan Wei, ICE Dragon Corrosion Inc.
Noelia Díaz, Barrick

Paper 820385
Finite Element Analysis (FEA) Study of Microstructural Influences on Hydrogen Embrittlement (HE) of High Strength Martensitic Steels
Tuhin Das and Rohan Chakrabarty, McGill University
Salim V. Brahimi, IBECA Technologies Corp.
Stephen Yue, McGill University

Paper 824644
Effect of Surface Treatment on Corrosion Control of Fe-Cr and Fe-Cr-Ni Alloys in Hydrothermal Liquefaction Processing of Biomass
Joey Kish, McMaster University
Yimin Zeng, Natural Resources Canada - CanmetMATERIALS
Elliott K. Asare, McMaster University

Paper 831664
Comparison of the Corrosion of Wrought and Electron Beam Melted Ti-6Al-4V for Biomedical Applications
Mohammadali Shahsavari and Edouard Asselin, University of British Columbia

Paper 834432
The Passivity of Ti-45Nb Alloy in Sulfuric Acid in the Presence of Fluoride
Amin Imani and Edouard Asselin, University of British Columbia

Paper 834731
Rust Never Sleeps: Uncovering the Hidden Business Risks from Physical Asset Degradation
Zoe L. Coull, ICE Dragon Corrosion Inc.
MINERAL PROCESSING: Novel Technologies for Environmental Footprint Reduction

Paper 811721
**Ferric Leaching of Pyrrhotite Tailings under Controlled pH And ORP Using Different Ferrous Oxidizers**
*Dazhi Ren, Georgiana Moldoveanu, Radhakrishnan Mahadevan, Elizabeth A. Edwards, and Vladimiros G. Papangelakis, University of Toronto*

Paper 814742
**Plant-Wide Economic Model Predictive Control Application in Mineral Processing**
*Alex Thivierge, Jocelyn Bouchard, and André Desbiens, Université Laval*

Paper 814845
**Developing a Phenomenological Dynamic Model for Particle Flow in Wet Low-Intensity Magnetic Separation**
*Juan Sebastian Guiral-Vega, Université Laval - COREM, Jocelyn Bouchard and Éric Poulin, Université Laval, Laura Pérez-Barnuevo*

Paper 815480
**Reprocessing of Historical Gold Mine Tailings in Nova Scotia Using Chloride Hydrometallurgy**
*Terry C. Cheng, CanmetMINING, Natural Resources Canada, Michael B. Parsons, Geological Survey of Canada, Natural Resources Canada*

Paper 816021
**Turning Waste to Value: Selective Recovery of Rare Earth Elements from Coal Fly Ash with Ion Exchange Technologies**
*Mehdi Mostajeran, Jean-Michel Bondy, and Rory Cameron, Natural Resources Canada - CanmetMINING*

Paper 816559
**Exploring the Potential Benefits of Considering Mineral Liberation Explicitly in Process Control**
*Edgar Manuel M. Pérez García, Jocelyn Bouchard, and Éric Poulin, Université Laval*

Paper 816849
**CanMicro: Scaling up Microwave Technology for the Mining Industry**
*Erin R. Bobicki, Darryel Boucher, and John H. Forster, University of Toronto, Christopher Pickles and Adam Olmsted, Queen's University*

Paper 818006
**Accelerated Carbonation of Natural Canadian Silicates (Kimberlite and Wollastonite) for CO₂ Sequestration**
*Rafael M. Santos, Ye Eun Chai, Salma Chalouati, Cibi Chakravarthy, and Hugo Fantucci, University of Guelph*
Paper 818903
An Analytical Tool to Assess the Carbonation Potential of Mineral Deposits and Mining Wastes
Carlos Paulo, Ian Power, and Amanda Stubbs, Trent University
Nina Zeyen and Sioban A. Wilson, University of Alberta

Paper 818972
Functionalized Biopolymer for Enhanced Metal Recovery in Froth Flotation Processes
Laura Benavides, Integrity Mining and Industrial
Cameron Bruin, Base Met Labs

Paper 819030
A Comparison of Two Circuit Applications for Implementation of Coarse Particle Flotation
Eric B. Wasmund, Eriez Flotation Division
Rafael Regino, Cozamin site, Capstone Mining Corporation
Oscar Lopez, Eriez Flotation Division
Hank Wong, Fluor Canada Ltd
Kathy Adams, Paterson and Cooke
Drew Hobert, Eriez Flotation Division

Paper 819143
Model Predictive Control – A Digital Transformation Initiative at Vale Long Harbour Processing Plant
Kevin S. Brooks, BluESP
Michael Roy, Lindani Ntombela, Ryan Peterson, and Trevor Batstone, Vale
Paul Yanchus, Hatch Ltd.

Paper 819461
Investigation of Ferrous Bio-Oxidation Kinetics in a Batch Bioreactor
Heping Shen, Vladimiros G. Papangelakis, Minqing Yang, Georgiana Moldoveanu,
Elizabeth A. Edwards, and Radhakrishnan Mahadevan, University of Toronto

Paper 819694
Application of Switchable Biopolymers to Mitigate Clay Minerals in Mineral Processing
Erin R. Bobicki and Nahid Molaei, University of Toronto

Paper 819916
Recovery of Battery Metals (Ni and Co) from Pyrrhotite Tailings
Rory Cameron, Natural Resources Canada - CanmetMINING
Yves Thibault and Rolando Lastra, Natural Resources Canada
Jean-Michel Bondy, Natural Resources Canada - CanmetMINING
Doug Gould, Self

Paper 819919
Control Strategies with Environmental Benefits for Mineral Processing Operations
Carole Prévost and Marc Tardif, BBA Inc.

Paper 820189
Biodegradation of Diethylenetriamine and Metal-Diethylenetriamine Chelates
Erin R. Bobicki and Erin Furnell, University of Toronto
Paper 820250
Process Analytics and Machine Learning to Predict Arc Loss in an Electric Arc Furnace
Lee D. Rippon, Bhushan Gopaluni, and Ibrahim Yousef, University of British Columbia
Behroz Hosseini, Jean-Francois Beaulieu, and Carole Prévost, BBA
Sirish Shah, University of Alberta

Paper 820449
Selective Heat Ore Treatment: Shaking up the Economics of Mineral Recovery
Tracy Holmes, Jenike & Johanson Ltd.
Chris Dodds, University of Nottingham
David Craig, Jenike & Johanson Inc.
Andrew Batchelor and Sam Kingman, University of Nottingham
Erin Legault, SGS Canada Inc.
Mark Whetton, Teledyne e2v

Paper 820878
Mineral Process Dust Management, a Medium Range LiDAR for Fugitive Emissions Quantification
Jonathan Bernier, Rio Tinto
Martin Allard, Institut National d'Optique

Paper 826255
Niobium Ore Carbonate Minerals Flotation without Desliming
Elves Matiolo, Hudson Couto, and Amanda Freitas, Centro de Tecnologia Mineral (CETEM/MCTIC)
Joselito Silva and Andreia Camelo, Niobras - CMOC International
Stephanie Sá, Centro de Tecnologia Mineral (CETEM/MCTIC)

Paper 826454
Development and Application of Lime-Free Flotation Separation of Pb-Zn-S in Mining Plants
Yun Chen, Hunan Institute of Engineering
Ping Xiang, Hu’nan Huaqi Resources and Environment Science and Technology Development Co, Ltd.
Dongsheng He, Wuhan Institute of Technology

Paper 827172
High Definition Sorting System Based on New XRT, Visible Light and IR Detection Technologies
Jacek Kolacz, Comex

Paper 828528
Numerical Modelling of Non-Newtonian High Density Slurries in Thickeners
Guilherme A. Lindner, University of British Columbia
David N. Minson, MTP - MinTecProcess C & M Ltd.
Sanja Miskovic, University of British Columbia
PYROMETALLURGY: Rodney Jones Honorary Symposium on Chromite Processing

Paper 807611
Practical Considerations in the Design of an Experimental Set-Up for Laboratory-Scale Investigation of Slag Freeze-Linings
Pieter J. Bezuidenhout, Mintek
Joalet D. Steenkamp, Mintek / University of the Witwatersrand
Quinn G. Reynolds, Mintek

Paper 814752
The Role of Chromite in the Refractory Products
Dean Gregurek, Jürgen Schmidl, and Alfred Spanring, RHI Magnesita

Paper 818915
Cr Oxidation in Ferrochrome Smelter Dusts from Pilot-Scale DC Arc Furnace
Eleanor J. Berryman and Dogan Paktunc, CanmetMINING, Natural Resources Canada
David Kingston, National Research Council Canada

Paper 819647
Magnetic Fields in DC and AC Furnaces
Isobel McDougall and Piet Jonker, Tenova South Africa (Pty) Ltd
Bennie Henning, Bennie Henning Consulting

Paper 819709
The Recovery of Ferrochrome from Chromite and Stainless Steel Production Wastes Using DC Plasma Smelting
Tim Johnson, Tetronics International

Paper 820051
Chromite Ore Pellet Sticking and Fouling
Marc Duchesne and Nicole Bond, Natural Resources Canada

Paper 820131
Ferrochrome Production from Ontario’s Ring of Fire Chromite
Michael McCaffrey, Hatch Ltd.
Stephen Flewelling, Mark Baker, Ryan Weston, and Michael Desilets, Noront Resources Ltd.
Matthew Cramer, Hatch Ltd.

Paper 821558
Effects of the Reducing Atmosphere of the Calcination Stage on the Sulfur Deportment in Ferronickel Production via RK-EF Process
Sahand Sarbishei and Leili Tafaghodi Khajavi, University of British Columbia

Paper 824618
Responsible Chromite Mining in Ontario’s Ring of Fire
Ryan Weston and Mark Baker, Noront Resources Ltd.
Paper 825537
**Pilot Plant Smelting of Canadian and South African Chromite in a DC Furnace**
*Isabel J. Geldenhuys, Mintek*

Paper 825619
**Chromium Markets and Outlook for the 2020s**
*Nils R. Backeberg, Roskill Information Services*

Paper 825768
**Reduction of Synthetic Chromite with Methane**
*Vincent Y. Canaguier and Leiv Kolbeinsen, Norwegian University of Science and Technology*

Paper 825909
**Removal of Hexavalent Chromium by Means of Adsorption onto Chitosan and Chitosan/B-Cyclodextrin Beads from Cr-Contaminated Waters**
*Georgios Kolliopoulos, Université Laval*
*Tryfon Kekes and Constantina Tzia, National Technical University of Athens*
*Georgios Kolliopoulos, Université Laval*

Paper 826253
**Overfeeding in DC FeCr Smelting & Lessons Learned from the Aluminium Industry**
*Harmen Oterdoom and Johan Zietsman, University of Pretoria*

Paper 826533
**Phase Transitions and Microstructural Changes during Oxidation and Reduction of a Weathered Ilmenite Concentrate**
*Hossein Salehi, Norwegian University of Science and Technology*
*Stian Seim, TiZir Titanium and Iron*
*Leiv Kolbeinsen and Jafar Safarian, Norwegian University of Science and Technology*

Paper 827086
**New Technology Development in Pyrometallurgy - A Framework for Reliable and Sustained Progress**
*Johan H. Zietsman, Heine Weitz, and Nicole Sweeten, Ex Mente Technologies*

Paper 827256
**Leveraging Process Mineralogy for Integrated Management of Chromite Processing**
*Alessandro Navarra, McGill University*
*Felipe Peña, Universidad Católica del Norte*
*Tassos Grammatikopoulos, SGS Canada Inc.*
*Alain Kabemba*
PYROMETALLURY: Third Novennial Symposium on New Technology Implementation

Paper 814506
90 MW 3 Electrode Furnace with an Electrically Islanded Power Plant Utilizing SPLC, SVC for Electrical Efficiency and Stable Operation in Shielded Arc and Immersed Arc Modes
Mohammad Sedighy and Yan Elksnis, Hatch Ltd.
Denis Shevchenko, Pronico S.A.
Dong Shen, Hatch Ltd.
Alexander Sherstobitov and Denis Pershin, Pronico S.A.

Paper 819148
Extraction of Copper from Copper-Cobalt Alloy by Molten Magnesium
Dawei Yu, Chunxi Zhang, Xueyi Guo, and Qinghua Tian, Central South University

Paper 819367
Uncovering and Managing Hidden Catastrophic Business Risks from Asset Corrosion in Mining
Zoe L. Coull, ICE Dragon Corrosion Inc.

Paper 819765
Market Challenges for Using Rare Earths to Treat Waste Streams
Mason R. Haneline, Neo Chemicals & Oxides

Paper 819890
Recent Advancements in Refractory Management Technology for Furnace Campaign Life Extension
Mitchell Henstock, Afshin Sadri, Winnie Ying, Blair Climenhaga, Joshua Barnard, and Maria Tibbo, Hatch Ltd.

Paper 819986
Metal processing R&D at CanmetENERGY-Ottawa
Marc Duchesne and Robin Hughes, Natural Resources Canada

Paper 822016
Laboratory and Pilot Scale Study for Mercury (I) Chloride Oxidation to Mercury (II) Chloride Using Sodium Hypochlorite Dissociation in an Acidic Medium
Francois X. Cardin and Charles Desroches, CEZinc

Paper 825075
Application of a Refractory Corrosion Model (RCM) –Simulation and Validation of the Model
Christoph Pichler, Christoph Wagner, and Daniel Kreuzer, RHI Magnesita
Christoph Sagadin and Stefan Luidold, Christian Doppler Laboratory for Extractive Metallurgy of Technological Metals
Paper 825892
The Effect of Aging on Refractory Thickness Calculations for Process Vessels and Furnaces
Afshin Sadri, Winnie Ying, Mitchell Henstock, and Blair Climenhaga, Hatch Ltd.
Julia Allard, McGill University

Paper 826223
McNulty 4.0: Towards a Predictive Parametric Approach
Harmen Oterdoom, University of Pretoria

Paper 826964
A Semi-Quantitative Catastrophic Risk Likelihood Prioritization Framework for the Metallurgical Industry
Stefan Hlouschko and Matthew Cramer, Hatch Ltd.
Martin Pergler, Balanced Risk Strategies Ltd.

Paper 828414
Catastrophic Risk Management of Tailings Storage Facilities
Karl H. Pearce, Johan DuToit, Aravind Raman, Carmen Bracho, Rafael Davila, Dan McEvoy, Winnie Chan, and Daniel Molina, Hatch Ltd.