# MATERIALS PROCESSING FUNDAMENTALS

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Proceedings of a symposium sponsored by the
TMS Process Technology and Modeling Committee and
Extraction and Processing Division

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TMS 2013 Annual Meeting & Exhibition
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*Edited by*

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**Justin Crapps**

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# Preface

The key interest areas to be covered in the symposium of Materials Processing Fundamentals are all aspects of the fundamentals, synthesis, analysis, design, monitoring, and control of metals, materials, and metallurgical processes and phenomena.

Topics will include:

- The experimental, analytical, physical and computer modeling of physical chemistry and thermodynamics
- Transport phenomena in materials and metallurgical processes involving iron, steel, non-ferrous metals, and composites
- Second phase particles in metals and processes, such as non-metallic inclusions and bubbles in metals (steel, aluminum, silicon, magnesium, etc.) or gas bubbles in slag or electrolyte (foaming, gas evolution, or injection); the fundamentals (experimental studies or theoretical studies) on the nucleation, growth, motion and removal of these second phase particles from the molten metal or reactors
- Physical chemistry, thermodynamics and kinetics for the production and refining of rare earth metals
- Control of industrial processes in the field of extraction and processing of metals and materials: novel sensors for hostile-environment materials processes, such as online inclusion detection, temperature, and velocity in molten materials, surface condition of hot moving products, etc.; innovative online sampling and analysis techniques; models for real-time process control and quality monitoring systems

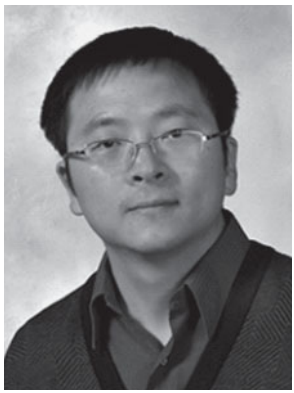
This year more than 60 abstracts and 35 papers were accepted for this symposium.

Lifeng Zhang
Antoine Allanore
Cong Wang
James A. Yurko
Justin Crapps

## Editors

**Lifeng Zhang** currently is a professor and the dean of the School of Metallurgical and Ecological Engineering at University of Science and Technology Beijing. Lifeng received his Ph.D. degree from University of Science and Technology Beijing in 1998 and has 15 years teaching and research work at different universities – University of Science and Technology Beijing, Missouri University of Science and Technology, Norwegian University of Science and Technology, University of Illinois at Urbana-Champaign, Technical University of Clausthal and Tohoku University. Lifeng has compound backgrounds in primary production, refining, casting, and recycling of metals; recycling of electronic wastes and solar grade silicon; and process modeling for metallurgical processes. Lifeng has published over 250 papers and gave over 170 presentations at meetings and conferences. He is a Key Reader (Member of Board of Review) for four journals and a reviewer for over 30 journals. Lifeng is a member of TMS, AIST and ISIJ. He has received several best paper awards from TMS and AIST.

**Antoine Allanore** is Assistant Professor of Metallurgy at the Massachusetts Institute of Technology (Cambridge, Massachusetts), in the Department of Materials Science and Engineering where he currently holds the Thomas B. King Chair. He earned a chemical engineering degree from the Ecole Nationale Superieure des Industries Chimiques de Nancy and a M.Sc. and Ph.D. in chemical engineering from the Institut National Polytechnique de Lorraine. Prior joining MIT, he worked as a research engineer at ArcelorMittal R&D on the development of new electrolytic processes for primary steel production. Dr. Allanore was a TMS Extraction and Processing Division Young Leader Professional Development Award winner in 2011 and co-recipient of the Vittorio de Nora Prize awarded at TMS 2012.



**Cong Wang** is Senior Research Engineer of Saint-Gobain Innovative Materials R&D. Prior to joining Saint-Gobain, he worked at the Alcoa Technical Center. He obtained his Ph.D. from the Carnegie Mellon University; M.S. from the Institute of Metal Research, Chinese Academy of Sciences; and B.S. from Northeastern University with distinctions, respectively. His specialties are in materials processing, micro-structure characterization, mechanical testing, and electrochemistry.

**James A. Yurko** is a Principal Technologist with Materion Brush Beryllium and Composites (Elmore, Ohio), the global leader in beryllium and non-beryllium based metal matrix composites. Dr. Yurko's primary technical focus is in the area of bulk metallic glass processing. Prior to joining Materion, he co-founded Electrolytic Research Corporation (ERC) LLC with Prof. Don Sadoway of MIT to commercialize molten oxide electrolysis (MOE) technology. Before working with ERC, Jim was the R&D team leader and staff metallurgist of BuhlerPrince, Inc. where he was responsible for commercializing the Semi-Solid Rheocasting (SSR) process and various die casting development projects of aluminum, magnesium, and bulk-metallic glass alloys.

Dr. Yurko received a Ph.D. in metallurgy from the Massachusetts Institute of Technology and a B.S.E. in materials science and engineering from the University of Michigan. He is currently a member of TMS and ASM and serves on the University of Michigan Materials Science and Engineering External Advisory Board. In 2010, Dr. Yurko was selected as the TMS EPD Young Leader Professional Development Award winner and was a co-recipient of the Vittorio de Nora Prize awarded at TMS 2012.

**Justin Crapps** attended Mississippi State University, studying Mechanical Engineering. As an undergraduate, Justin was very involved in leadership and extracurricular activities with several organizations including the student chapter of the American Society of Mechanical Engineers (ASME), Engineering Student Council, and Bulldog Toastmasters. Justin also participated in the Cooperative education and professional internship programs, spending three semesters working at Georgia Pacific Paper in Monticello, MS and three summers working at Eaton Aerospace in Jackson, Mississippi. In 2005, Justin was awarded the prestigious ASME Charles T. Main silver medal for leadership and service to his student section over a period of more than one year. After finishing his undergraduate education, Justin enrolled in the Ph.D. program at Mississippi State University. During graduate school, Justin's research focused on using finite element modeling for process simulation and developing a combined roughness and plasticity induced closure modified strip-yield model to simulate fatigue crack growth. After graduate school, Justin accepted a postdoctoral appointment at Los Alamos National Laboratory where he is working on projects focused on manufacturing process development for bonding cladding to nuclear fuel, reprocessing fuel through a casting process, multiphysics models for nuclear fuel performance, and development of testing methodologies and specimens for nuclear fuel-cladding bond strength measurement.