Below are a selected sampling of work performed by the Steel Center faculty members at Missouri S&T. All entries are listed by these categories:

**Steel Making**
- EAF & BOF
- Refining
- Non Metallic Inclusions

**Refractories**

**Foundry**
- Melting and Liquid Metal Processing
- Casting and Solidification
- Refractories and Mold Materials
- Physical Metallurgy

**Continuous Casting**

**Steel Processing** - rolling, forging, welding, heat treatment

**Steel Product Properties**

**Modeling & Simulation**

**Energy**

**Environmental**
- Recycling & Life Cycle Assessment
- New Environmentally Friendly Processes
- Coatings & Corrosion

Research projects and publications are listed chronologically by year.
STEELMAKING: EAF & BOF

Projects:

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Sponsor</th>
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<tbody>
<tr>
<td>Effects of Scrap Analysis on Melting Operations, Phase I - Charge Value Optimization</td>
<td>Gamma Tech</td>
<td>2008</td>
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<tr>
<td>Steel Deoxidation Study, Phase I &amp; II</td>
<td>Eramet Metals Company</td>
<td>2001</td>
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<tr>
<td>Study to Improve Efficiency of Cupolas through Oxygen Injection</td>
<td>MG Industries/MRTC</td>
<td>1998-99</td>
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<td>Modeling of Post-combustion in Electric Furnace Steelmaking</td>
<td>MG Industries/MRTC</td>
<td>1997-99</td>
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<tr>
<td>Mathematical Modeling of Slag Splashing</td>
<td>UM Research Board/UMR Appleyard Fund</td>
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Papers:

STEELMAKING: Refining

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<tr>
<th>Project Name</th>
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<tr>
<td>Steel Refining and Continuous Casting Collaborative Research</td>
<td>Shougang Research Institute</td>
<td>2008-10</td>
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<tr>
<td>Development of Process to Continuously Melt, Refine, and Cast High Quality Steel</td>
<td>AOE</td>
<td>2003-06</td>
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Papers:

STEELMAKING: Non Metallic Inclusions

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<tr>
<th>Project Name</th>
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<tr>
<td>Ingate and Filling Design for the Reduction of Inclusion Entrapment During Steel Ingot Teeming Process Ingot</td>
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Papers:

REFRACTORIES

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<tr>
<td>Steelmaking Nozzles that Resist Clogging</td>
<td>AISI/DOE</td>
<td>2002-04</td>
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<tr>
<td>Steel Foundry Refractory Lining Optimization: Electric Arc Furnaces</td>
<td>DOE</td>
<td>1999-2002</td>
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<tr>
<td>Development of Submerged Entry Nozzles that Resist Clogging</td>
<td>AISI/DOE</td>
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<tr>
<td>Research and Development in Reducing and Recycling Spent Refractories from Metal Producing Industries in Missouri</td>
<td>MDNR</td>
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Papers:

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<tr>
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<tr>
<td>High Performance Alloy Materials and Advanced Manufacturing of Steel Castings for Improved Weapon System Reliability</td>
<td>Army</td>
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<tr>
<td>Basic Model for EAF Clean Cast Steel</td>
<td>Univ of Alabama</td>
<td>2001-02</td>
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<tr>
<td>Study to Improve Efficiency of Cupolas through Oxygen Injection</td>
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FOUNDRY: Solidification and Casting

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<td>Lightweight Steel Encapsulation of SiC Tiles</td>
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<td>Manufacturability Improvement for P900 Effector Plate for Energy Absorbing Blast Protection</td>
<td>Leonard Wood Inst</td>
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<td>Manufacturing of Steel Castings for Improved Weapon System Reliability</td>
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<td>High Performance Alloy Materials and Advanced Manufacturing of Steel Castings for Improved Weapon System Reliability – Yr2</td>
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<tr>
<td>High Performance Steels</td>
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<td>P900 Armor Castings with High Energy Absorbing Properties</td>
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<td>Light-Weight Steel Castings for Ceramic Armor Systems</td>
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<td>TTR Phase I: Rapid Freeze Prototyping of Investment Cast</td>
<td>O'Fallon Casting</td>
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<td>Analysis of Weight Loss During Investment Cast Process</td>
<td>O'Fallon Casting</td>
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<td>ESMART Energy Efficiency in Melting: Precision Casting</td>
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FOUNDERY: Refractories & Mold Materials

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<td>Burnt-on/Burnt-in Sand Defects in Steel Castings</td>
<td>SFSA</td>
<td>2001-04</td>
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<td>Silicon Carbide Behavior in Ferrous Melting Process Studies</td>
<td>Katz</td>
<td>2001-03</td>
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<td>Steel Foundry Refractory Lining Optimization</td>
<td>DOE</td>
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<td>Development of Lightweight Steel P900 Castings for Future Combat Systems</td>
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<td>Improved Design and Tolerancing Practice for Casting Machinability</td>
<td>ATI/DOE</td>
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<td>High Performance Steels</td>
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CONTINUOUS CASTING

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<td>Castrip Process Metallurgy Research - Phase 1&amp;2</td>
<td>Nucor-Yamato Steel</td>
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<td>Modeling Fluid Flow in Continuous Centrifugal Casting</td>
<td>Gerdau</td>
<td>2010-12</td>
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<td>Steelmaking Nozzles that Resist Clogging</td>
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<td>Relationship of Mn/Si Ratio to Continuous Casting of Structural</td>
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<td>Steels</td>
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Papers:

STEEL PROCESSING: Rolling, Forging, Welding, & Heat Treatment

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<td>Effects of Steel Processing on Property Variations in</td>
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<td>Eglin Steel</td>
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<td>Steel Process Optimization</td>
<td>Steel Dynamics</td>
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<td>Effects of Steel Processing on Austenitic Grain Size-Phase I</td>
<td>Nucor-Yamato Steel</td>
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STEEL PRODUCT PROPERTIES

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<tr>
<td>Study of Inclusions and Microstructures on Property Variations in Steel</td>
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<td>Design and Testing of Coating Interface Fatigue Specimen</td>
<td>Caterpillar</td>
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<td>Inclusion Characterization System for Material Behavior</td>
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<td>Mechanical Property Evaluation of Fe-(Cr,Mo)-B Hard-facing Alloys</td>
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<td>Evaluate Carbide Stabilities in Cast Stainless Steel</td>
<td>SFSA</td>
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<td>Tailoring Fe-Base Alloys for Intermediate-Temperature</td>
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ADVANCED HIGH STRENGTH STEELS

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<td>Phase Transformation Behavior of Lightweight Steels</td>
<td>POSCO</td>
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<td>Development of Lightweight Steel P900 Castings for Future Combat Systems</td>
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<td>Development of Nano-acicular Duplex Steels</td>
<td>NSF</td>
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Ingate and Filling Design for the Reduction of Inclusion Entrapment During Steel Ingot Teeming Process Ingot

IMF 2009-11

Papers:


ENERGY

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<td>Impact of AHSS and Embedded Electronics on recyclability of Autos</td>
<td>AISI-AIST</td>
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<td>Metals Recovery from Spent Refractory Phase I - Characterization</td>
<td>Olin</td>
<td>2007</td>
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<td>Life Cycle Greenhouse Gas Emission Comparison Of Steel with Other Materials</td>
<td>AISI/AIST</td>
<td>2006-07</td>
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<td>Research and Development in Reducing and Recycling Spent Refractories from Metal Producing Industries in Missouri</td>
<td>MDNR</td>
<td>1997</td>
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<td>Research and Development in Recycling Used Automotive Oil Filters</td>
<td>MDNR/Gray Automotive</td>
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<td>Studies of Used Oil Filter Recycling</td>
<td>Purolator Products, Inc.</td>
<td>1995-96</td>
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### Papers:

ENVIRONMENTAL ASPECTS OF STEEL MANUFACTURING: New Environmentally Friendly Processes

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<tr>
<td>Geological Sequestration of CO2 by Hydrous Carbonate w/ Slag</td>
<td>AISI/DOE</td>
<td>2005-07</td>
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<tr>
<td>Application of Submerged Combustion in-bath Smelting Process for Treatment of K061</td>
<td>Bayou Steel / SMI / Chapparel</td>
<td>1996-97</td>
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Papers:

ENVIRONMENTAL ASPECTS OF STEEL MANUFACTURING: Coatings & Corrosion

Projects:

Project Name: Cerium-based Conversion Coatings for Aerospace Applications
Sponsor: PPG Industries
Date: 2012

Project Name: Inorganic Structure of Corrosion Inhibitors and Coating Performance Studies
Sponsor: Boeing Research & Technology
Date: 2011

Project Name: Corrosion Inhibiting Electrocoat System for Body-in-White Assemblies
Sponsor: GM/USAMP
Date: 2010-11

Project Name: Corrosion Finishing/Coating Systems for DoD Metallic Substrates Based on Non-Chromate Inhibitors and UV Curable, Zero VOC Materials
Sponsor: SERDP
Date: 2006-09

Project Name: Non-Chrome Coatings
Sponsor: Air Force
Date: 2004-06

Project Name: Environmentally Friendly Corrosion Resistant Coating System
Sponsor: Air Force
Date: 2004-06

Project Name: Environmentally Sound Aircraft Coatings
Sponsor: Air Force
Date: 2002-05

Papers:


