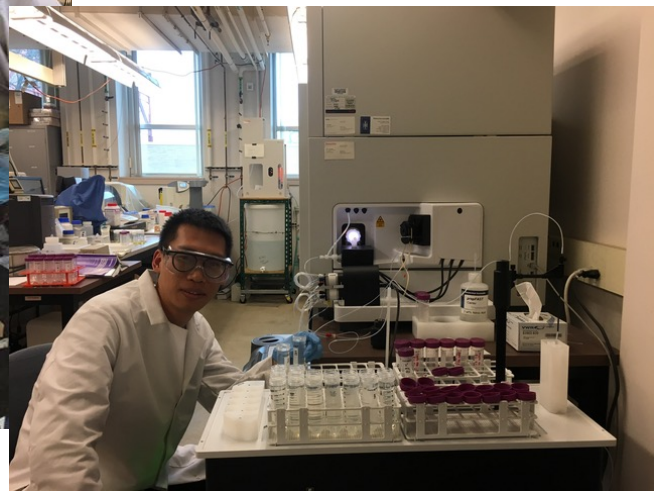
Center for Resource Recovery and Recycling



An NSF Industry/University Cooperative Research Center

University Partners

WPI

MINES

KU LEUVEN

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Center Directors

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Colorado School of Mines

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Mission

The Center for Resource Recovery and Recycling (CR^3) is committed to being the premier cooperative research center focused on sustainable stewardship of the earth's resources. Our focus is on helping industry address a pivotal societal need to create a sustainable future. At CR^3 you will advance technologies that recover, recycle and reuse materials throughout the manufacturing process. These advancements will help your business reduce energy costs and increase profitability, while protecting our natural resources.

Members

Aurubis

Boliden

Campine

East Penn Manufacturing

General Motors

Global Mineral Recovery

Glencore

Gopher Resource

Heritage Environment

Indium

Israel Chemicals Ltd.

SMS Group

Umicore

U.S. Army Research Laboratory

Value to Industry

As a CR3 member your company…

- Submits and votes on research projects undertaken annually by CR^3
- Networks with global industry leaders
- Has royalty-free IP rights to pre-competitive research
- May opt to sponsor company-proprietary research that remains exclusive
- Has access to findings from large-scale projects funded by the U.S. government or foundation grants

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Value to Industry

As a CR3 member your company…

- Can recruit top students from various engineering disciplines
- has access to CR^3 technical reports and process data
- Will know that membership fees are used for research expenses only without any institutional overhead
- Has access to characterization facilities at all member institutions
- Can consult CR^3 faculty, which helps members get timely solutions to factory floor problems without additional cost
- Can sponsor student projects (senior thesis) and industrial internships

Value to Industry

CR3 Center for Resource Recovery and Recycling

As a CR3 member your company…

Can work with sister centers, such as:

- **Center for Heat Treating Excellence (CHTE)**
- **Kroll Institute for Extractive Metallurgy at CSM**
- **EIT-KIC Programs at KU Leuven**

to broaden your understanding of research in recycling at partner universities.

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Our Achievements

CR³ Center for Resource Recovery and Recycling

2010-2022

Projects:

- 40 Completed Research Projects
- 7 Current Research Projects

Patents: Provisional and full patents granted: 13

Students Graduated & Placed: 30

Our Achievements

CR³ Center for Resource Recovery and Recycling

2010-2022

Publications:

Journals: 75 (from solicitation)
Conference proceedings: 30
Conference presentations: 60

Journal Launched:

Journal of Sustainable Metallurgy (Springer)

Publicity & Promotion:

Website, e-mail, marketing and industry press

Professional Partnerships:

TMS – REWAS, Engineering Solutions For Sustainability
KUL – Bauxite Residue Valorization

Our Achievements

CR³ Center for Resource Recovery and Recycling

Completed Research Projects

- Auto-Al Scrap Material Flow Analysis with Compositional Projections
- Battery Design for Disassembly in Support of Materials Reuse
- Beneficiation of Flat Panel Functional Coatings
- Conditioning of Machined Chips
- Copper Separation from Steel
- Development of Aluminum-Dross Based Materials for Engineering Applications
- Development of Pre-Treatment Technology for Recovering Valuable Metals from Waste Lithium Ion Batteries

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Our Achievements

CR³ Center for Resource Recovery and Recycling

Completed Research Projects

- Dezincing of Galvanized Steel
- Electro-Oxidation of Metals and Inorganics in Metallurgical Operations
- Fundamental Study of Lithium Ion Battery Recovery
- Increased Gas Injection Efficiency Through Sonic Jetting Regime
- Innovative Refining Technologies for Antimony Recovery
- Innovative Refining Technologies for Sb Recovery
- Magnet Separation Recycling Technologies
- Metal Recovery Via Automated Sortation
- Molten Metal Compositional Sensing to Enhance Scrap Recycling
- Near Real Time Sub-ppm Detection of Elements in Metals

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Our Achievements

CR³ Center for Resource Recovery and Recycling

Completed Research Projects

- Novel Recycling Process Development for Li-Ion Batteries
- Online Moisture Analysis of Heterogeneous Material Flows
- Online Slag and Bullion Analysis by LIBS
- Opportunities and Barriers to Resource Recovery and Recycling from Shredder Residue in North America
- Optimization of Concrete Mixture for 3D Printing
- Optimization of Inorganic Polymers for 3D Printing
- Optimized Sorting and Separation Technologies for Remanufacturing with Product - Centric Recycled Reclaimed Scrap
- Physical and Chemical Benefication for Recycling of Photovoltaic Materials

Our Achievements

CR³ Center for Resource Recovery and Recycling

Completed Research Projects

- Pre-Treatment Processes for Waste PCB's
- Rare Earth Metals Recovery from Bauxite Residue
- Rare-Earth Recovery from Magnets, Catalysts, and other Secondary Resources
- Recovery of Rare Earth Metals from Phosphor Dust
- Recovery of Rare Earth Metals from Phospher Dust of Waste Fluorescent Light Fixtures
- Recovery Valuable Metals from Fines

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Our Achievements

CR³ Center for Resource Recovery and Recycling

Completed Research Projects

- Recovery of Valuable Metals from Flue Dust and Other Fines from Mechanical Treatment of E-Scrap
- Recovery of Value-Added Products from Red Mud and Foundry Bag House Dust
- Recovery of Zinc and Iron from EAF Dusts Including Hot Stage Slag Engineering and Energy Recovery
- Recycling of Bag-House Dust from Foundry Sand through Chemical and Physical Benefication
- Recycling of Waterborne Paint Sludge

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Our Achievements

CR³ Center for Resource Recovery and Recycling

Completed Research Projects

- Reuse Opportunities for Bauxite Residue
- Separation of Al Sus and Resin from Waste Printed Circuit Boards
- Separation of Eu and Y from Phosphor Dust
- Synthesis of Inorganic Polymers from Metallurgical Residues

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Our Achievements

CR³ Center for Resource Recovery and Recycling

Current Research Projects

- Contactless Flow Measurement of Molten Materials
- Assessment of Environmental Properties of Non-Ferrous Metal Production Slags
- Machining Fluid Filtration and Particle Count Measurement
- Structure Property Relations of Slags, Application and Carbonation Potential
- Metal Recovery from Industrial By-Products Using Bromine
- Cleaning of Fayalite/Olivine Slags using H2 (and CO): Measurement for the Recovery of Technology elements, e.g. Pb, Zn, Sb, As, etc. from Bath Smelting Slags
- G-METS Distillation for Continuous Efficient Lead Refining

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Our Achievements

CR³ Center for Resource Recovery and Recycling

Research Funding 2010-2022

Industry Membership: 7.5 million USD

Federal funding: 2 million USD (NSF to WPI/CSM)

Leveraged Federal Funding: >20 million USD

Leveraged External Funding: >10 million USD (international partners)

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Our Achievements

CR³ Center for Resource Recovery and Recycling

Companies Launched

Kinetic Batteries

BATTERY RESOURCERS

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Graduates

CR³ Center for Resource Recovery and Recycling

Some of the Employers of CR3 Graduates

- Air Liquide
- Battery Resourcers
- Boston Power
- Copper Consulting of Anaconda
- FTI Consulting
- Gopher Resources
- Honeywell
- NCycle
- Pohang Steel Company
- Radikal Therapeutics
- Severstal Steel
- State Development and Investment Corporation of China
- Solvus Global
- Umicore
- UTRC
- VJ Technologies
- WPI

Join us…

Fall Industrial Advisory Board (IAB) Meeting

WPI

Worcester, MA

November 9-10, 2022

For information visit:

wpi.edu/+cr3/