CENTER FOR
RESOURCE RECOVERY AND RECYCLING
wpi.edu/+cr3/

An NSF Industry/University Cooperative Research Center
University Partners

CR³ Center for Resource Recovery and Recycling

Worcester Polytechnic Institute

Colorado School of Mines

KU Leuven

University of Tokyo

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Our Team

CR³ Center for Resource Recovery and Recycling

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The Center for Resource Recovery and Recycling (CR³) 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 – the need to create a sustainable future. At CR³ 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.
Our Members

- The Aluminum Association
- Aurubis
- East Penn Manufacturing
- General Motors
- Gopher Resource
- Heritage Environment
- Hydro Aluminium Rolled Products
- Indium
- JX Nippon Mining & Metals

- Metallo Belgium
- nanoRanch
- Olympus
- SMS Group
- Steinert
- Surface Combustion
- Tianqi Lithium
- Umicore
- U.S. Army Research Laboratory

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As a CR³ member your company...

- submits and votes on research projects undertaken annually by CR³
- 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
As a CR³ member your company...

- can recruit top students from various engineering disciplines
- has access to all (past and current) CR³ technical reports and process data
- membership fee is used for research expenses only without any institutional overhead
- has access to characterization facilities at all member institutions
- can consult CR³ faculty, which helps members get timely solutions to factory floor problems without additional cost
- can sponsor student projects (senior thesis) and industrial internships
As a CR$^3$ member your company...

Can work with sister centers, such as:

- Advanced Casting Research Center (ACRC) and Center for Heat Treating Excellence (CHTE)
- Center for Materials Processing Data (CMPD) at WPI
- Kroll Institute for Extractive Metallurgy at CSM
- EIT-KIC Programs at KU Leuven and
- Research into Artifacts – Center for Engineering at Univ. of Tokyo

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

2010-2017

Projects:

• 24 Completed Research Projects
• 12 Current Research Project

Patents: Provisional and full patents granted: 13

Students Graduated & Placed: 16
## Our Achievements

### CR³

**2010-2017**

### Publications:
- Journals: 68 (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

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Our Achievements

Completed Research Projects

• Development of Aluminum-Dross Based Materials for Engineering Application (2011)
• Physical and Chemical Beneficiation for Recycling of Photovoltaic Materials (2011)
• Recovery of Rare Earth Metals from Phosphor Dust (2011)
• Recycling of Bag-House Dust from Foundry Sand (2011)
• Molten Metal Compositional Sensing to Enhance Scrap Recycling (2012)
Our Achievements

Completed Research Projects

• Rare-Earth Recovery from Magnets, Catalysts, and other Secondary Resources (2012)
• Recovery of Eu/Y from Phosphor Dust (2013)
• Conditioning of Machined Chips (2013)
• Beneficiation of Flat Panel Functional Coatings (2013)
• Metal Recovery via Automated Sortation (2013)
• Recovery of Value-Added Products from Red Mud and Foundry Bag House Dust (2013)
Completed Research Projects

• Dezincing of Galvanized Steel (2014)
• Development of a Novel Recycling Process for Li-Ion Batteries (2014)
• Fundamental Study of Lithium Ion Battery Recovery (2014)
• Magnet Separation Technologies for Recycling (2015)
• Recovery of Zinc and Iron from EAF Dusts (2015)
• Synthesis of Inorganic Polymers from Metallurgical Residues (2015)
• Recovery of Valuable Metals from Fines (2016)
Completed Research Projects

- Value Recovery from Mining Wastes (2016)
- Battery Design for Disassembly in Support of Materials Reuse (2016)
- Rare Earth Metals Recovery from Bauxite Residue (2016)
- Hydrometallurgical Treatment of e-Scrap (2017)
- Reuse Opportunities for Bauxite Residue (2017)
Current Research Projects

- Paint Sludge (Dec 2019)
- Copper Separation from Steel (Dec 2020)
- Optimization of Concrete Mixtures Containing Metallurgical Process Residues for 3D Printing (Dec 2020)
- Online Slag and Bullion Analysis by LIBS (Dec 2018)
- Recovery of Valuable Metals from Flue Dust and Other Fines from Mechanical Treatment of e-Scrap (Dec 2018)
- Waste Water Treatment Sludge & High Value Grinding Swarf Recycling (Dec 2018)
## Current Research Projects

- Separation of Eu and Y from Phosphor Dust (Dec 2018)
- Auto-Al Scrap Material Flow Analysis with Compositional Projections (May 2018)
- Pretreatment Processes of Waste Printed Circuit Boards (June 2018)
- Online Moisture Analysis of Heterogeneous Solid Material Flows (Dec 2020)
- Vacuum Distillation of Complex Lead Bullion (Dec 2018)
Industry Membership: 5.2 million USD
Federal funding: 1.5 million USD (NSF to WPI/CSM)
Leveraged Federal Funding: 4.5 million USD
Leveraged External Funding: 6.5 million USD (international partners)
Our Achievements

CR³ Center for Resource Recovery and Recycling

Companies Launched

Kinetic Batteries, LLC

Battery Resources, LLC
Our Graduates

Employers of Graduates

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

CR³ Center for Resource Recovery and Recycling

Summer 2018 Center Industrial Advisory Board (IAB) Meeting

Colorado School of Mines
Golden, CO
June 28-29, 2018

For information visit:
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