



Rare Earth Element (REE) Program



S&T Campaign: Materials Research
Tier 2 High Strain Rate & Ballistic Materials

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Research Objective

Resolve the fundamental barriers to achieving a reliable domestic supply chain for critical Heavy Rare Earth Elements (HREE).

- HREEs are essential to many defense, green energy, high tech and Energy Coupled to Matter (ECM) applications
- Processing involves complex inorganic chemistry and high temperature metallurgy
- China supplies virtually 100% of the worlds HREEs
- Currently no commercial HREE extraction, separation, and reduction capacity in North America
- Vastly improved novel processes required to make a domestic supply chain a reality.

ARL Facilities and Capabilities Available to Support Collaborative Research

Thermodynamic Modeling Software

- Thermocalc – Phase diagram calculations
- DICTRA – Diff. controlled phase transformation
- TC-Prisma – 3D diff. precipitation kinetics

Extraction

- Characterization Tools
 - XRD, SEM/EDS, EBSD, FIB, HR-TEM, AFM, FT-IR, XPS, BET, Horiba PSA, XRF, TGA/DTA, UV-Vis
- Metallurgical Processing Equipment
 - Sieves, Rotap, sample splitter, pressure filtration
 - High Temp/Pressure Chemical Reaction Vessel

Separation

- Microfluidics Experimental Suite
 - Pressure pumps, flow sensors, temp control (-4–50°C)
- Custom kinetics measurement and process chips
- 11 Telos flow manifolds (up to 70 channels each)

Reduction/Alloy Making

- Vacuum Induction Furnace
- Vacuum Arc Melting
- Crucible Melting Furnaces (300 lb. Al and Mg)
 - Pressure Infiltration

Descriptive figure caption

Challenges

- Domestic high volume/value, HREE containing products must be identified and developed.
- Intellectual property for the current state of the art processing must be re-established.
- Novel/disruptive REE processing (extraction, separation, reduction) must be identified and developed to reduce the necessary CapEx, OpEx, and environmental issues.

Collaboration Opportunities and Needs

- Projects that synergistically incorporate HREEs, materials-by-design, and Energy Coupled to Matter
- Enhanced rare earth oxide reduction capacity
- Development of applications requiring HREEs manufactured in North America
 - High-performance Alloys
 - Ceramics
 - Phosphors