

THE RARE EARTH CRISIS AND THE CRITICAL MATERIALS INSTITUTE'S (CMI'S) ANSWER

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Abstract

The Critical Materials Institute (CMI) of the Ames Laboratory is a U.S. Department of Energy (DOE) Innovation Hub dealing with energy critical materials. At the present time CMI is concerned with five rare earth materials (yttrium, neodymium, europium, terbium and dysprosium), and lithium and tellurium. The Institute has four focus areas – (1) diversifying supply, (2) developing substitutes, (3) improving reuse and recycling, and (4) crosscutting research. There are four national DOE laboratories involved (lead by the Ames Laboratory, together with Idaho National Laboratory, Lawrence Livermore National Laboratory and Oak Ridge National Laboratory), six industrial organizations and seven universities.

Extended Abstract

In response to a Department of Energy Funding Opportunity Announcement (FOA) on critical materials a consortium, called the Critical Materials Institute (CMI), lead by the Ames Laboratory was informed on January 8, 2013, that they were selected as the latest DOE Energy Innovation Hub. The actual start date of CMI was June 1, 2013.

The CMI is composed of four focus areas: (1) diversify the global supply chain, (2) develop substitute materials, (3) enhance recycling, reuse and efficient use of materials, and (4) crosscutting research. The CMI is led by Alex King (Ames Laboratory), Director; Rod Eggert (Colorado School of Mines), Deputy Director; and Karl Gschneidner (Ames Laboratory), Chief Scientist. The CMI consortium is composed of four national DOE laboratories, six industrial organizations, and seven academic institutions. The four national laboratories are: the Ames Laboratory, Oak Ridge National Laboratory, Idaho National Laboratory and Lawrence Livermore National Laboratory. The six companies are: Advanced Recovery, Inc., Cytec, General Electric Co., Molycorp, OLI Systems, Inc., and Simbol Materials. The academic institutions are: Rutgers University, University of California-Davis, Colorado School of Mines, Brown University, Iowa State University, Florida Institute of Phosphate Research, and Purdue University. CMI's mission is to eliminate materials criticality as an impediment to the commercialization of clean energy technologies for today and tomorrow.

The CMI addresses seven critical or near-critical chemical elements: yttrium, neodymium, europium, terbium, dysprosium, lithium, and tellurium. Of these seven elements only the five rare earth metals are on the European Critical Raw Materials list. Initially 35 projects were selected for study by applying several criteria: potential for impact at a key point in a

material's lifecycle in a realistic timeframe; integration of strengths and capabilities across the Hub; a clear path to deployment, i.e. commercialization plan in place; an annual evaluation to address continued adherence to the timeline and the above criteria. As things change projects are expected to be terminated and new ones started.

Focus area 1 (diversifying supply) has three thrusts: new sources, transformational processes, and new uses for co-products. Within the three thrusts there are eight projects.

Focus area 2 (developing substitutes) has three thrusts: magnets, lighting, and materials development framework. In this focus area there are nine projects.

Focus area 3 (improving reuse and recycling) has only two thrusts, but nine projects. The two thrusts are: source separation and concentration, and transformative extraction and materials production.

Focus area 4 (crosscutting research) consists of three thrusts and nine projects. The three thrusts are: enabling science; environmental sustainability; and supply chain, economic analysis and policy.

Within the 35 CMI Projects there are 125 tasks being carried out by about 200 scientists, engineers, and technicians at the various organizations in the USA. This amounts to about 80 full-time equivalent technical and 20 full-time equivalent support personnel. As a result of recent both internal and external reviews several CMI projects were combined to improve the interactions between the staff working on related topic reducing the number of Projects to 30. Furthermore, tellurium was dropped as one of the seven critical elements because the company who was going to manufacture CdTe photovoltaic solar cells for energy conversion decided to use other photovoltaic materials. Also, the funding for several projects were reduced and may be zeroed out in the next 6 to 12 months depending upon meeting milestones. At least two new projects are expected to start in the second year, but they have not been announced.

During the first year of operation the staff of the Institute disclosed 10 inventions for possible patent protection.

The Critical Materials Institute offers a variety of educational opportunities through several partners. In particular Colorado School of Mines offers several short courses such as Recycling Metals from Industrial Waste, and Mineral Processing. While Iowa State University offers a broad based course on the rare earths, which is available for distance learning.

The Critical Materials Institute has a membership program in which organizations can be involved as a Team Member, an Affiliate Member or an Associate Member. Team members have either research subcontracts from CMI or provide cost sharing funds. Affiliates (full or observing), through paid membership in the CMI, are informed about CMI research outcomes, may submit proposals for funding graduate student projects, and provide input to CMI. Associates are entities who want to access the unique capabilities and expertise of the CMI on a one-time basis. Associates, Team and Affiliate members may provide funding for a specific project via a Cooperative Research and Development Agreement (CRADA) or a Work for Others (WFO) agreement; all research agreements are done on a best effort basis and with full cost recovery.