INL scientists will use expertise from recycling nuclear fuel to support the Critical Materials Innovation Hub. The national effort led by DOE's Ames Laboratory is working to secure the supply of rare earth metals and other energy-critical materials.

Reverse mining: Scientists extract rare earth materials from consumer products

By Nicole Stricker, *INL Communications & Governmental Affairs*

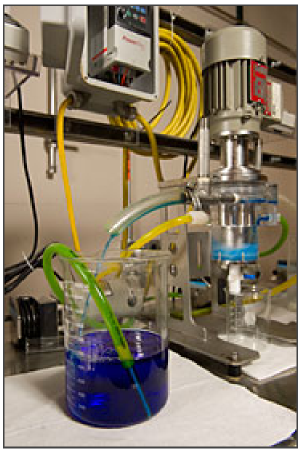
In a new twist on the state's mining history, a group of Idaho scientists will soon be crushing consumer electronics rather than rocks in a quest to recover precious materials.

Scott Herbst helps lead the INL scientists studying ways to recycle rare earth and other critical elements from discarded electronics.

So-called rare earth elements are deeply embedded in everything from fluorescent light bulbs to smartphones — and they're critical for electric vehicles, wind turbines and solar panels. Because these materials are subject to supply disruptions, the U.S. Department of Energy is investing in solutions to potential domestic shortages. On Jan. 9, DOE announced the creation of a new Critical Materials Innovation Hub led by the Ames Laboratory.

Idaho National Laboratory scientists will contribute to that effort with expertise from recycling fissionable material from used nuclear fuel rods. They'll now apply similar principles to separate rare earth metals and other critical materials from crushed consumer products. The work could also help improve extraction from the mining process.

"We think of electronics as being a different kind of ore," says Eric Peterson, the business line lead for INL's Process Science & Technology division. "Today's consumer recycling efforts recover about 40 to 50 percent of the critical materials. Our goal is to get that to more like 80 percent recovery."



INL's nuclear recycling expertise is contributing to work for the new Critical Materials Innovation Hub.

Not-so-rare earth metals
Rare earth metals — many of which can be found floating at the bottom of a standard periodic table — likely aren't far from where you're sitting. The bright red in that smartphone text or image: Europium. Powerful magnets driving electric motors in everything from wind turbines to vehicles to hand tools: Dysprosium, Neodymium. Phosphors coating the innards of energy-efficient light bulbs: Terbium, Yttrium, Europium.

Many of these elements are the same ones nuclear reprocessing research has targeted for years. They're members of the lanthanide family of elements, which inhibit the fission process but are chemically similar to fissionable actinides. INL scientists have a long history of expertise devising new ways to effectively separate lanthanides from complex mixtures.

INL will now apply that expertise to recycle rare earth and other critical elements from discarded electronics. The team will develop and test new processing methods that selectively recover critical metals using supercritical fluids, membranes and electrochemical approaches. These advanced separation techniques might also help mining operations by boosting extraction from raw ore.

"In many ways, enhancing the recovery of critical materials is just a massive separations puzzle," Peterson said. "INL has vast experience in separations for both nuclear and industrial applications."

A national effort
Despite the moniker, rare earth metals aren't particularly rare. But they are difficult and expensive to obtain, and the U.S. has a limited supply that is vulnerable to disruption. Supply challenges for rare earth and other energy-critical materials could affect the deployment and security of clean energy technologies.

That's why the DOE is investing $120 million over five years to establish an Energy Innovation Hub aimed at reducing U.S. dependence on critical materials and minimizing the impact of supply shortages. The Critical Materials Institute will address challenges across the life cycle of each critical material to help make better use of accessible materials and reduce the need for materials that are susceptible to supply disruptions.

Specifically, the hub's research areas will target ore processing, efficient manufacturing and use, recycling, and substitute materials. Cross-cutting research that includes computational tools and economic analyses will support the basic science needs in all areas. Partners include four DOE national laboratories, six universities, one research institute and seven private companies. Team members have expertise spanning the rare earth supply chain, from mining to clean energy technologies.

INL researcher Troy Garn and intern Tara Smith discuss separations science in INL's Centrifugal Contactor Lab.

INL will lead the recycling and recovery focus — developing better chemical separation methods in collaboration with both the mining and recycling industries. The lab also will work on biological and geochemical approaches to improve extraction of critical elements from ores and waste streams. Finally, INL has significant roles in environmental research related to waste water processing and in economic analyses of processes developed throughout the hub.

"It's really significant work for us because it's an important problem and relies on existing lab skills sets that came out of our nuclear heritage," says David Miller, director of INL's Process Science & Technology division. He also notes previous work related to other critical materials such as platinum. "That earlier program provided the technical foundation to build many of the capabilities we're using today."

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Feature Archive